Survey Quality from Photogrammetry?

Are measurements derived from photographs taken from the ground, using photogrammetric techniques, as accurate as measurements made with surveying equipment?

Why is this project necessary?

- It would be useful and nice to be able to accurately find the height of an object without having to own a costly total station (TPS).

Has it been done before?

- As far as I know my project has never been done before. Similar projects have been done where airphotos were used to calculate heights of campus buildings, but no one has used photos taken from the ground to calculate building heights.

Main Goal and Objectives

- To find out how close to survey quality measurements you can get from photogrammetric techniques.

Study Area

- Strong Hall
- Library bell-tower
- Rappel Tower
- Trash Can Concealment Fence

Data

- I used Monica's digital camera to collect the data, I took the photos on a day with shadows with strong angles to measure with. I will also used Archer Engineers Total Positioning System (TPS) and verified the heights of the buildings. To compare with the heights that I calculated using photogrammetric techniques.

Hypothesis

- I think it is possible to achieve survey quality accuracy from photogrammetric techniques, but there are many sources of error that come in to play and it will be difficult to completely eliminate those errors and achieve survey quality measurements.

Potential Sources of Error

- Distortion errors inside the camera.
- Errors in the total station. (may be out of calibration.)
- Errors created through photogrammetric process. (human errors in interpretation.)

Camera Error

- Can be eliminated by shooting a perfect grid then adjusting the distortion out of the photo’s.
- I don’t think this step is necessary because whatever error may be in the camera will be constant for every picture.

Error’s in the TPS

- The schools total station may have never been calibrated, or it may have gotten out of calibration throughout the years.
- Potential angular error may be created when we cant access the top of some buildings to take a shot, will have to turn the angle from the ground at the base of the building to the roof, and then use triangle solutions to calculate the height.

Potential Sources of Error (using photogrammetric techniques)

- Human errors created when assigning coordinates to the points where the shadow cast by the object converges with the ground and the top and toe of the object itself
- Accurately figuring the photo’s scale

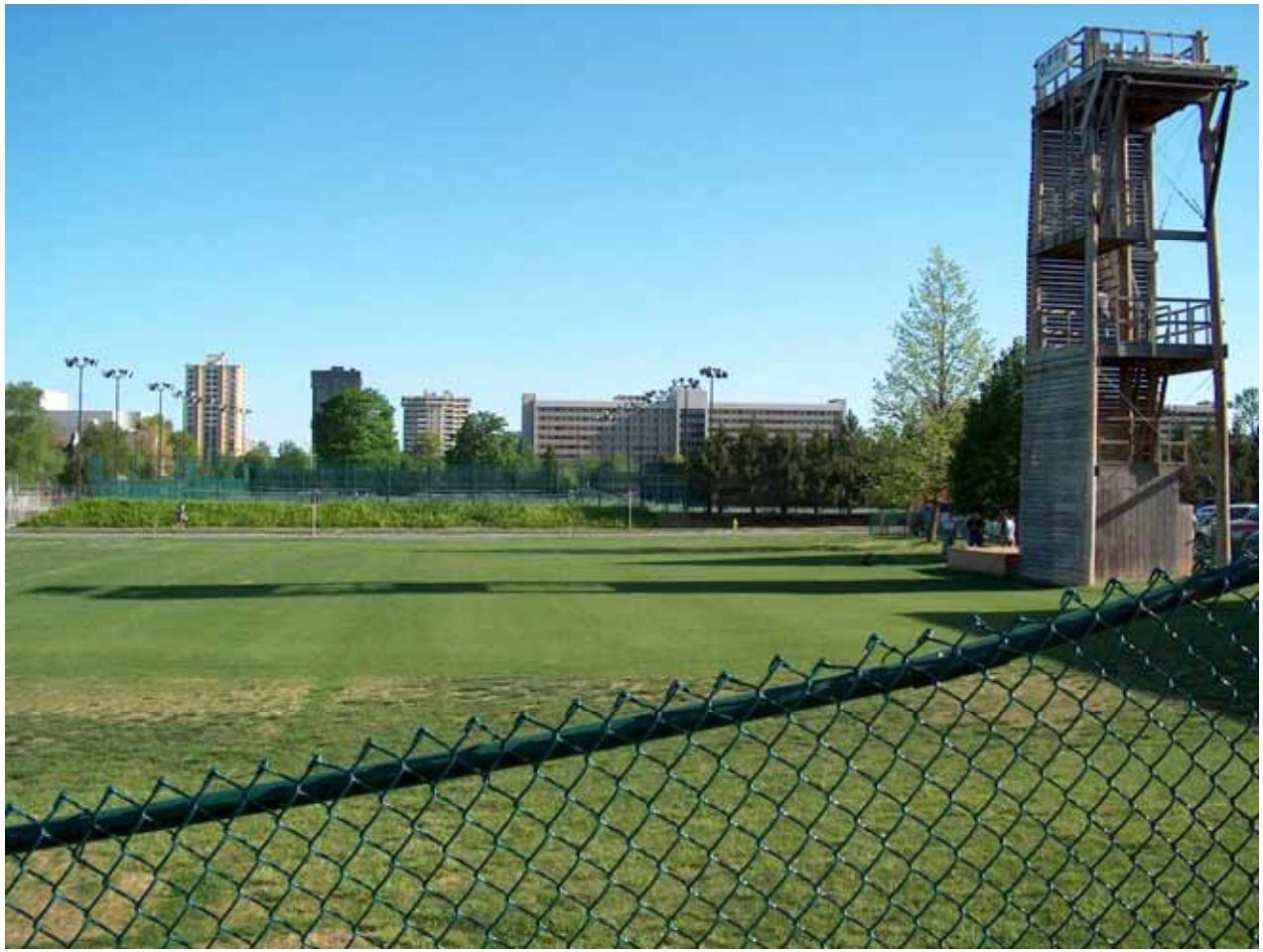
Who will benefit from this project?

