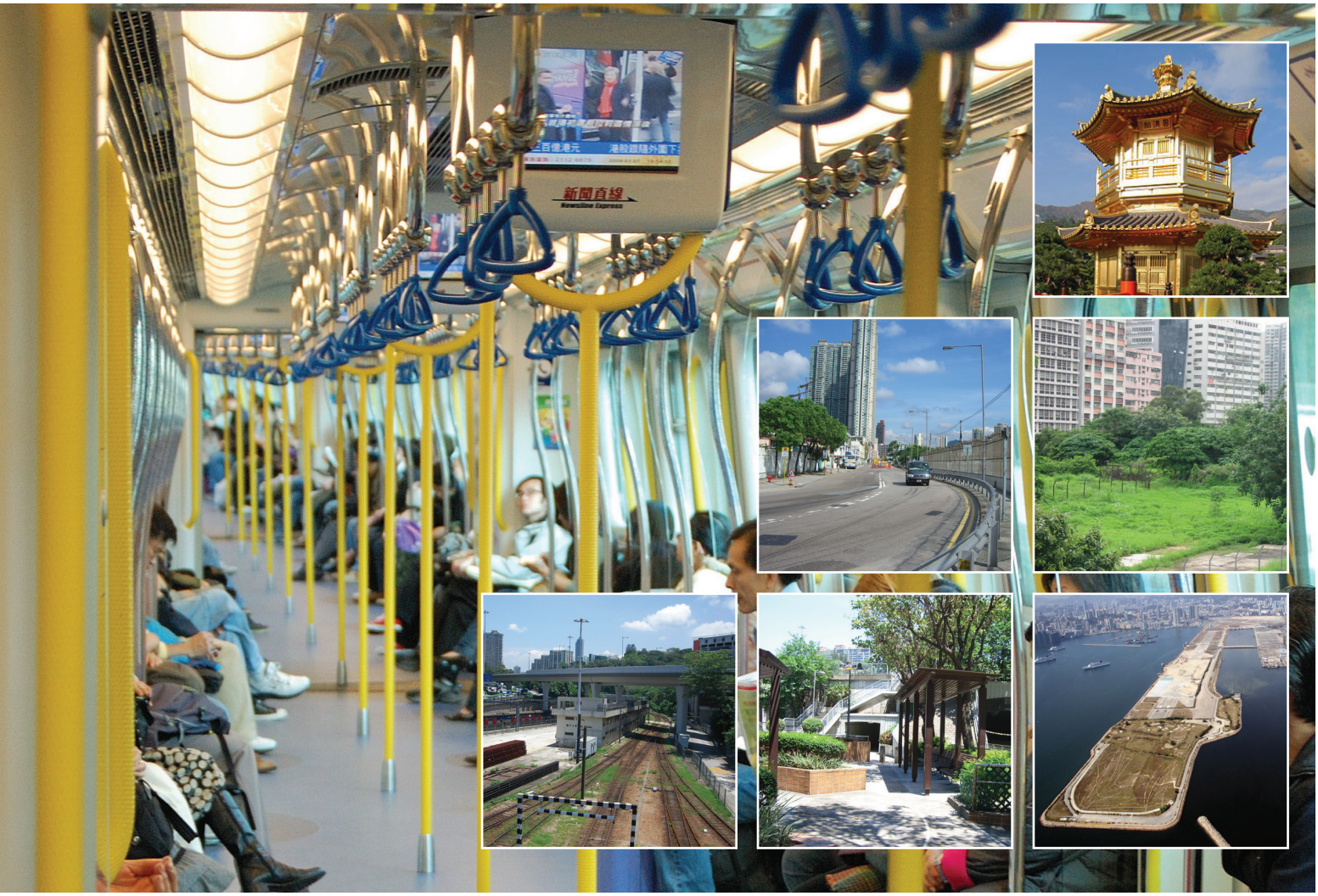
MTR港鐵

Consultancy Agreement No. NEX/2201

Shatin to Central Link
Tai Wai to Hung Hom Section

WP CE15 Conditions Survey of Former Royal Air Force Hangar in Diamond Hill

July 2009



MAUNSELL | AECOM

Maunsell Consultants Asia Ltd

Shatin to Central Link

Tai Wai to Hung Hom Section Preliminary Design

WP CE15 Condition Survey of Former Royal Air Force Hangar in Diamond Hill

July 2009

Prepared by : Alex Yeung / Mingo Li

Checked by : Eric Poon
(Deputy Team Leader)

