ARCADIS Design & Consultancy for natural and built assets

ATP LOCOMOTIVE WORKSHOPS

Design Basis Report - Retail

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Incorporating Hyder

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MIRVAC
ATP LOCOMOTIVE WORKSHOPS

Design Basis Report - Retail

Structural

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
1	25/07/2017	Draft report issued for SSDA submission	NS	JL
2	17/08/2017	Minor alterations to load allowances	NS	JL
3	16/10/2017	Final report issued for SSDA	NS	JL
4	20/10/2017	Minor Revisions - Travellator	NS	JL

CONTENTS

1 PROJECT DESCRIPTION

1.1 Introduction

This report supports a State Significant Development Application (SSDA) submitted to the Minister for Planning pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Application (referred to as SSDA 8517) seeks approval for the adaptive reuse and redevelopment of the eastern portion of the Locomotive Workshop (being Bays 1-4a) within the Australian Technology Park (ATP), Eveleigh as described in the Proposed Development Description section of this report.

1.2 Background

Historically, ATP was used for railway maintenance, storage and other associated industries. Use of the site as marshalling yards and workshops formed part of a large railway-based precinct on both sides of the main railway line, dating from 1882 and growing in size until its closure in 1989. Since this time, the precinct has been progressively redeveloped and repurposed.

In 2014, the NSW Government resolved to offer development sites within the ATP for sale through a selective tender process conducted by Urban Growth NSW Development Corporation (UGDC). In November 2015 Mirvac Projects Pty Ltd (Mirvac) was named as the successful party and ownership and development rights of the precinct were subsequently transferred.

In December 2015, an SSDA was submitted to the Department of Planning & Environment for a multi-building redevelopment (i.e. Buildings 1, 2 and 3 shown in Figure 2) of the ATP to provide new commercial office, retail and community uses and a significant upgrade to the ATP public domain. Following public exhibition, and the submission of additional information, the development was approved by the Planning Assessment Commission on 20 December 2016. The construction of Buildings 1, 2 and 3 is currently underway.

The redevelopment of the Locomotive Workshop is also part of Mirvac's redevelopment strategy for the ATP. The Locomotive Workshop is to be redeveloped in its entirety, however planning approvals are sought through the submission of two separate SSDAs. This Application relates to the eastern portion encompasses the heritage Bays 1 and 2, the existing Blacksmith operation and Bays 3,4 and 4a. In conjunction with SSDA 8449 that relates to Bays 5-15, this Application is envisaged to be the next phase of urban regeneration within the ATP.

1.3 Site Location

The Locomotive Workshop is located within the Australian Technology Park (ATP), Eveleigh. The ATP precinct is located approximately 5km south of the Sydney CBD, 8km north of Sydney airport and within 200m of Redfern Railway Station and has an overall area of approximately 13.2 hectares. An aerial photograph of the ATP precinct is shown in Figure 1 and the locational context of the Locomotive Workshop is identified in Figure 2.

