Design Development Report

Vertical Transport

University of Wollongong – Western Building

V.3 -October 2017

T H O M S O N
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1 Vertical Transportation Services

1.1 Introduction

The intent of this document is to serve as a Detail Design report providing design assumptions, performance requirements and performance outcomes that have been reviewed and developed during the design process.

The vertical transport detail design report has been prepared to articulate:

- Revised design basis and assumptions;
- Highlight items that have influence over the building's layout and envelope;
- Detail our revised design outcomes;
- Support the specification.

It is intended that these items would provide the basis for progressing the documentation into our detailed specification for the vertical transport services.

1.1.1 Project Information

Project Information	
Building Name	University of Wollongong Western Building
Building Type	University (Educational / performance)

1.1.2 Design Methodology

While the performance of vertical transportation elements within commercial buildings is largely defined by the Property Council of Australia, there is no comparative advisory body for educational / university developments.

For the purpose of our analysis we have referenced the University of Wollongong Lift Design Standards version 4.0 dated November 2015. Further references are discussed within the Chartered Institute of Building Services Engineers – Transportation Systems in Buildings (CIBSE) Guide D.

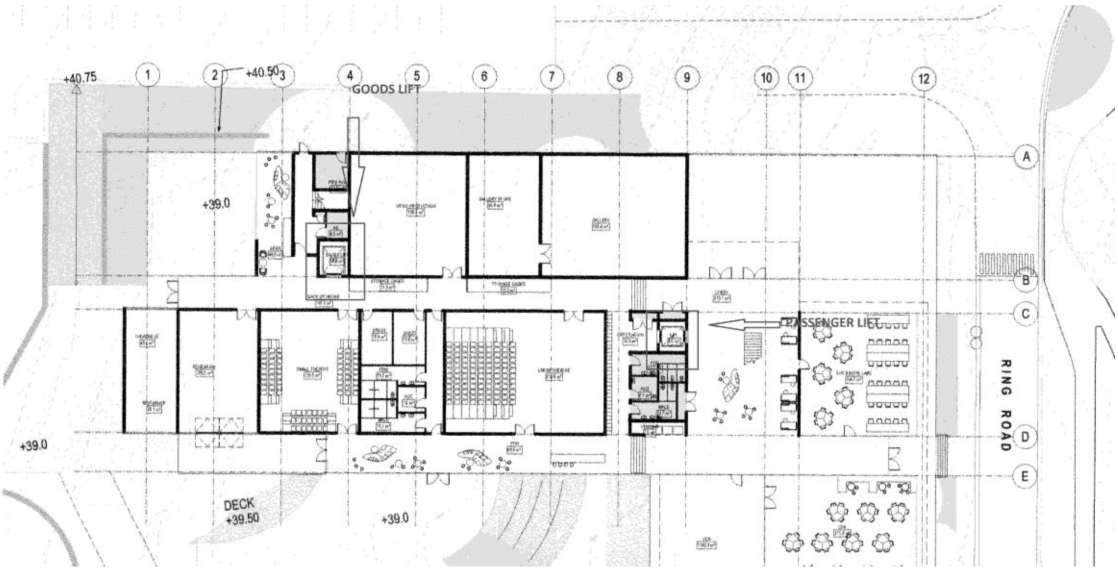
CIBSE Guide D is an internationally recognised document for defining the parameters of elevator equipment and performance outcomes when designing vertical transportation systems.

1.1.3 Forecasted Passenger Movement

To determine the appropriate vertical transportation solution, various assumptions have been used in terms of how staff, students and visitors access the building and engage with the vertical transportation services.

The following is a summary of anticipated passenger flows which are being used in the preparation of performance simulations, traffic calculations and the proposed Vertical Transportation design solution.

- The primary access for staff, students and visitors to the main passenger lift and the Goods lift will be at the ground floor lobby.
- There will be teaching spaces on the upper levels to which the primary access will be stairs. All lifts will provide access to these floors for staff and persons with limited mobility.
- The Goods lift will be designed with a larger car to accommodate large musical equipment (up to the size of a baby grand piano), furniture, plant and teaching equipment and the like.



