

## **Architectural Photogrammetry in Malaysia: An Experience**

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### **Abstract**

In Malaysia, there are many historic buildings and monuments. The government realise that the historic buildings and monuments need to be conserved and restored. For this purpose, the National Museum was given the responsibility to record all the historic buildings and monuments. Architectural photogrammetry is one of the method that can be used for recording. It has been used by many countries in the world. However, this method has been used recently in Malaysia.

This paper reports an architectural photogrammetry work that has been carried out to produce line drawing of the main entrance facade of the Eastern & Oriental Hotel, Penang. In this work, the photographs were taken using metric camera Wild P32 and the line drawing was produced using an analytical plotter.

### **1.0 INTRODUCTION**

The history of Malaysia started with the foundation of Melaka (i.e. one of Malayan states in the 15th century). At that time Melaka was ruled by a king known as Sultan Iskandar Shah. Later, in 1511, Melaka was occupied by the Portuguese. Melaka was then occupied by the Dutch and finally by the British. Since 1874, all the Malayan states came under the rule of the British. During the colonisation process, many buildings were built. A large number of these still exist today and many are now of national importance.

Malaya gained independence on 31st August 1957. Following this, on the 16th September, 1963, Malaysia was formed consisting of 14 states including Singapore. In 1965, Singapore separated from Malaysia and become independent. After independence Malaysia started to develop and the government is working very hard to make it a developed country in the year 2020. In this respect, the government does not ignore her responsibility to conserve the environment and the historical heritage.

The historic buildings and monuments include buildings built by the colonist, historic forts, old buildings and religious building. Example of important buildings which possess historic characteristics, attract local and foreign tourists are the fort in Melaka built by the Portuguese in the 16th century, the Red Building in Melaka built by the Dutch in 17th century and the Sultan Abdul Samad Building and Malayan Railway Headquarters Buildings in Kuala Lumpur built by the British in 19th century.

In Malaysia, historic buildings and monuments have been recorded i.e. the photographs are taken using non-metric camera and all the related information are recorded. This work is carried out by the National Museum. Architectural photogrammetry has been used in the case of Sultan Abdul Samad and Malayan Railway Headquarters Buildings. In 1995, an architectural photogrammetric survey was carried out to record the main entrance facade of the Eastern and Oriental Hotel in Penang.

### **2.0 THE EASTERN AND ORIENTAL HOTEL (E & O HOTEL)**

As early as 1821, the Sarkies Brothers of Armenia were noted for their successful exploits, business and enterprise in Southeast Asia. At that period of time, they were already owners of two of the three largest business houses in Singapore. They were rich and influential in the city, their families were large and their sons were sent out periodically around the region for further business opportunities and avenues of future enterprise for the family.

In 1884, the Sarkies Brothers decided to settle in Penang. They established a hotel "facing the Esplanade" which they named the Eastern Hotel. The following year another hotel was opened - the Oriental - on a plot of land facing the sea. Both these establishments flourished and they combined both these hotels into one large hotel known as Eastern & Oriental Hotel.

Despite the change in ownership, service and comfort remain keystones of consideration in the day-to-day running of the E & O Hotel. Although the years have passed, its values of traditional service and comfort for the guest, remains the same. Today, E & O Hotel ranks as one of Southeast Asia's great hostelry, not because it is the most modern but because it is one of the few still left that have retained a distinct old world charm and atmosphere while keeping abreast with the needs of the modern traveller.

### 3.0 FIELD OBSERVATIONS

The field work that has been carried out involved two processes i.e the process of taking photograph and establishing ground and photo controls.

#### 3.1 Photography

The photographs of the facade were taken normal to the facade using Wild P32 metric camera at A and B. The base to distance ratio is 1:15. The photographs were taken in the form of stereopair and the overlapped area is 90%. The format of the photograph is 80mm x 60mm and the focal length of the metric camera is 63.95mm. A few sets of photographs were taken at different exposure and aperture. Figure 1 shows the photograph of the main entrance of the E & O Hotel taken using Wild P32 metric camera.

#### 3.2 Establishing of ground and photo controls

After the photographs have been taken, the ground and photo controls were established. The photo controls are in the form of artificial and natural targets. The artificial photo controls are made of plastics and pasted temporarily on the facade. Figure 2 shows the form of artificial target that was used. The images of the photo controls will be recorded when photographs are taken. The location of the photo controls on the facade of the main entrance of the hotel are shown in Figure 3.