Figure 1 – ATP Precinct

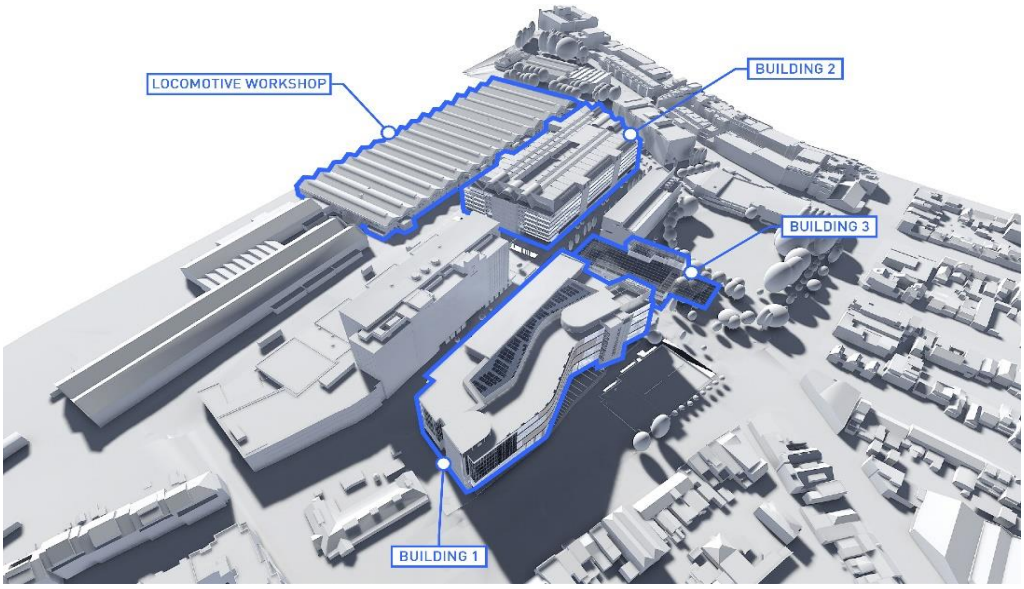

Figure 2 – Locational context of the Locomotive Workshop

Source: Sissons

1.4 Proposed Development Description

This SSDA seeks approval for the following:

- demolition of existing 'modern' infill fit-out elements to Bays 3-4a, including display barriers in Bays 1 & 2;
- relocation of moveable heritage items;
- adaptive reuse of the Bays 1-4a and two annex structures for retail premises uses, function centre uses, information and education facility uses, general industrial uses, recreation facility (indoor) uses and associated back of house facilities;
- construction of internal and external alterations to Bays 1-4a;
- heritage interpretation and conservation works;
- public domain improvements within the curtilage of Bays 1-4a;
- provision of an external building illumination system;
- signage; and
- associated utilities and infrastructure.

A more detailed and comprehensive description of the proposal is contained in the EIS prepared by Ethos Urban.

2 SITE DATA

Note: Reports prepared by third parties are taken at face value and will be included into the design documentation as such. Arcadis will not be responsible for incorrect recommendations and advice by third parties.

Arcadis' design will be undertaken under the assumption that any third-party data supplied has been prepared by competent qualified professionals vetted by the client.

2.1 Geotechnical information

The final geotechnical report for the site by Douglas Partners [Reference: 84955.04.R.001.Rev1 dated 10th October 2017 has been incorporated into the design of the new foundation system for new columns. Low strength rock is typically encountered between 2.5 metre to 5.5 metres below the existing floor level, upon which new piled foundations will be supported on.

2.2 Groundwater and Contamination

Arcadis understands that contamination investigations have been commissioned by Mirvac for the site. This information will be incorporated into the design brief as it is made available.

We anticipate that contaminated soil strata may be present within the development.

2.3 Existing in Ground Services

Existing services in the location of the piling works and any basement construction are to be diverted or made redundant prior to commencement of works.

2.4 Foundation Types

Arcadis assumes that bored or screw piles will be required for the site. Allowable bearing pressures of 700 kPa for very low strength shale (Class IV and V), and 2MPa for low strength shale (Class III) are the recommended geotechnical parameters for design. Where possible, existing footings supporting the cast iron columns will be re-used for new columns, as well as existing piles between Bays 3 to 5. The existing piles between Bays 3 to 5 will need to be load tested during detailed design stage, however based on preliminary estimates of existing load conditions, they are adequate to support the new 1-storey structure.

2.5 Shoring and Retention Systems

Shoring and retention will be required to accommodate the new travellator structure. This is to be designed and constructed by others – Arcadis will act to review the proposed design such that our design intent is maintained. Arcadis assumes that a soldier pile wall will be installed for retention.

2.6 Basement vehicle Access

Not Applicable

2.7 BCA Report

Philip Chun have been commissioned by Mirvac to provide BCA reporting. Arcadis will incorporate the findings of the report into this documentation as required. We

anticipate that the BCA report will provide direction regarding the requirement for the upgrade of the existing structure for modern earthquake design as well as providing guidance regarding fire ratings. Preliminary advice with regards to fire rating is as follows –

- Type 'B' construction for retail area Bays 1 to 4a [no requirements for fire rating for all structural elements but provision to be made for fire rated columns for flexibility to Type 'B' construction]

Fire rating and earthquake design will have a significant impact on the structural engineering for the heritage structure as it is likely that the current structure does not comply with the BCA requirements for one or both.