Signed : *[Original signed by Eric Poon]*

Date :

Endorsed by : Ian Whitton
(Team Leader)

Signed : : *[Original signed by Ian Whitton]*

Date :

Maunsell
in association with
Aedas
Atkins
PBA
MVA
EDAW
Knight Frank
ENSR
DLS
Simon Kwan & Associates

Revision Record

Revision	Date	Description/Filename	Prepared	Checked	Approved

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1.0 INTRODUCTION

1.1 Background

1.1.1 The Aircraft Hangar is classified as a Grade 3 historic structure built in early 1930s, which is located at the previous Tai Hom Village near Hollywood Plaza, Diamond Hill, as shown in **Figure 1**. It was the aircraft workshop of the Royal Air Force's airport facilities originally located at the former Kai Tak airfield and was subsequently relocated to the present site in 1940s. In view of the aircraft hangar is located within the CDA site boundary proposed for the Diamond Hill Depot of the project of Shatin to Central Link, relocation of this hangar is necessary.

1.1.2 Maunsell Consultants Asia Ltd. (MCAL) was engaged by MTR Corporation Ltd. (MTRCL) to provide consultancy services for conducting a superficial survey for the aircraft hangar. The superficial visual survey for the aircraft hangar aims to collect information on the general condition of the aircraft hangar to further assess and to provide information for determining the appropriateness for relocation of the aircraft hangar.

1.1.3 The superficial survey for the aircraft hangar was carried out on 6 and 7 January 2009. This report presents the findings of the aforesaid survey works including proforma and photographic records.

1.2 Scope of Work

1.2.1 The scope of work for superficial survey comprised the following:

(a) Condition survey on structural elements of the aircraft hangar;

(b) Visual survey to identify visible defects (e.g. cracks, spalling, rust) as recorded in proformas;

(c) Identifying and recording the conditions of existing members of steel structure;

(d) Assessing the general condition of the structure; and

(e) Reporting the findings of the survey work.

1.3 Services and Information Supplied by the Client

1.3.1 The Client provided the following assistance to MCAL:

- Provision of structural drawings both plan and elevation view for marking up defects.
- Liaison with all relevant government department and parties to ensure safety access of MCAL staff during survey work.
- Provision of temporary access including scaffolding, if necessary, for MCAL staff during the condition survey.

2.0 SURVEY RESULTS AND DISCUSSION

2.1 Survey Locations

2.1.1 With reference to **Figure 1**, the site area of the aircraft hangar is about 60m x 30m. The structure is a single storey steel structure supported by 31 steel-I-columns with concrete footings (**Photo 1**) and retained by the concrete retaining wall (**Photo 2**). In order to locate and describe the structure member of the aircraft hangar clearly, the whole structure is divided into 31 locations of steel-I-columns as shown in **Appendix A**. It was essential to note down all the visually observable defects by the naked eyes particularly for the lower levels of the structures at safe and accessible level. The summary of visible defects and photographic records are presented in **Appendix B**.

2.2 Survey Findings

2.2.1 The original aircraft hangar is built of steel members and its roof is formed by the truss with corrugated zinc sheet roof and bitumen sheet waterproofing layer on top (**Photo 2**). The truss roof (**Photo 4**) is supported by a series of steel I-columns and concrete block footings, as shown in below photos. The side walls are also built of steel channels tied with the steel-I-columns along the perimeter of structure and covered with corrugated zinc sheet cladding. Typical defect photos are extracted and shown in **Appendix C**.