2 Vertical Transportation System Design

2.1 Detailed Design Items

The following items have been included in our design since the schematic design phase of the project.

- As advised by the UOW, the Goods Lift is to be designed to carry a baby grand piano if required. Dimensions provided for this are 1520mm long, 1480mm wide, 1010mm high. In addition the UOW has requested the lift be able to carry an elevated work platform “Snorkel S1930” meaning a Class C Goods Lift will be required to accommodate large point loading effects.
- We recommend the Goods Lift serve the Plant Room area to facilitate maintenance of air conditioning equipment etc.
- The Goods lift is located at the Western end of the building. The lift shaft wall is shown on as sharing a wall with a video production facility on the Ground floor, a design studio on level 2 and a sound lock/control room on level 3. The level 3 walls are shown as being sound proofed, whilst the walls on the Ground floor and level 2 are not. It is not possible to sound isolate the lift rails and brackets from the shaft structure. The new lift itself will not be inherently noisy, however consideration may need to be given to additional structural sound isolation on the Ground floor and level 2.
- Electrical noise may be an issue, especially with the video production suite, and will need to be considered in the Electrical Design for the building.

2.2 Elevator Performance Traffic Analysis

The traffic analysis will be based on the following methodology and design considerations.

- Theoretical building population;
- Floor levels and number of floors served;
- Location of the main and any secondary entrances to the building;
- Entrance bias at each entry level;
- Peak arrival rate (handling capacity) over a 5 minute period;
- Targeted interval / waiting times;
- Allowance for stair usage.

2.3 Performance Targets

Following is a summary of performance targets as provided by the UOW Lift Design Standards and the Chartered Institute of Building Services Engineer's – Transportation Systems in Buildings (CIBSE) Guide D for normal buildings and specifically for university developments.

Functions	Acceptable Limit
Maximum vertical acceleration	<1.0 m/s^2
Maximum jerk rate	<1.5 m/s^3
Horizontal quaking	<15 milli-g
Vertical quaking	<15 milli-g
Average Noise	<52 dBA
Maximum Noise	<58 dBA
Door opening speed	<2.5 sec
Door closing speed	>2.5 sec
Capacity to handle up-peak capacity (preferred but not compulsory)	15% (min)
Average waiting interval (preferred but not compulsory)	<30.0 seconds
Maximum waiting interval (preferred but not compulsory)	<65 seconds

2.4 Design Consideration and Criteria

To determine the appropriate vertical transportation solution, various assumptions regarding building criteria and lift performance have been used and summarised below.

2.4.1 Population

The theoretical building population has been provided by Donald Cant Watts Corke and dated 27/06/2017.

Level	Purpose	Population	
		Friday Night	Business Hours
Ground	Performance Theatres/Video Production/Laboratories	400	200
Level 1	Offices/Laboratories		25
Level 2	Offices/Studios	10	100
Level 3	Offices/Rehearsal Rooms/Studios	140	100
Level 4	Plant		

2.4.2 Handling Capacity

Handling capacity is defined as the total number of passengers (expressed as a percentage of the total assumed building population) that an elevator system can transport from the main lobby level in a period of 5 minutes during the peak period. Handling capacity is considered a measure of the “quantity” of lifting that the elevator system provides.

For the purposes of our analysis we have assumed a 15% handling capacity, based on a 2-way traffic profile.

The term “waiting interval” was used in the guidelines because that is the term used by the Property Council of Australia (PCA). It means the arrival rate of a lift car at the main landing lobby in a 5 minute up peak period. The waiting interval will remain approximately constant even if the lift system is saturated with calls, as lifts will leave at approximately the same time even if the cars are full and people cannot enter the lift car.

A more appropriate measurement is “Average Waiting” time which is how long a passenger could expect to wait to actually catch a lift, not just how long it takes for it to arrive. If there are a lot of passengers in the lift lobby they all may not be able to catch the first lift to arrive so the average waiting time may exceed interval. A well “lifted” building should have an average waiting time of no more than the interval.

Passengers with disabilities do slow lift systems down as time to enter/exit lift cars can be extended. Wheel chairs, power operated ones in particular, take up the space of up to 4 able-bodied passengers so not only is the lift slower to operate, increasing waiting times, but the capacity to handle passenger numbers is reduced.