Apart from photo controls, two ground controls are established close to the facade namely A & B. The location of A & B is fixed on the ground, to approximately  $\pm 3^\circ$  parallel to the facade as shown in Figure 3. The reference coordinate system used is an arbitrarily coordinate system where the line from A to B is assumed as the X axis, the Y axis is perpendicular with the X axis and the Z axis is perpendicular to the X and Y axis. The coordinates from A and B will be transferred to all the photo controls using the theodolite intersection method. The location of A and B are marked with iron nail on the surface of the ground. In this case, the coordinate of A is assumed as X = 100.000m, Y = 100.000m and Z = 100.000 m. Next the location of B is determined from A. The coordinate of B is X = 101.527 m, Y = 99.979 m and Z = 100.000 m. The distance between A and B was measured using EDM and the distance is 1.527 m. Also, the distance from A and B to the facade was measured as 29.160 m using EDM.

Once, the ground and photo controls have been established, observations were made from A and B to all the photo controls with four zero settings using theodolite intersection method. Vertical angles were also observed from ground controls A and B to all the photo controls. Finally, the height of instrument was measured both at A and B.

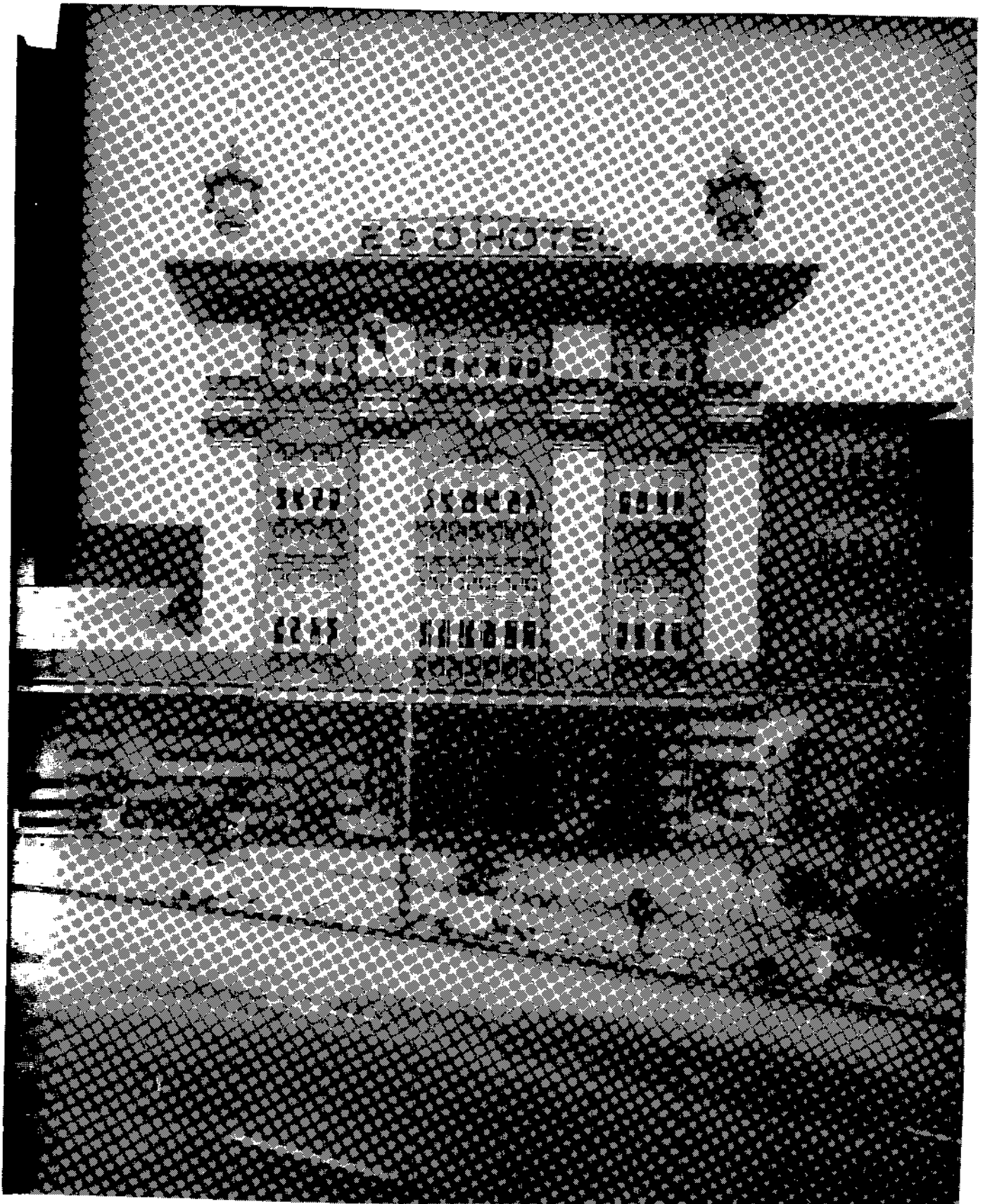


Figure 1: The photograph of the main entrance facade of the E & O Hotel

#### 4.0 PRODUCTION OF LINE DRAWING

Before any data from the photograph are extracted, a few processes have to be carried out. The process consist of computing field data, developing the photographs and acquiring the data from the photographs using analytical plotter.



Figure 2: Artificial target

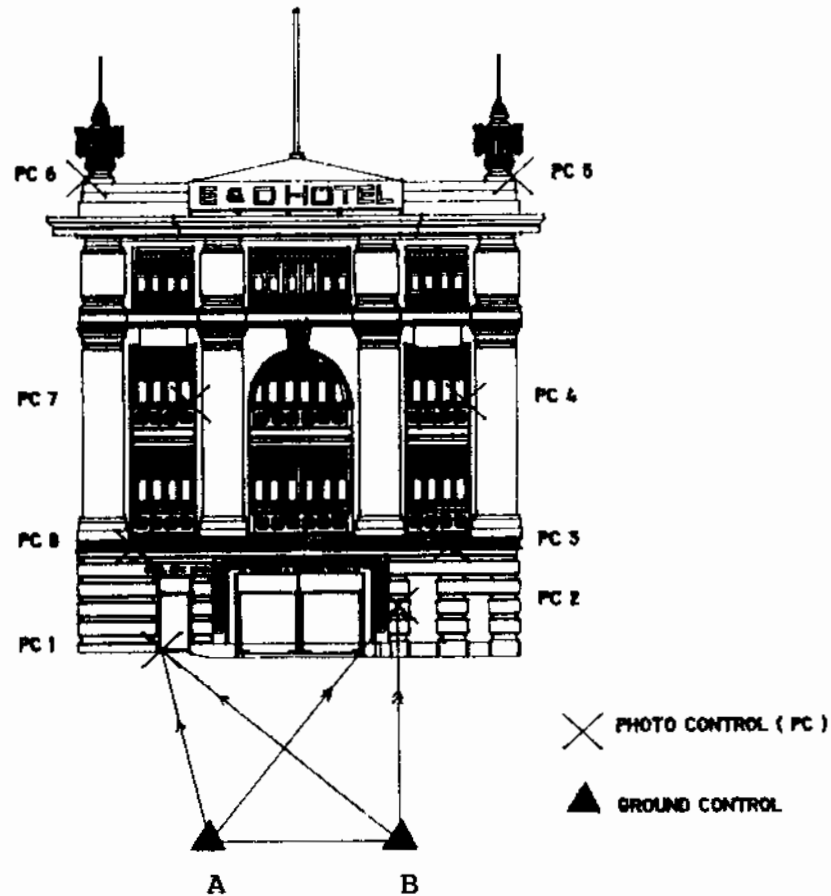
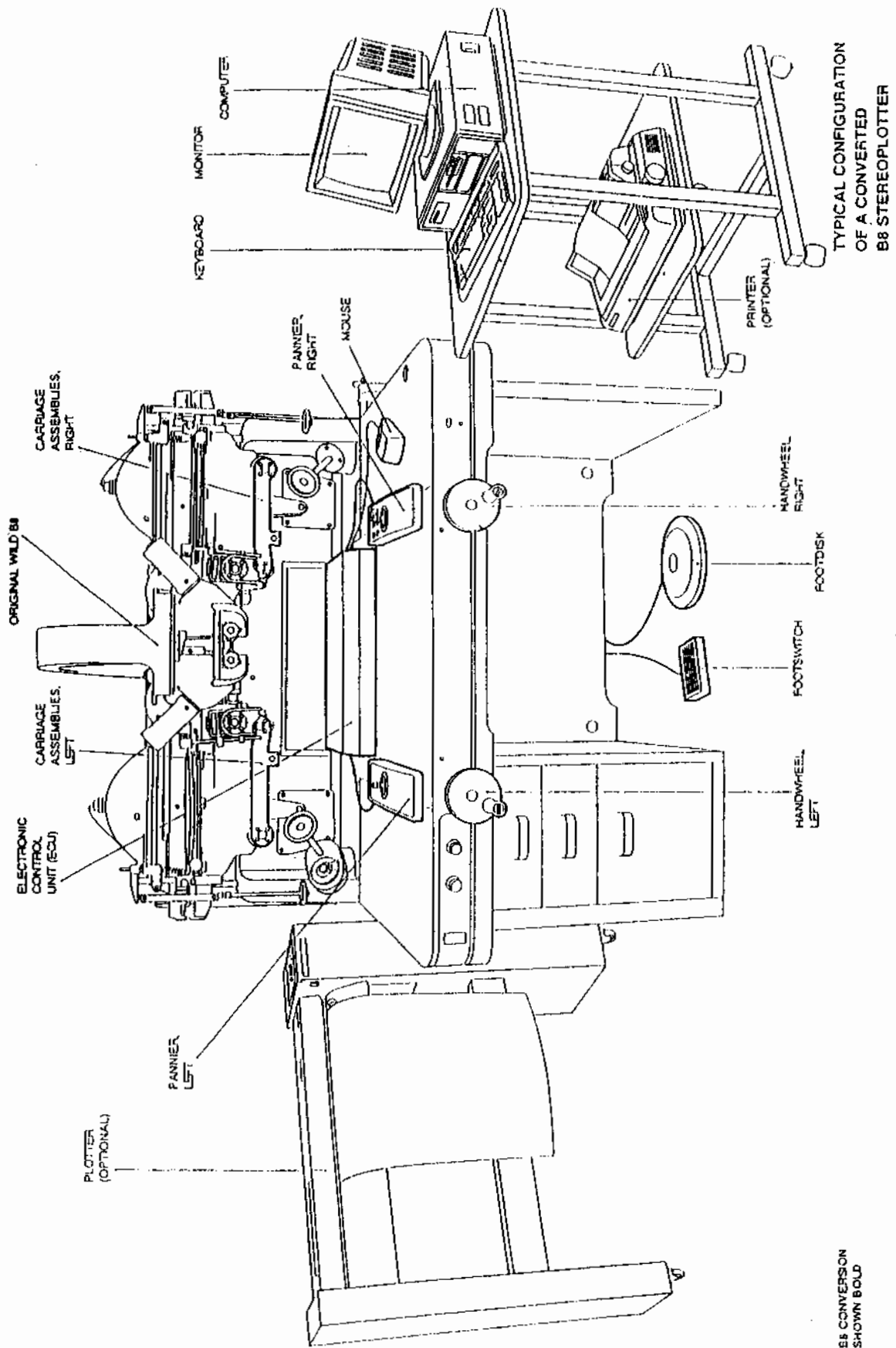