Photo 1 – Steel-I-column with concrete footing

Photo 2 – Corrugated zinc sheet roof and bitumen sheet waterproofing layer at the main entrance

Photo 3 – Mass Concrete side wall with grown vegetation

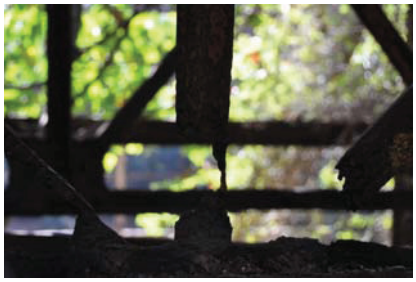
Photo 4 – Significant rusting at beam on roof

2.2.2 With reference to the visual survey, the existing aircraft hangar is in poor condition in view of lacking of maintenance and protection on the roof and side-walls. There are some corrugated zinc sheets with waterproofing bitumen sheet coating on the roof sheeting at the main entrance of the aircraft hangar (**Photo 5**). Majority of the defects identified in the survey were associated with corrosion and deterioration of the steel components, particularly the locations of interface between different materials or elements (**Photo 6**). Water and moisture were easily retained in these places and induced corrosion. Besides, both protective coatings peel off and direct contact of different metal materials (e.g. Stainless / galvanized steel with carbon steel), with so-called bi-metallic corrosion, will accelerate the corrosion of steel frames. The corrosion of metallic elements will reduce loading capacities and service life of the structure. Surface preparation and re-coating of these steelworks are recommended to stop further corrosion.

Photo 5– Corrugated zinc sheet with waterproofing bitumen sheet coating

Photo 6– Significant rusting at beam on roof

2.2.3 As the aircraft hangar structure had been exposed to the atmosphere for long period under wet and dry weather, most of the steel members of the frame were corroded with different levels of deterioration. Particular to the small steel members, they are deteriorated with less than 50% of original size left and some even broken and fallen down on the floor. Most of the bolts and nuts at the connection joints of the structure were corroded and deteriorated; this would reduce the whole structural strength of the aircraft hangar, and would also cause impacts to the relocation of the structure. A few steel-I-columns have buckled (**Photo 7**). Most of the concrete footings at each steel-I-column and side walls are grown with vegetation (**Photo 9** & **10**), which would increase the difficulty of relocation of the structure.

 Photo 7 – Buckle at I-beam	 Photo 8 – Corroded and deteriorated steel frame
 Photo 9 – Location 9 - Grown vegetation at the footing	 Photo 10 – Vegetation attached on steel frame
 Photo 11 – Corroded bolts and nuts at joint	 Photo 12 – Damaged steel members

2.2.4 According to the survey result, it is difficult to relocate the aircraft hangar as most of the steel members and joints are partly or fully corroded and deteriorated (**Photo 8, 11 to 14**). The whole structure of the aircraft hangar may fall down if any member of the aircraft hangar is dismantled.

	
Photo 13 – Significant rusting at beam on roof	Photo 14 – Significant rusting at beam on roof

2.2.5 However, if the relevant government departments and parties or other stakeholders insist to keep and relocate this aircraft hangar, further investigation including temporary works design and protective measures would be carried out in advance in order to repair and protect the existing condition of steel hangar before proceeding with any relocation works. In addition, over 20~30% of the steel members cannot be reused at the new location and such deteriorated members (e.g. deteriorated member at location 16) should be replaced by other new steel members. Therefore, the whole structure of aircraft hangar should also be re-designed as necessary to meet the current design standards for the new location. More defect finings are recorded with photos as shown in **Appendix B**.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1.1 Based on the superficial survey results, the general condition of the aircraft hangar is in poor conditions, but the defects identified are not posing immediate hazards to the stability of the structure. Significant surface corrosions of the steel members at the upper and lower portions of the aircraft hangar were observed. Immediate repair is considered not necessary at this moment as the handling of this historical structure is yet to be confirmed. However, in order to prevent further deterioration of the structure, it is recommenced to review the status of the defects of the structure on a routine basis (e.g. inspect the structure every 6 months).

3.1.2 Most of the steel members have extensively corroded and deteriorated, which would affect the structural integrity of the aircraft hangar. Some of damaged steel members were observed at different areas of the structure. It is therefore difficult to relocate the existing structure to a new location in view of the existing structural integrity. In order to determine the strength of structure members of the aircraft hangar, taking of samples of steel members for testing would be required. Appropriate non-destructive tests (e.g. Breakout inspection window for the concrete element including mass concrete side wall and I-column concrete footing. For the NDT of steel members, condition ultrasonic thickness measurement, magnetic particle inspection to welds at connection joints, coating thickness measurements, etc) can also be used to collect more information on the material condition of the structure and to provide useful input to any proposed rectification methods, if necessary. It is required to conduct detailed non-destructive testing (NDT) and sampling at representative areas of the structure for in-depth appraisal of the materials condition of the structure.