The goods lift will be available for passenger use at peak times and for those entering the building from the Western end.

Many people will use a building entrance at or near their intended destination. The stairs will be open and appealing for use.

The lifts must be available for those that need them the most, i.e. the disabled or mobility impaired and for goods use. Heavy inter-floor or single floor passenger traffic is not envisaged, particularly on the lower floors.

Note. The proposed lift call system will be the traditional 2 button direction collective method. This will be the most versatile and efficient system particularly in a low rise facility such as this.

2.4.3 Two Way Traffic Profile

All performance calculations have been prepared using a two-way traffic profile whereby passengers are simultaneously entering and exiting the building, generally during the day / break period.

Supplied peak times for the Theatres are on Friday nights, however the Theatres are located on the Ground floor and will not require the lifts for access.

2.4.4 Average Waiting Interval (AWI)

Average Waiting Interval (AWI) is the average time between elevator car arrivals at the main lobby during the peak period. AWI is considered a measure of the “quality” of the elevator service when a conventional dispatching system is used.

For the purposes of our analysis we have targeted an average waiting interval of less than 65 seconds as per UOW Design Guidelines.

2.5 Design Outcomes

2.5.1 Passenger Lifts (Lift 1)

Item	Details
No of lifts	1
Type of lift	MRL
Handing capacity	15%
Lift departure interval (2 way traffic)	<65 seconds
Stair factor	80%
Car capacity	1600 kg (21 passenger)
Car size	1600 mm wide x 2000 mm deep
Car height (clear)	2400 mm
Door size	1100 mm wide x 2100 mm high
Number of Car Entrances	2
Lift speed	1.00 m/s
Shaft size	2500 mm wide x 2600 mm deep
Pit and headroom	1650 mm / 4000 mm
Levels Served	5 Levels: G, UG, 1 – 3
Travel	11.9 metres
Budget Price	$130k + GST

Note: The stair factor of 80% will allow for 20% of the floor population to use the lifts to travel 1 floor. The stair factor will reduce at each floor above level 1.

2.5.2 Goods Lift (Lift 2)

Item	Details
No of lifts	1
Type of lift	MRL
Handing capacity	NA
Lift departure interval	NA
Car capacity	Class C Goods Loading 2500 kg (33 passenger)
Car size	1800 mm wide x 2500 mm deep
Car height (clear)	2300 mm
Door size	1600 mm wide x 2100 mm high
Number of Car Entrances	1
Lift speed	1.0 m/s
Shaft size (per lift)	3350 mm wide x 3000 mm deep
Pit and headroom	1700 mm / 4300 mm
Levels Served	5 Levels: G, 1 – 4
Travel	16.1 metres
Budget Price	$195-210k + GST

Note that the door height and internal car height could be increased further if required for specific uses, but car would be non-standard.

3 Elevator Equipment Design and Features

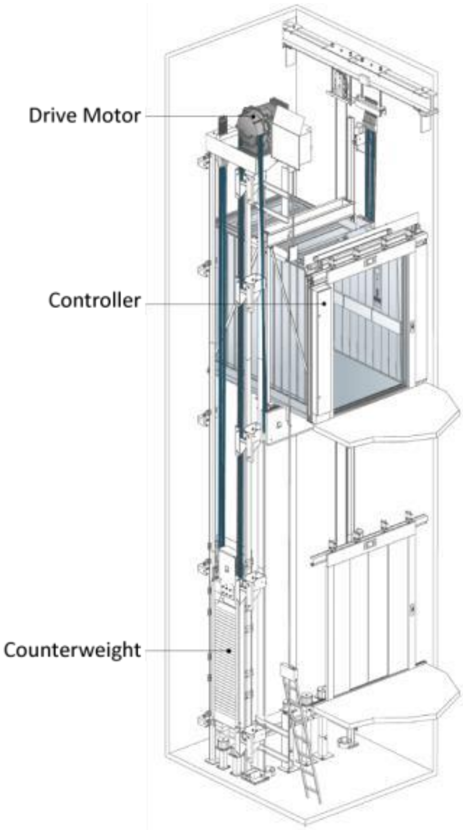
3.1 Lift Type

All equipment shall be of latest technology. The type of elevator equipment specified shall have been in continuous operation for a minimum of five (5) years prior to being tendered and have a substantiated record of reliability and serviceability under comparable traffic loads and environment.

