



MONITORING OF HIGH RISE BUILDING USING VERY LONG FOCAL LENGTH OF CAMERA LENS AND THREE DIMENSIONS GOOGLE IMAGES

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Abstract: A new approach of monitoring of building tower of University of Baghdad has been implemented through the use of accurate cameras which include Sony camera (a65) with GPS and two zoom lenses (18-55mm & 55-200mm) as well as MTO 1100mm 10.5 mirror lens mounted on Pentax K-x camera. The positions of damages were located on three dimensions (3D) Google images; therefore it has been dispensed with the use of original drawings which are often lost or missing.

Keywords: : *Monitoring, damages, binoculars, Pentax K-x DSLR camera, GPS, focal length, MTO lens, 3D Google images.*

رصد بناية شاهقة باستخدام عدسة كاميرا ذات بعد بؤري كبير جدا وصور كوكل ثلاثية الابعاد

الخلاصة: تم تنفيذ اسلوب حديث في رصد بناية البرج في جامعة بغداد من خلال استخدام الكاميرات الدقيقة والتي تتضمن كامرة Sony (a65) مع نظام تحديد المواقع العالمي مع عدستين (18-55 ملم و 55-200 ملم) وكذلك عدسة مرآة MTO 1100mm 10.5 والمركية على كامرة Pentax K-x. تم تثبيت مواقع الاضرار على صور Google ثلاثية الابعاد، ولهذا تم الاستغناء عن استخدام المخططات الاصلية والتي غالبا ما تكون مفقودة او ضائعة.

1. Introduction

The monitoring process is periodically required for each construction to maintain its performance, safety and to increase its useful life. The monitoring of high rise building is not an easy process as it should be monitored from a long distance that requires special preparations to use very long focal length of camera lens where the main causes of preparations related to qualified and most suitable tools to detect such distant and small damages can be detected.

In Reference [1] it was explained the importance of digital camera, binoculars and some other tools in the measurement and documentation in visual inspection for structural Integrity of building at risk in which cracks of width 0.75mm to 31.5mm were documented because of differential settlement induced by inadequate foundations.

In [2] Kodak camera DSC 660 was used with a six-megapixel (3000 x 2000) resolution with a lens of focal length 28-mm for similar monitoring process.

Also in [3-5] a modern approach of visual inspection was applied using Global positioning System (GPS) and high resolution DSLR cameras with a 600mm long focal length lens for inspection of bridge and large structures (Dams and Cooling Towers) respectively.

The building tower of University of Baghdad has been selected for monitoring process as it is considered as the tallest building in Baghdad which has been subjected to some projectiles from the east after the events of 2003 and there are some concerns about the presence of expanded cracks and also there may be the possibility of the fall of small pieces later.

2. Preparations and Selection of Tools

It is important for any construction that has to be monitored to make some required preparation to select the locations in which the construction would be inspected as well as the tools that are appropriate for inspection from such location and after some attempts in which binocular has been used to visually inspect such damages, it was concluded that the most suitable location of monitoring such distant and small damage is from a distance of about 60 meters away from the building. Monitoring of high rise building from such distance requires special tools which include very long focal length of camera lens, accurate digital camera with the capability of image stabilization as well as steady tripod. The selection of tools can highly affect the quality of the images. The lighting condition of the damages surface can also affect the quality of such images.

3. Needed Tools and Results

The damages first were inspected by binocular (20x60) to identify their locations with respect to their floor level as shown in Fig.1.



Fig. 1 Binoculars 20x60.

It is important to highlight the attention and the aesthetic of the tower building, thus Sony a 65 camera was used (as shown in Fig.2) which is a Digital Single Lens

Translucent (DSLT) camera that has 24MP with The Global Positioning System (GPS) that can determine the site location which based on satellite navigation system.



Fig. 2 Sony a65 camera.

The longest focal length that can be found is 1100mm with F10.5 for MTO lens which is mirror lens (as shown in Fig. 3).



Fig. 3 MTO mirror lens (1100mm, 10.5).

MTO lens was mounted to Pentax K-x which is a DSLR camera with 12MP and has image stabilization in its sensor which is important to prevent any blurred that is related to such magnification power of the lens. The magnification power is very high, thus a

tripod is essential to minimize any hesitations or vibration caused by carrying the camera by hand and also a remote control was used to minimize the small vibration shock caused by pushing the shutter release bottom (as shown in Fig. a and b).



A



B

Fig. 4 (A & B) Pentax K-x camera mounted with MTO 1100mm lens on a tripod.