Figures

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MTR

SHATIN TO CENTRAL LINK

ORIGINATOR

MAUNSELL | AECOM

Maunsell Consultants Asia Ltd.
茂盛(亞洲)工程顧問有限公司

In association with Atkins, PBA, Aedas, MVA, EDAW, and DLS

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TITLE

NEX/2201 - TAW TO HUH SECTION
PRELIMINARY DESIGN
LOCATION PLAN OF RAF HANGER

SCALE	FIGURE NO.	REV.
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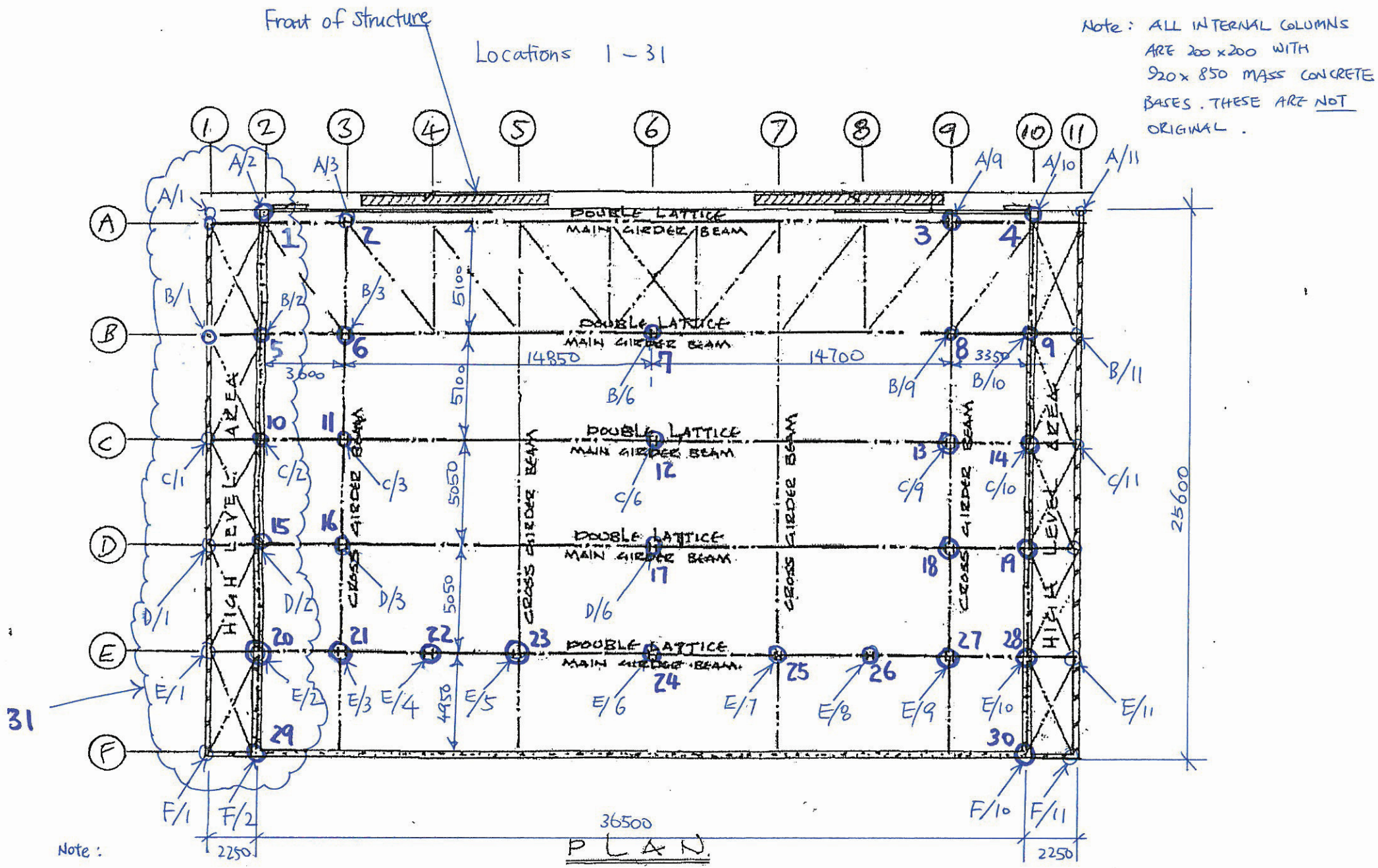
APPENDIX A