2.8 Fire Engineered Solutions

Refer Fire Engineering Professionals report – Fire Engineering Brief Questionnaire for relevant information.

2.9 Dilapidation Report

Arcadis understands that a dilapidation report has been commissioned by Mirvac to be completed by VDM Consulting.

A separate dilapidation report is not included in Arcadis' Scope of Works but we have provided a proposal to carry out an inspection of the existing condition of the heritage structure as a part of our review of the workshop for structural engineering design purposes.

2.10 Green Star Requirements

Refer to NDY Green Star scorecard for details regarding number of points targeted for Mat-4 Concrete and Mat-5 Steel. The current targets are one point for concrete and no points for steel.

2.11 Existing Survey

Arcadis has possession of an existing point cloud survey of the locomotive workshop. This forms the basis of our understanding of the setout of the existing structure. The survey is to be incorporated into our Revit model.

2.12 Materials Testing

Results from the materials testing of the existing structure from BCRC have been incorporated into the current concept design. The final results will be used to validate the concept design.

3 STRUCTURAL CONFIGURATION

3.1 Overview

As the development is a refurbishment of an existing structure, the structural configuration refers to both the layout of the new and existing structures. The following heading will be split into Heritage and New-Build components where necessary.

The new structure will consist typically of a three-bay-long structures within the building envelope between bays 3-4a. The three-bay structure will be split in half by a corridor running North-South for the full length of the workshop.

Excavation is to occur along the edge of the structure bounding Locomotive Street to allow for the incorporation of a new travelator connecting Building 2 to the Locomotive Workshops. Refer to Section 2.5 for information regarding shoring. Arcadis is to review the impact on the proposed travellator on the existing structure and strengthen as required. Refer to Sissons drawings *SA-AR-DWG-BB-B4-SK_067[C]* and *SA-AR-DWG-BB-B4-SK_068[C]* for layout information.

3.2 Lateral Stability

New Build

Lateral stability for the new build structures will be provided by cores that are to be constructed either out of steel or concrete. The cores are located at the rear of the new building and these will need to provide sufficient capacity to resist applied torsional moments. Arcadis anticipated that, due to the substantial mass of the existing structure and the low maximum height, the earthquake case will govern the design of the lateral resisting system.

Existing

Arcadis will complete a review of the existing structure according to current code requirements to determine the compliance to current Australian codes. Arcadis awaits input from the BCA consultant, Philip Chun to determine if the current stage of works sets off a requirement for upgrade.

Arcadis will attempt to minimise the structural impact of the new works on the existing structure.

3.3 Vertical Elements

New Build

Vertical loads for the structure are supported by steel columns and reinforced concrete core walls or steel bracing.

The new structure will have a line of support that corresponds with the location of the existing cast iron columns. Arcadis has reviewed the feasibility of connecting to the existing columns and have considered the following:

- Compliance of the Structure to BCA – Type ‘C’ or Type ‘B’ Construction
- Fire Rating of the existing columns with respect to the new structure
- Capacity of the existing columns and foundations
- Connection detailing – cast iron cannot be welded
- Available information with respect to foundations

Based on the above, the current concept scheme minimises in-ground foundation works by relying on the existing cast iron columns and footings for support where possible as shown on our concept sketches. Two options are presented depending on Type ‘B’ or ‘C’ construction. These are –

- Type ‘B’ construction – concrete filled steel tube columns supported on existing cast iron column footings
- Type ‘C’ construction – hanging columns supported off new steel beam spanning between existing crane girders to cast iron columns

The existing cast iron columns and crane girders have sufficient capacity to support the new structure. The capacities of the existing structure have been derived from preliminary material testing results from BCRC, available existing drawings and information from point cloud survey.

Existing

Vertical loads within the heritage structure are transferred from the roof and from the original crane beams into the existing cast iron columns. An existing mezzanine structure was installed during the 1990s which appear to be supported off the existing cast iron columns using steel posts fixing to the crane beams over.

A preliminary review of the existing roof elements has been conducted to determine any additional capacity. Our current review has found an additional capacity of approximately 0.5kpa as detailed in previous correspondence (reference: A0003-AA009582-AAL-01).