The camera was placed at an estimated distance of about 60m from the tower of university of Baghdad while the inspected damages were at estimated heights of about 25-60m above the ground.

The aesthetic of an image depends on focal length of the lens, camera position and lighting condition (see Fig 5). In Fig. 5A the image was taken from the ground where the effect of perspective view indicates a taller tower than an actual due to the effect of vanishing lines that are not normal with the base. While in Fig. 5B, the image was taken from second floor that making the tower seems in normal perspective view.

**A****B**

Fig. 5 (A&B) Building tower of University of Baghdad.

The aesthetic of perspective view depends on focal length of lens, camera position and lighting condition (see fig 5 A and B). In fig. 5A the image was taken from the ground where the effect of perspective view indicates a taller tower than an actual due to the effect of vanishing lines that are not normal with the base. While in Fig. 5B, the image was taken from second floor that making the tower seems in normal perspective view.

4. Damage location in Three Dimensions (3D)

The location has been identified by the binoculars, and then the digital camera Sony a65 was used to identify the coordination of GPS service which determined the coordinates of the location which are used to find the related place from Google images.

Google Earth offer 3D images for some high rise and distinguishing constructions such for tower building of University of Baghdad which can be used to locate the damage clearly as shown in Fig. 6 (A & B).

The colored arrows show the direction of the images that covered the damages at the east side of the tower (red arrow).

The location is identified by GPS coordinates as shown in the Fig. 7 with respect to the latitude and longitude.

The locations of the damages are clearly presented at 3D view of Google map as shown in Fig. 7.

It is clear from this figure that upper parts of the tower are clearer than lower parts because the image was taken from the top on the contrary on that shown in figure 8 where the image was taken from the bottom and all damages were marked with a colored circle code for each damage.

The lower parts of the building damages can be clearly presented on the normal building images as shown in Fig.8

The damages caused by projectiles are shown in figure 9 for heights between 25-45 m while in Fig. 10 the damages for heights 55-60 m are shown according to their colored circle code.

The sub image that has colored rectangular code was taken from the enlargement of the part of the original image.

The perspective view of a construction in Google 3D map offer many advantages as shown in Fig. 11 which are:

1. It can offer more details in upper parts than any other images. Such images cannot be taken by normal ways.
2. The perspective view can be rotated and shifted to any direction to show its front, side and any other views.
3. The ability to show any details at any angle of view simply, clearly and without missing any other details.
4. The use of 3D Google images also presents the geographic position and direction of the building with respect to the North or any direction by presenting the accurate horizontal angle with respect to its direction.



A



B

Fig. 6 (A & B) Google map of University of Baghdad.