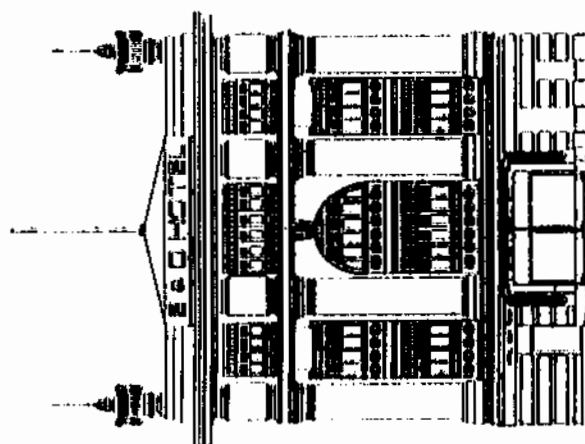



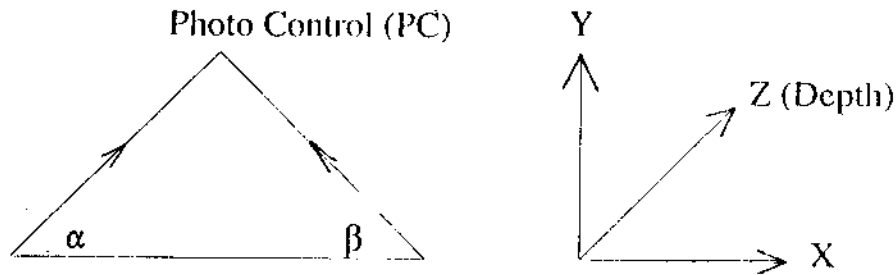
Figure 3: Location of ground and photo controls on the facade