With speeds of between 1.0 mps and 2.5 mps and a duty range from 630kg up to 5000kg, machine-roomless elevators are ideally suited to low-medium rise university applications.

We have selected machine-roomless lifts being used for both lifts.

Typical Machine-Roomless (MRL) Lift

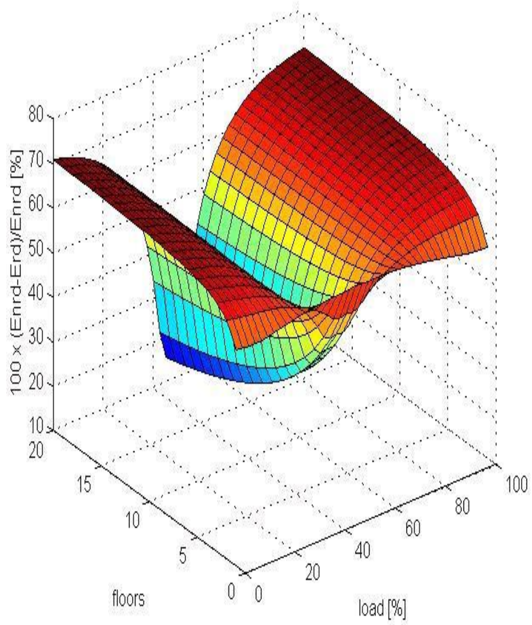


3.2 Sustainability

The elevator installation will be designed to deliver to performance targets with a minimal environmental impact.

All lifts shall include Variable Voltage Variable Frequency (VVVF) motor drives and where beneficial, Regenerative Drive features.

Elevators with a regenerative drive feature allow the elevator to generate power back into the building's internal electrical system when the out of balance load is assisting the direction of travel, i.e. when the elevator is travelling in the up direction with limited load and the counterweight is heavier than the car.



Additional equipment features that will be specified to reduce the power consumption of the elevator system include:

- High efficiency permanent magnet gearless motors;
- LED down lights, T5 fluorescent or equivalent low energy units;
- Motion sensing / timing devices to turn off elevator car lighting and ventilation fans when the elevator is not in use.

3.3 Lift Security

All lifts shall be fully integrated with the building access security control system and include the following provisions where required:

- Electronic data key or swipe card readers in each lift which allows for individual floors to be secured and released.
- Have allowance for CCTV cabling within the lift car trailing cables.

3.4 Emergency Power Supply

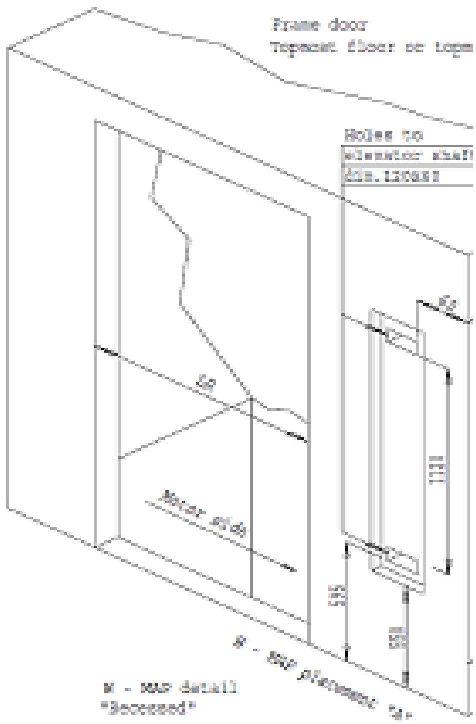
Each lift will be fitted with an Automatic Rescue Device which in the event of a power failure will allow the lift to safely travel to the nearest floor and open the doors.

3.5 Maintenance Requirements

All equipment shall be of latest technology with a proven reliability and serviceability under the anticipated traffic loads and environment.