3.4 Floor Systems

New Build

Arcadis have provided the following concept designs options for architectural input as follows:

- Steel framed composite flooring
- Post-tensioned slabs and beams
- Steel framed timber slab
- Reinforced concrete shoring box for new travelator

The current preferred option is steel framed composite flooring, for maximum structural efficiency and depths due to restrictions in floor to floor height. The steel beams will also have web penetrations to for integration of a structure and services zone.

Existing

The ground floors of the existing structure appear to be a concrete slab-on-grade. An existing steel framed mezzanine structure is also present within the building which will be demolished as part of the new development.

Tenancy Penetrations

Arcadis will specify 2 to 3 locations for intertenancy stair penetrations within the typical 3 bay tenancy that will have a minimal impact on the base building structure. Specific tenancy penetrations outside of these locations will be reviewed as a part of tenancy fitout works.

3.5 Design Standards

The structural design of the development shall be carried out in accordance with the provisions of the relevant Australian Standards, Council Standards and the National Construction Code (NCC) of Australia, and in accordance with the accepted practice and principles of structural engineering.

3.6 Design Codes

The structural systems shall be designed to satisfy the provisions of the following codes:

1. AS/NZS1170.0:2002 – Structural Design Actions: General Principles
2. AS/NZS1170.1:2002 – Structural Design Actions: Permanent, Imposed and Other Actions
3. AS/NZS1170.2:2011 – Structural Design Actions: Wind Actions
4. AS1170.4:2007 – Structural Design Actions: Earthquake Actions in Australia
5. AS3600:2009 – Concrete Structures
6. AS3700:2011 – Masonry Structures
7. AS4100:1998 – Steel Structures
8. AS4600:2005 – Cold Form Steel Structures
9. AS 2159:2009 – Piling Code
10. AS 3826:1998 – Strengthening Existing Buildings for Earthquake

Where there is no relevant Australian Standard or Code, appropriate overseas standards or recognised methods of analysis, design or testing will be used.

See separate Arcadis reports for material specifications.

4 LOADS

Generally, all loadings and load combinations will be in accordance with the current version of AS1170. The proposed design works shall be carried out in compliance with the relevant requirements of NCC, particularly the requirements of BP1.1.

4.1 Dead Loads

Dead loads shall be calculated as provide for in the current version of AS1170.0. The major dead loads to be used in design include the following:

Material	Density (kN/m^3)
Reinforced concrete generally	24kN/m^3
Lightweight concrete	20kN/m^3
Water (in storage tanks)	9.8kN/m^3
Masonry	To be determined in accordance with AS 3700 depending on masonry wall type such as single skin, double skin or block walls. (kN/m^2 vertical)
Soil (in planters)	18kN/m^3
Glazed panels (windows, doors)	30kN/m^3
Structural steel	77kN/m^3
Timber	10kN/m^3 minimum

Table 2: Dead loads

4.2 Floor Live Loads

Live loads shall be calculated as provided for by the current version of AS1170.1 Dead and Live Loads. The live loads shown below should be applied with flexibility of future use in mind. For example, a lesser loading than generally required over a large area should not be used for one room just because that room has a lower code loading requirement. The major live loads to be used in design include the following (distributed loads shown - point loads as per code or lift/plant manufacturer):

Area	Loads (kPa)
Office areas	3.0 kPa
Carparking	2.5 kPa
Compactus areas	7.5 kPa for 5% of office floor NLA
Storage	5.0kPa, based on 2.0m of maximum storage height
Storage – Major Retail	15.0kPa