Survey Locations



Note:

10 Location

APPENDIX B

Summary of Visible Defects and Photographic Records

SCL - Structural Survey for Aircraft Hangar
Summary of Visible Deterioration

Location (grid ref)	Steel elements condition (grade 0 to 5)				Column block condition	Photo*
	Main girder	Other beam and bracing	Gusset and fastener	Column		
A / 1	3	4	4	3	N/A	P1070424
A / 2	3	4	3	3	N/A	P1070425
A / 3	3	3	3	2	No visible damage	P1070426, P1070429
A / 9	3	0	3	2	No visible damage	P1070430, P1070432
A / 10	4	4	4	3	N/A	P1070434
A / 11	4	4	4	4	N/A	P1070433
B / 1	4	4	4	3	N/A	
B / 2	4	4	4	3	N/A	
B / 3	4	4	4	2	Partially concealled, no visible damage	P1070435, P1070437
B / 6	2	2	3	2	Partially concealled, no visible damage	P1070442, P1070445
B / 9	4	4	4	2	Partially concealled, no visible damage	P1070450, P1070453
B / 10	4	4	4	3	N/A	P1070460
B / 11	4	3	3	3	N/A	P1070459
C / 1	3	3	3	3	N/A	
C / 2	4	3	3	3	N/A	P1070463
C / 3	3	3	3	2	Partially concealled, no visible damage	P1070465, P1070468
C / 6	2	2	2	2	Totally concealled	P1070474, P1070477
C / 9	4	3	3	2	Partially concealled, no visible damage	P1070484, P1070490
C / 10	4	4	4	4	N/A	P1070492
C / 11	4	4	3	4	N/A	
D / 1	4	4	3	3	N/A	
D / 2	4	4	4	4	N/A	P1070500, P1070501
D / 3	4	3	4	2	Partially concealled, no visible damage	P1070502, P1070505
D / 6	4	3	3	2	Totally concealled	P1070510, P1070513
D / 9	4	3	3	2	Partially concealled, no visible damage	P1070519, P1070522
D / 10	3	3	3	3	N/A	P1070529, P1070530
D / 11	3	4	3	3	N/A	
E / 1	4	4	3	4	N/A	P1070532
E / 2	4	4	4	3	N/A	P1070433, P1070534, P1070535
E / 3	4	3	3	2	Partially concealled, dents on sides possibly due to honeycombing	P1070536, P1070539, P1070540
E / 4	4	2	3	2	Partially concealled, dents on sides possibly due to honeycombing	P1070543, P1070545, P1070547
E / 5	4	3	5	2	Partially concealled, no visible damage	P1070551, P1070555, P1070554
E / 6	3	2	3	2	Partially concealled, no visible damage	P1070561
E / 7	2	2	2	2	Partially concealled, no visible damage	P1070564, P1070568
E / 8	4	2	3	2	Partially concealled, no visible damage	P1070572, P1070575
E / 9	4	3	3	3	Partially concealled, no visible damage	P1070579, P1070586
E / 10	4	4	4	4	N/A	P1070588
E / 11	4	4	4	4	N/A	
F / 1	4	4	4	4	N/A	
F / 2	4	4	4	4	N/A	P1070592
F / 10	4	4	4	4	N/A	P1070594
F / 11	4	4	4	3	N/A	

* Additional photos are included in this appendix to show general condition of the hangar.