- People who need to know the precise height of an object but who do not have access to and cant afford a TPS.

Photo scale

- To get an accurate scale to measure with you must:
- Use an object of known length
- The object must be perfectly perpendicular to the camera
- The object used for scale must be the same distance from the camera as the object that you wish to know the height of.
- The object used for scale needs to be near the principle point of the image

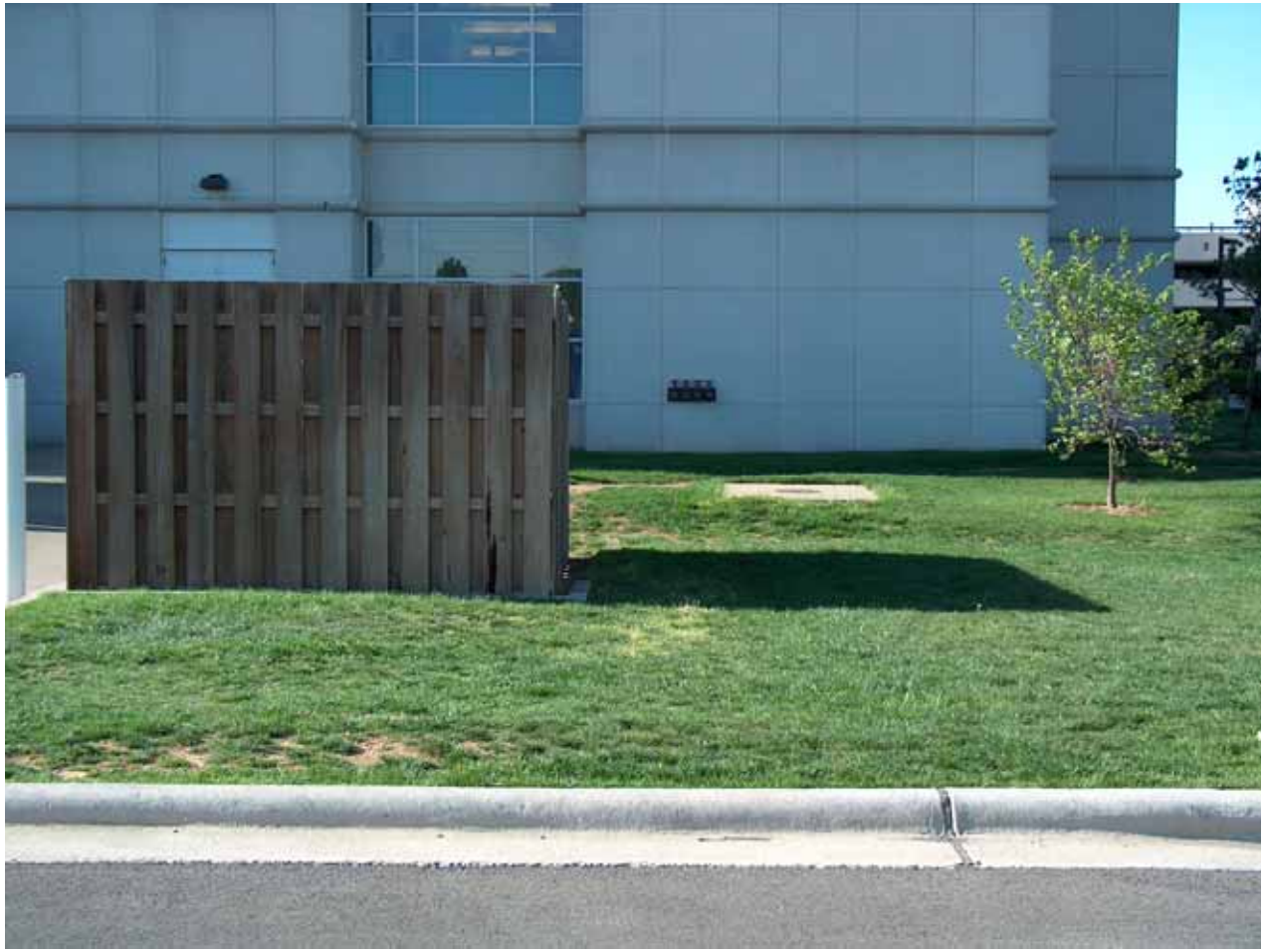
Experiment 1



Experiment 1

- Used the width of the tower to determine scale
- Since the tower is not perfectly perpendicular to the lens there is some error and the calculated height does not meet survey quality standards
- Actual height = 38.23 ft
- Calculated photogrammetric height = 46.11 ft
- Difference of 7.87 ft

Experiment 2



Experiment 2

- Used width of board on fence for scale calculation.
- Board used for scale is perfectly perpendicular to the camera, and is the exact same length from the camera as the object that is being measured
- Note that trashcan is built in parking lot and shadow is cast in grass approximately 3 in higher than the bottom of fence.
- Actual height of fence = 96 in.
- Calculated height using photogrammetric techniques = 94.68 in
- Difference of 1.32 in, but would be almost perfect if trash can was built on ground level.