 <p>Sketch of the building's location on a map.</p>	<div data-bbox="446 976 1031 1417">  </div> <div data-bbox="1055 1029 1104 1281"> <p>MAIN ENTRANCE</p> </div>	
<p>PHOTOGRAMMETRIC SURVEY OF RESTORATION OF E &amp; O HOTEL ( MAIN ENTRANCE )</p>		
 <p>Survey Department, Malaysia</p>	<p>LICENSED SURVEYOR :</p>	
<p>PLAN NO. : JK/AL/PS/21/CID</p>	<p>DATE : 10/10/2018</p>	

#### 4.1 Computing field data

Having acquired the data in the field, the three dimensional coordinates (X, Y, Z) of the photo controls computed using the following formulae:



$$X_{PC} = \frac{(Z_A - Z_B) + X_B \cot \alpha + X_A \cot \beta}{\cot \alpha + \cot \beta}$$

$$Z_{PC} = \frac{(X_A - X_B) + Z_B \cot \alpha + Z_A \cot \beta}{\cot \alpha + \cot \beta}$$

$$Y_{PC} = R \cdot L_A + H \cdot I_A \pm V_A$$

$$Y_{PC} = R \cdot L_B + H \cdot I_B \pm V_B \text{ (check)}$$

where

$RL$  = reduced level

$HI$  = height of instrument (i.e theodolite)

$\alpha, \beta$  = horizontal angle

Table 1 shows the X, Y and Z coordinates of all the photo controls using the above formulae.

PC	X (m)	Y (m)	Z (m)
1	101.104	100.867	73.493
2	109.769	101.622	72.045
3	111.801	103.788	75.397
4	111.773	108.723	72.453
5	113.957	116.846	72.167
6	98.500	116.724	70.514
7	102.275	108.924	70.709
8	100.196	103.823	74.141