Machine-roomless elevators typically have a control panel located adjacent to the landing entrance of the top floor served, for each lift.

The panel can be concealed behind foyer finishes however the maintaining lift contractor will require free and easy access to this panel at all times to conduct maintenance routines and interrogating the control systems in the event of an equipment failure. To minimise “boots on floor” most manufacturers offer a modification whereby the control panel (for each lift) can be relocated to the second top floor served or to the rear of the shaft if required.



4 Standards, Codes and Regulations

The vertical transportation services will be designed to comply with all requirements of the following codes and standards:

- UOW Lift Design Standards V4.0 November 2015
- Australian Standards;
- NCC;
- SafeWork NSW;

4.1 Building Code of Australia

The following areas of the NCC are relevant to the vertical transportation design solution and will be captured within specification documentation.

Item	BCA Requirement	Design Outcome and Comment
3. Lift car emergency lighting (Clause E3.1)	A lift car must have an emergency lighting system designed— (a) to come on automatically upon failure of the normal lighting supply; and (b) to provide at least 20 lux of lighting for 2 hours on the alarm initiation button.	All lifts to comply
4. Cooling of lift shaft (Clause E3.1)	While a lift in a lift shaft is in service, the cooling of the lift shaft must— (a) ensure that the dry bulb air temperature in the lift shaft does not exceed 40°C; and (b) if the cooling is by a ventilation system, be provided with an air change rate determined using a temperature rise of no more than 5 K.	As required – Mechanical engineer to verify
5. Lift foyer access (Clause E3.1)	Where there is a security foyer in a building, access may be via locked security doors provided— (a) security doors revert to the unlocked state in the event of— (i) power failure; or (ii) fire alarm; and (b) locked foyer areas are monitored by closed circuit television and intercom system to a 24 hour staffed location.	Architect to note

Stretcher facility in lifts (Clause E3.2)	(a) A stretcher facility in accordance with (b) must be provided— (i) in at least one emergency lift required by E3.4; or (ii) where an emergency lift is not required, if passenger lifts are installed to serve any storey above an effective height of 12 m, in at least one of those lifts to serve each floor served by the lifts. (iii) A stretcher facility must accommodate a raised stretcher with a patient lying on it horizontally by providing a clear space not less than 600 mm wide x 2000 mm long x 1400 mm high above the floor level.	Main passenger lift and the goods lift will provide stretcher capacity
Emergency lift (Clause E3.4)	(a) At least one emergency lift complying with (e) must be installed in— (i) a building which has an effective height of more than 25 m; and (ii) a Class 9a building in which patient care areas are located at a level that does not have direct egress to a road or open space. (b) An emergency lift may be combined with a passenger lift and must serve those storeys served by the passenger lift so that all storeys of the building served by passenger lifts are served by at least one emergency lift. (c) Where two or more passenger lifts are installed and serve the same storeys, excluding a lift that is within an atrium and not contained wholly within a shaft— (i) at least two emergency lifts must be provided to serve those storeys; and (ii) if located within different shafts, at least one emergency lift must be provided in each shaft. (d) An emergency lift must— (i) be contained within a fire-resisting shaft in accordance with C2.10; and (ii) in a Class 9a building serving a patient care area— (A) have minimum dimensions, measured clear of all obstructions, including handrails, etc complying with Table E3.4; and (B) be connected to a standby power supply system where installed; and (iii) if the building has an effective height of more than 75 m, have a rating of at least—	