Defect categories (steel elements)

Cat. 0 Defect not visable
Cat. 1 No rust or only thin rust on some surface area (consider no material lost due to rusting)
Cat. 2 Moderate rust on steel surface area (estimated some member having up to 10% material lost due to rusting)

Cat. 3 Serious rust on large surface area with observable lost of material (estimated some member having up to 30% material lost due to rusting)
Cat. 4 Large scale of steel material lost due to rusting (estimated some member having up to 50% material lost due to rusting)
Cat. 5 Member of the element missing or discontinue

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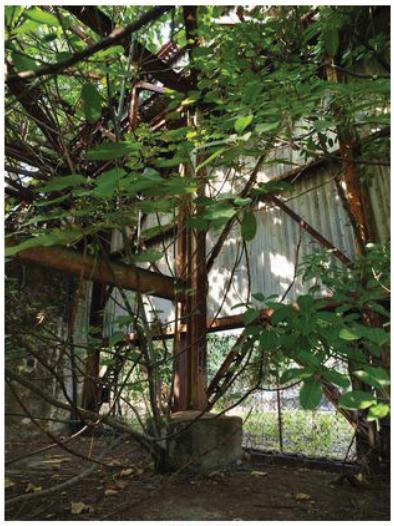
P1070425



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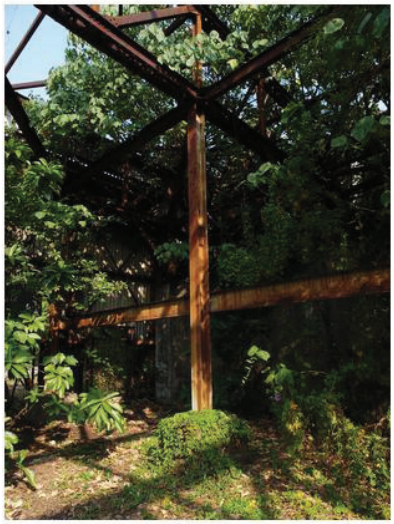

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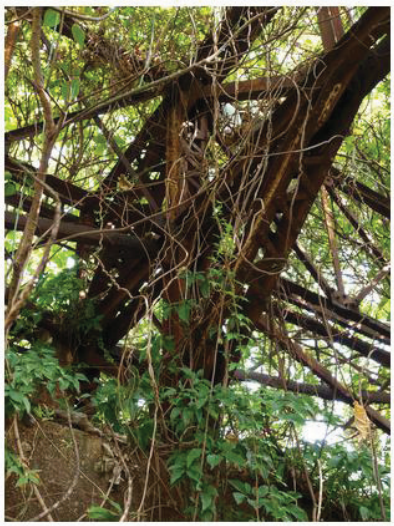

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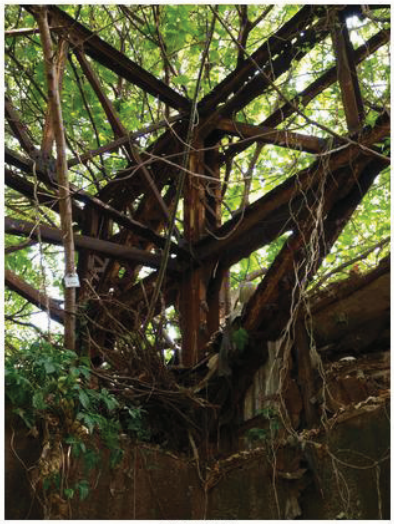

P1070594

APPENDIX C

Typical Defects

Photo P1070434 – Location 04 – roof structure

Photo P1070437 – Location 06 – roof structure and support

Photo P1070455 – Location 8 – footing block

Photo P1070460 – Location 9 – roof structure

Photo P1070477 – Location 12 – roof structure and support

Photo P1070508 – Location 16 – at mid height of column

Photo P1070541 – Location 21 – at mid height of colum

Photo P1070575 – Location 26 – roof structure and support

Photo P1070591 – Location 29 – roof structure and support

Photo P1070596 – Location 30 – roof structure

Photo P1070613 – Location 31 – roof structure

Photo P1070631 – Location 31 – roof structure and support

Photo P1070648 – Location 31 – roof structure

Photo P1070647 – Location 31 – roof structure

Photo P1070601 – General

Photo DSC_0628 – Front of structure

Photo DSC_0642 – Front of structure – typical cladding detail