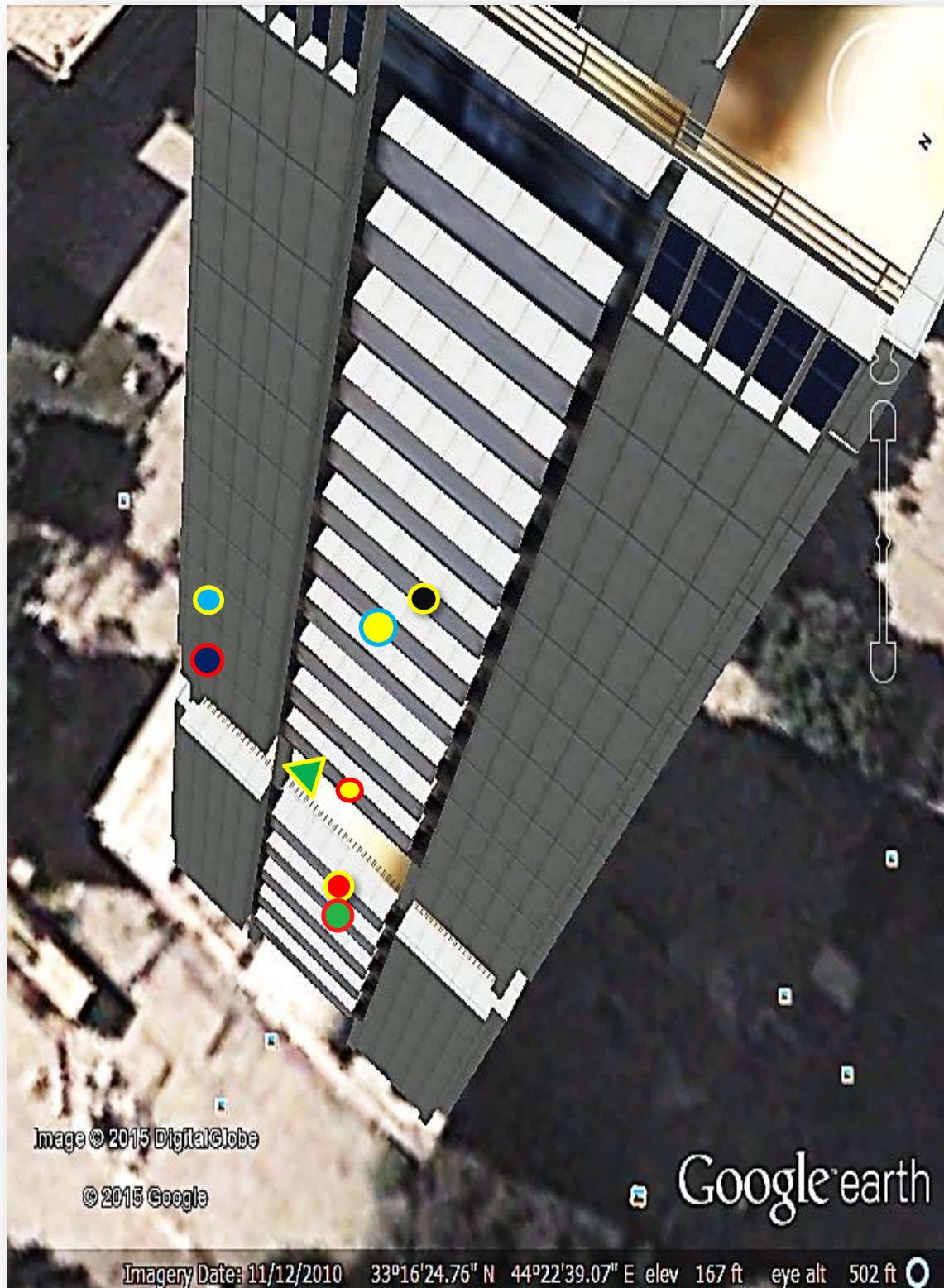


Fig. 7 Google 3D view of the tower of University of Baghdad where the projectile damages are presented by colored circles and irregular opening in the roof presented by colored triangle (The image includes coordinates of the location which show latitude and longitude).



Fig. 8 Image of the Tower of University of Baghdad which has projectile damages that presented by colored circles.



Fig. 9 Damages caused by projectiles at an estimated height of 25-45m (Pentax K-x with MTO 1100mm 10.5).

Note: Damage in A is an irregular opening in the roof (is not caused by projectile, it may be caused by maintenance work).