	(A) 600 kg if not provided with a stretcher facility; or (B) 900 kg if provided with a stretcher facility.	
Facilities for Persons with Disabilities (Clause E3.6b)	Lifts to be provided with: • Handrail complying with the provisions for a mandatory handrail in AS 1735.12 • Lift floor dimension of not less than 1400 mm x 1600 mm for lifts with a travel over 12m. • Lift floor dimension of not less than 1400 mm x 1600 mm for lifts with a travel under 12m. • Minimum clear door opening complying with AS 1735.12. • Passenger protection system complying with AS 1735.12. • Lift car and landing control buttons complying with AS 1735.12. • Lighting in accordance with AS 1735.12. For all lifts serving more than 2 levels: (a) Automatic audible information within the lift car to identify the level each time the car stops; and (b) audible and visual indication at each lift landing to indicate the arrival of the lift car; and (c) audible information and audible indication required by (a) and (b) is to be provided in a range of between 20–80 dB(A) at a maximum frequency of 1 500 Hz. • Emergency hands-free communication, including a button that alerts a call centre of a problem and a light to signal that the call has been received.	All lifts to be specified to meet the requirements of AS1735.12.
Fire Service Controls (Clause E3.7)	Where lifts serve any storey above an effective height of 12m, the following must be provided: (a) A fire control switch complying with E3.9 for— (i) a group of lifts; or (ii) a single lift not in a group that serves the storey. (b) A lift car fire service drive control switch complying with E3.10 for every lift.	Fire service control to be provided for main passenger lift and the goods lift. Key switch to be located at main lobby

4.2 Lift Standards

The following Australian Standards are relevant to the vertical transportation design within the UOW

Item	Requirement	Design Outcome and Comment
The use of ventilation and air-conditioning in buildings AS 1668.1 (Clause 8.9)	Lift shaft air relief Where zone pressurisation is used a 0.1m2 ventilation opening will be required at the highest practical location within each lift shaft enclosure. This opening shall vent to atmosphere directly or via a duct that maintains any required compartmentation FRL. Fire dampers shall not be installed on relief ducts. Air control dampers may be installed on the vents which shall open in the fire or failure mode.	To be incorporated as required by the fire engineering design.
Automatic fire sprinkler systems AS 2118.1 (Clause 5.7.2)	Sprinkler heads in lift shafts Sprinklers shall be installed in all lift shafts that are inside or in communication with buildings. Sprinklers shall be located in the top and base of each lift shaft. Sprinklers installed in lift shafts and sheave rooms shall be protected by stout metal guards and shall have a temperature rating of not less than 100°C in accordance with the appropriate part of AS 1735. Pipe work in hoist and lift shafts shall be galvanized.	All lifts to be provided with sprinklers
Design for access and mobility AS 1428.2 (Clause 12)	Lift car size Lifts installed for public use should have audio, visual and tactile information. Lifts shall comply with AS 1735.12, except that the floor area in lifts shall be increased 300 mm in each direction, from the minimum size specified in AS 1735.12. i.e. 1400mm wide X 1700mm deep.	Main passenger lift and the goods lift shall comply.

The lift installation will be developed in accordance with the following standards;

- AS 1735 - Lifts, Escalators and Moving Walks
- AS 1735.1 - General Requirements
- AS 1735.2 - Passenger and goods lift - Electric (For reference in the event of silence or ambiguity within AS1735.1 and code referenced within)
- AS 1735.11 - Fire-rated landing doors
- AS 1735.12 - Facilities for persons with disabilities

- AS 4431 - Guidelines for Safe Working on New Lift Installations in New Constructions
- Building Code of Australia
- AS 1428.2 - Design for Access and Mobility; Part Two: Enhanced and Additional Requirements – Buildings and Facilities
- AS1428.4 - Design for access and mobility - Means to assist the orientation of people with vision impairment - Tactile ground surface indicators
- AS 1668.1 - Ventilation and Air-conditioning in Buildings – Fire and Smoke Control
- AS1668.2 - Acceptable Ventilation Guidelines
- AS1530 - Methods for fire tests on building materials, components and structures
- AS1657 - Fixed platforms, walkways, stairways and ladders - Design, construction and installation
- AS1670.4 - Fire detection, warning, control and intercom systems - System design, installation and commissioning - Sound systems and intercom systems for emergency purposes
- AS1170.4 - Earthquake actions in Australia
- AS1418.8 - Cranes, hoists and winches – special purpose appliances
- AS 2118.1 - Automatic Fire Sprinkler Systems
- AS/NZ 3000: Electrical Installations (known as the Australian/New Zealand Wiring Rules). Wiring requirements for lift installations
- AS/NZ 3008 - Electrical Installations – Selection of Cables – Cable sizes for lift installations
- ISO 7465 - Passenger lifts and service lifts -- Guide rails for lift cars and counterweights
- ISO 9001 - Quality Systems