Area	Loads (kPa)
Areas without obstacles for moving people Corridors, Lift lobbies, Aisles, Concourses Terraces and Plazas (not subject to wheeled vehicles)	4.0kPa
Plant Rooms and BOH areas	5.0kPa min (actual plant loading should be used if greater than 5.0 kPa)
Public and Fire Stairs	4.0kPa
Terrace Areas	4.0 kPa
Garbage Rooms	5.0kPa
Public Areas generally, Lobbies, Lounges (subject to wheeled vehicles trolleys etc)	5.0kPa
Gymnasia, Studios	5.0kPa
Lift Motor Rooms	5.0kPa (actual loads should be used plus reactions by lift manufacturer)
Lift Pits	Reactions as advised by lift manufacturer
Restaurant and Café, Specialty Retail	5.0kPa
Major Retail Tenancies	7.5kPa
Re-heat Kitchens	3.0kPa
Fire Control Room	3.0kPa
Loading dock and Access Driveways -specialty tenancies and office	10.0kPa
Loading dock – major tenancies	15kPa
Roof Trafficable	3.0kPa
Roof Non-trafficable	0.25kPa minimum.
Substation	TBC
Courtyard	TBC
Façade maintenance loads	Rope and rail access points anchor loads. TBC by manufacturer
Handrails and balustrade posts	Refer to AS 1170.1
Interior walls and permanent partitions, fixings and supports shall be designed to resist all loads to which they are subjected, but not less than a lateral force of 0.25 kPa applied perpendicular to the wall	

Table 3: Live loads

For other areas not defined, refer to AS1170.1. TBC denotes to be confirmed.

4.3 Floor Superimposed Dead Loads

Design superimposed loading as appropriate to the final design configuration and to be confirmed by the Architect, but not less than:

	Partitions	Services	Ceilings	Floor Finishes
Car Park	-	0.5 kPa	-	-
Lobby	1.0 kPa	0.25 kPa	0.25 kPa	1.5 kPa
Office	0.5 kPa	0.25 kPa	0.25 kPa	0.5 kPa
Retail	0.5 kPa	0.25 kPa	0.25 kPa	1.5 kPa
Bathrooms	3.0 kPa	0.25 kPa	0.25 kPa	1.2 kPa
Gymnasia, Studios	0.5 kPa	0.25 kPa	0.25 kPa	1.0 kPa
Plant Rooms	1.0 kPa	0.5 kPa	-	2.5 kPa

Table 4: Superimposed dead loads

** nominal allowance for floor finishes. Carpet assumed. No allowance for heavy finishes on office floors.

4.4 Wind Loads

Design wind loading is to be in accordance with AS 1170.2-2011 including Amdt 1:2012 Amdt 2:2012, Amdt. 3:2013 and the current National Building Code using the following parameters:

From the National Building Code:

- Importance Level = 3
- Ultimate Annual Probability of Exceedance = 1:1000
- Service Annual Probability of Exceedance = 1:20
- Building Design Live of 50 years

From AS 1170.2:

- Regional Wind Speed, V_R = 46 m/s.
- Wind Direction Multiplier, M_d = 1.00 (worst case from west).
- Terrain Category, TC = 3.0
- Terrain Height Multiplier, $M_{z,cat}$ = Refer AS 1170.2 Table 4.1(a)
- Shielding Multiplier, M_s = 1.0

4.5 Earthquake Loads

Code – AS1170.4 – 2007: Structural Design Actions. Part 4: Earthquake Actions in Australia.

Code	AS1170.4:2007
Structure Classification	Importance Level 3
Location	Sydney
Structure Location (Hazard Factor 2)	0.08
Annual Probability of Exceedance	1/1000
Probability Factor (Kp)	1.3
Subsoil classification	C_e (Shallow soil site assumed)
Earthquake Design Category	III

Table 5: Earthquake design criteria

The building is to be rated as not being essential for post-Earthquake recovery.

The design and fixing of mechanical, hydraulic and electrical components to the structure shall be designed in accordance to AS 1170.4. The design and certification of these fixings is outside Arcadis' scope of works.

Conclusion: - With reference to Figure 2.2 of AS1170.4, a dynamic analysis is required. The new structure will be designed to resist lateral loadings fully independently of the existing structure. Lift cores/service cores are to be installed within the individual bays and these will be designed to resist the lateral loads applied to the new building.

The existing structure will be reviewed to determine compliance with AS1170.4 and AS 3826. Any strengthening requirements as determined by the BCA consultant and in conjunction with the above will be designed in accordance with the requirements of AS 3826.

4.6 Snow Loads

Snow loadings are not applicable.

4.7 Live Load Reduction

Given the limited height of the structure, Arcadis will not be applying live load reduction

4.8 Special loadings

The design will not incorporate any special or blast loadings, unless specifically requested by the client.