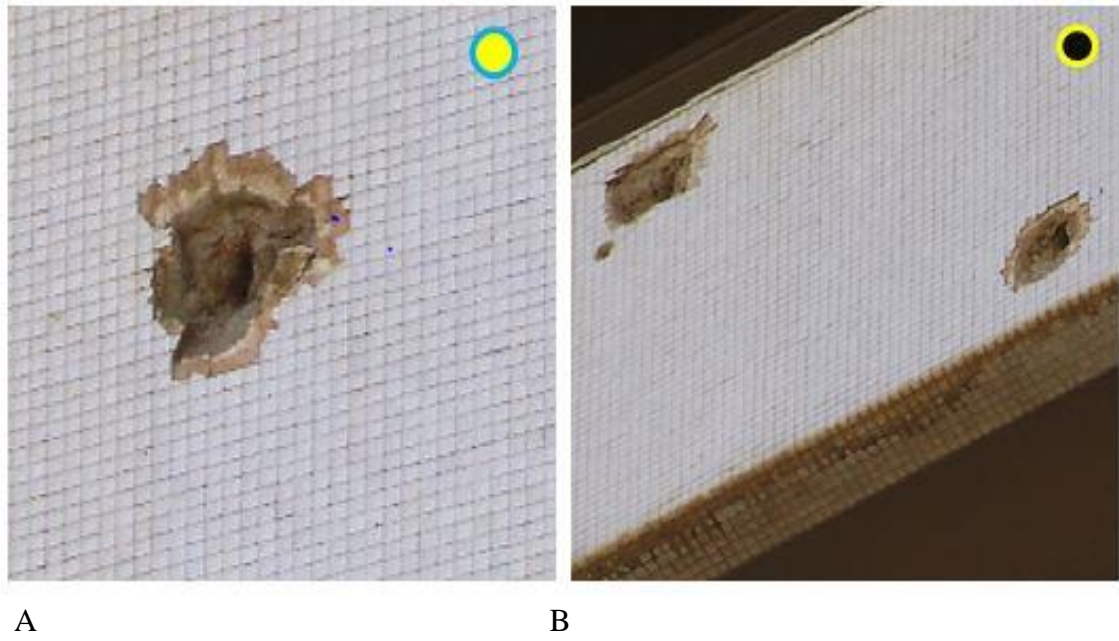


Fig. 10 Damages caused by projectiles at an estimated height of 55-60 m
(Image A by Pentax K-x with MTO 1100mm & image B by Pentax K-x with 55-300mm).

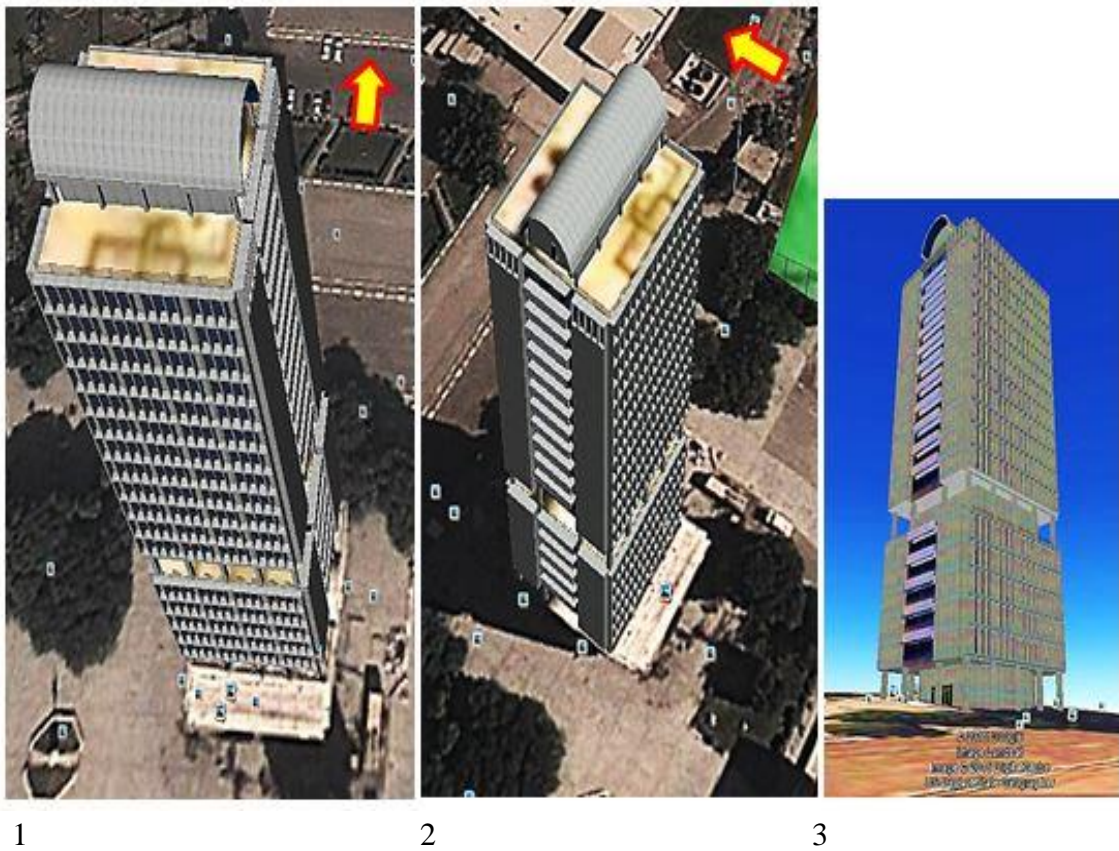


Fig. 11 Google different views of the tower of University of Baghdad (the perspective can be viewed, shifted and rotated at any angle even from ground level as in 1, 2, &3).

5. Conclusions

- It has been approved that using such approach was very successful and will reduce time and efforts due to their activity, accuracy and easiness of both damages recognition or identification of damages location when measured with respect to the traditional method.
- The new approach of monitoring process was essential to solve the problem of missing drawings and plans of the site.
- Google images are very useful and present clearer details than original drawing (which are usually missing) or any other drawings or maps and also easier to find locations of damages especially when used with colored arrows that present positions and directions of images of the damages.

6. References

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