Table 1 : Photo control coordinates

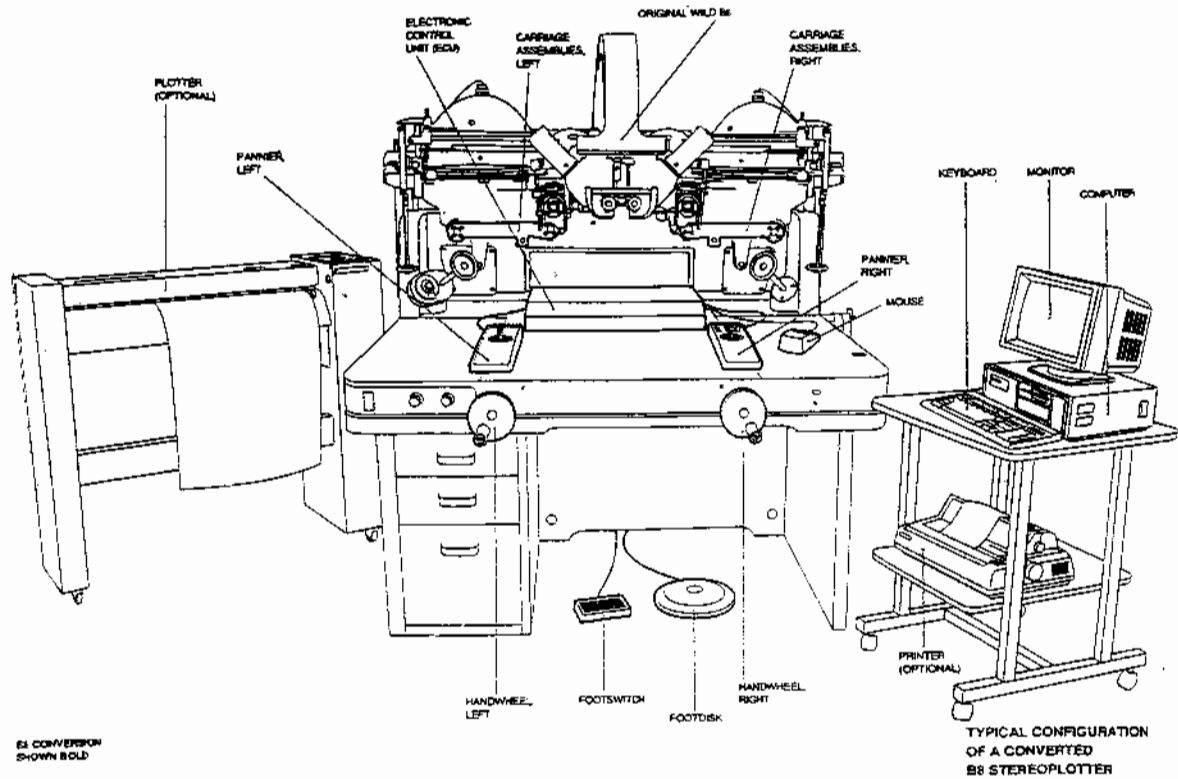


Figure 4: Adam Technology analytical plotter

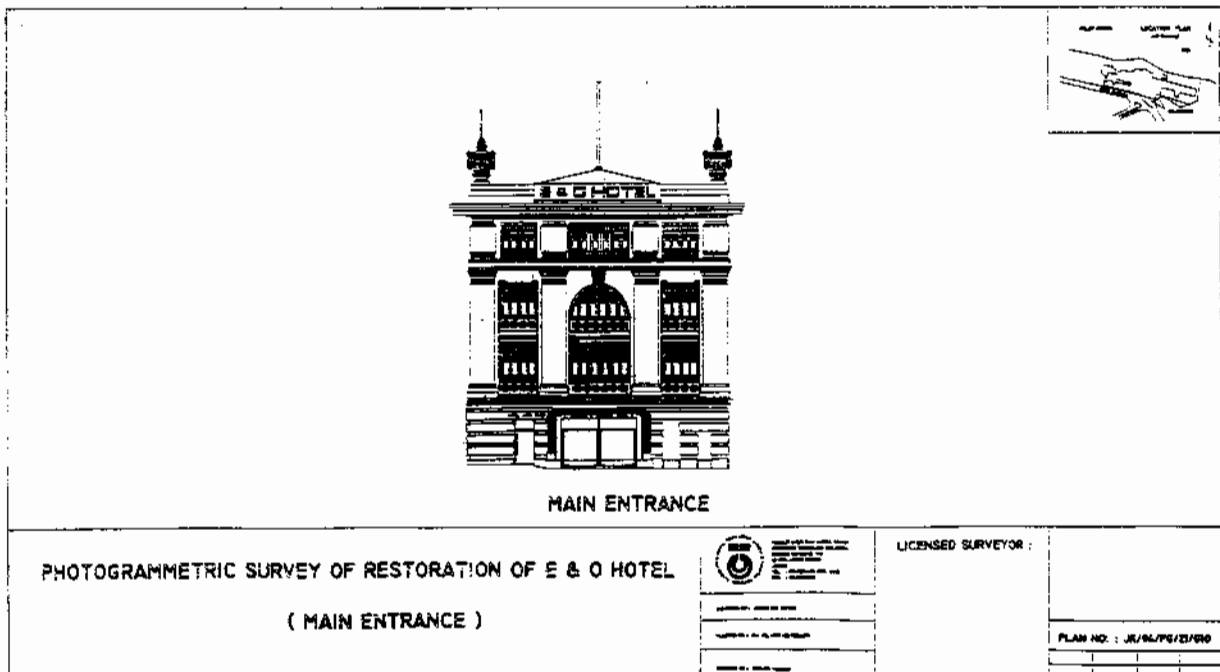


Figure 5: The line drawing of the main entrance facade of the E & O Hotel



#### **4.2 Developing the photographs**

The photographs of the facade were taken using black and white film and were developed using the following processes successively (i.e. developer, acid stop bath, fixer, washing and drying) in the dark room. After the photographs have gone through these processes, negative films were produced. Subsequently, diapositives were produced.

#### **4.3 Analytical plotter**

In the work carried out, the diapositives were placed in an analytical plotter to carry out measurements. The analytical plotter used was Adam Technology Conversion Plotter (i.e. Wild B8 converted from an analogue plotter to an analytical plotter). The process of setting up the stereomodel is the same as in other analytical plotter (i.e. interior and exterior orientation). The software used is menu driven and easy to understand. Hence, the procedure of setting up the stereomodel was found to be straight forward.

Once the stereomodel was set up, the process of digitising was carried out to produce line drawing of the facade. Having completed digitising, the line drawing was transferred to AutoCAD for editing and enhancement. Finally, the line drawing was plotted at the required scale. Figure 4 shows the Adam Technology analytical plotter and Figure 5 shows the line drawing of the E & O Hotel main entrance facade plotted not to scale.

#### **5.0 CONCLUSION**

From this work, it was found that the line drawing of the main entrance facade of E & O Hotel can be produced faster using the architectural photogrammetric survey method compared with direct measurement method. Also, the line drawing that was produced could be better visualised at any scale through the use of AutoCAD. Finally, from this experience it was found that the architectural photogrammetric method can be used for recording buildings.

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