5 DESIGN CRITERIA

5.1 Deflection

Design floor deflection in short and long term is to generally comply with the recommendations of 1170.0:2002, AS 3600 - 2009 and AS 4100 - 1998 as appropriate.

In addition to the deflection requirements set out in current version of AS 3600, all concrete components are to be designed such that:

1. The incremental deflection does not exceed the lesser of span/250 or 20mm
2. The total deflection does not exceed the lesser of span/250 or 30mm.
3. Total deflection of the perimeter of the floor structure after the installation of the façade shall be no greater than 20mm.

5.2 Building Motion

5.2.1 Vertical Motion

As the post-tensioned concrete and steel composite floors are relatively slender they will be checked for the dynamic response to footfall to ensure vertical vibration is within acceptable limits for occupants of an office. The basis of our design recommendations are based upon relevant recognised international publications referenced below.

Australian Standard AS2670.2:1990 has not been updated with relevant international standards.

The response to footfall will therefore be checked against the following:

BS6472 Part 1:2008 Guide to the evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting.

ISO 2631-1:1997 Mechanical vibration and shock- Evaluation of human exposure to whole –body vibration Pat 1 general requirements and

SCI Publication P354 – Design of Floors for Vibration (Revised Edition February 2009)

Reference

Assessing Vibration a Technical Guideline – Department of Environment and Conservation NSW Feb 2006

5.2.2 Lateral drift

The serviceability levels shall be designed and constructed to limit the inter storey drift such that the integrity of all connected building elements is maintained.

The lateral drift of the structure shall comply with the recommendations of AS1170.0 when subjected to serviceability limit state wind loads as follows –

Total lateral deflection shall not exceed height /500

Inter-storey deflection shall not exceed inter-storey height / 500 or 12mm whichever is lesser.

5.3 Strength

Structural concrete elements of the built form should have a design capacity that complies with the recommendations of AS 3600-2009. Structural steel elements of the built form should have a design capacity that complies with the recommendations of AS 4100-1998 and AS/NZS 2312-2002. Design capacities should be adequate to resist the load combinations in accordance with AS1170.0 and the relevant code limit state provisions.

5.4 Durability

Structural concrete elements of the built form should generally have a design durability that complies with the recommendations of AS 3600-2009. Structural steel elements of the built form should generally have a design durability which complies with the recommendations of AS 4100-1998 and AS/NZS 2312 - 2002.

5.5 Fire Rating

Structural elements should achieve the nominated fire resistance level in accordance with AS3600/AS3700/AS4100. The required fire rating is to be as specified in the BCA report and the Fire Engineering report.

5.6 Safety in design

Safety in Design reviews on all structural elements will be completed at the following milestones

- during the course of the project
- prior to issue of structural trade packages for tender
- prior to issue of structural drawings “For Construction”

5.7 Sustainability

The design will incorporate the use of cement substitutes and recycled steel content working in conjunction with Mirvac to achieve the required Greenstar rating.

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6 MATERIALS

6.1 Concrete

Reinforced and prestressed concrete, including elements reinforced with permanent steel formwork and plain concrete, shall comply with the provisions of AS3600:2009 – Concrete Structures and the standards referenced therein, in terms of analysis, design, and specification of constituent materials including reinforcement.

6.2 Steelwork

Structural steel, including steel used in composite construction and connections, shall comply with the provision of AS4100 – 1998 Steel Structures Code and standards referenced therein, in terms of analysis, design and the specification of constituent materials.

Structural steel with strength grades higher than provided for by AS4100 may be used subject to compliance with suitable overseas standards, research results or accepted practice.

6.3 Masonry

Masonry structures shall comply with the provisions of AS3700 – 2001 Masonry Structures and the standards referenced therein, in terms of analysis, design and the specification of constituent materials.

6.4 Existing Materials

Arcadis has specified testing to determine the design properties of the existing materials within the heritage structure. Our specification of testing was informed by our understanding of the heritage importance of the site. Our specification includes testing regimes for the following:

- Masonry
- Cast Iron
- Mild Steel
- Concrete

The testing regime has been provided to minimise the extent of strengthening to the existing structure, and to minimise the visual impact of any new structure.

Refer to F0001-AA009582-AA-R-02 for information regarding the testing of materials.