Experiment 3

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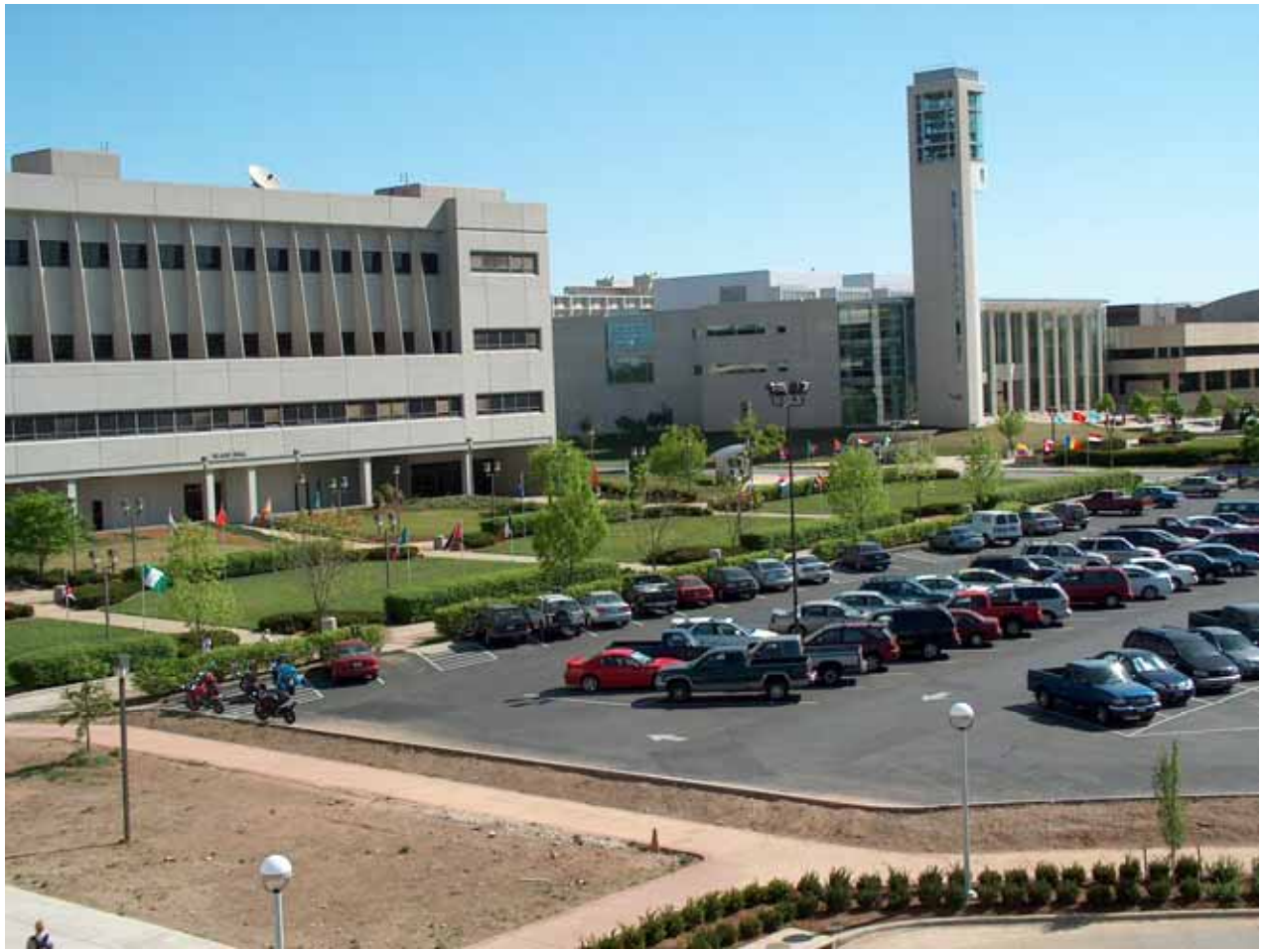
- Photo was taken from elevated position, scale was figured using red side walk that is perpendicular to lens but lower than principle point of image.
- Actual height of Strong Hall = 81.569 ft
- Calculated height = 88.26 ft.
- Difference = 6.69 feet

Experiment 4



Experiment 4

- Taken from an elevated position, used side of tower for scale but it was not perfectly perpendicular to lens.
- Oblique Shadow triangle, hard to calculate
- Actual height = 122.07ft
- Calculated height = 146.29 ft
- Difference = 24.22 ft

Conclusions

- Achieving survey quality measurements from photogrammetric techniques is possible, but everything must be just right with no human error. Experiment # 2 was a good example of the potential accuracy of photogrammetry, experiment s1, 3, and 4 were good examples of how human error and improper scale calculation can dramatically effect the results.
- The largest source of error was in calculating the scale of the photo. If the object used for scale was not perfectly perpendicular to the lens of the camera, then the calculated height will be wrong.
- The taller the object the greater the error will be when the scale is not properly calculated.