Creative Spaces Design Guide

PART 3G
TECHNICAL APPENDIX:
EXHIBITION SPACES

CREATIVE VICTORIA ARUP

CITY OF MELBOURNE CITY OF SYDNEY

We acknowledge the Traditional Owners of Country throughout Victoria and their ongoing connection to this land and water. We pay our respects to their culture and their Elders – past, present and future.

In preparing these guides, we acknowledge that First Peoples self-determination is a human right as enshrined in the United Nations Declaration on the Rights of Indigenous Peoples.

We also acknowledge that past injustices and continuing inequalities experienced by First Peoples have limited, and continue to limit, their participation in all land and resource management[1], including development of creative spaces.

Creative spaces exist on land for which sovereignty has not been ceded and, as such, development, design and operation of creative spaces should involve consultation with First Peoples and Traditional Owners. Engagement and operation must be carried out in a culturally safe manner.

Any use of First Peoples design should follow the principles outlined in the International Indigenous Design Charter[2], which stipulates that First Peoples must have opportunity to meaningfully participate in and influence design and development processes that affect their Country and community.

Artist — Dixon Patten, Yorta Yorta and Gunnai
This artwork, commissioned in 2019 by the (then) Victorian Department of Jobs, Precincts and Regions is about developing the economy by working with community to create First People's employment opportunities, supporting inclusion and economic prosperity and thriving First Peoples' communities.

The symbolism used represents opportunities for First Peoples to achieve personal and economic prosperity and improved employment outcomes, the diversity of First Peoples' knowledge, skills and resources in community, and the connection to cultural practices and ceremonies.

Terminology:
First Peoples – Throughout this document the term Victorian First Peoples is used to refer to Traditional Owners of Victoria and all other Aboriginal and Torres Strait Islander peoples who reside in this state.

Culturally-safe Spaces[3] – Culturally-safe spaces are built environments, places, areas, groups, dialogues or bodies of work that positively and proactively acknowledge, accept and provide for the inclusion of the full spectrum of diversity of participants in that space. They are empowering places of mutually-beneficial exchange, personal and collective growth, and strength-based approaches.

For First Peoples, culturally safe spaces are places where imbalances of power, primacy and status are identified and structural adjustment is made to ensure equitable conditions are achieved and maintained. Culturally safe spaces are cognisant of, and proactively provide cultural safety at all levels of operation.

1. DELWP, see Traditional Owner and Aboriginal Community Engagement Principles on page 10 https://www.delwp.vic.gov.au/__data/assets/pdf_file/0031/508099/Traditional-Owner-and-Aboriginal-Community-Engagement-Framework-compressed-2.pdf

2. The International Indigenous Design Charter, see Guiding Principles on page 8 at https://indigenousdesigncharter.com.au/international-indigenous-design-charter/

3. More information can be found via the UTS Design Index. http://www.utsdesignindex.com/researchmethod/culturally-safe-spaces/ and the Victorian Government's cultural safety framework: https://www.dhhs.vic.gov.au/publications/aboriginal-and-torres-strait-islander-cultural-safety-framework

Contents

Cover: Arts Project, Melbourne
Credit: Arts Project

Prepared by Arup for Creative Victoria, Office of the Victorian Government Architect, City of Melbourne and City of Sydney.

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Introduction

An abundant and diverse supply of creative space is essential to support a productive cultural sector. Due consideration for the operational, spatial, and technical requirements of these creative spaces can better support the functions and meet the needs of its users, operators and the community for the long-term.

Designing and delivering creative spaces that are fit for purpose will amplify its creative potential as well as increase operational efficiency, in turn reducing costs to the owner and/or operator.

Purpose of the technical appendices

The technical appendices to the Creative Spaces Design Guides have been developed to guide good decision making in the planning and delivery of creative space projects. They demonstrate best practice in effective, efficient and sustainable design of creative spaces, and not all aspects will be applicable or achievable for every project.

These appendices are technical in nature, relating to program, spatial requirements, structure, amenity and serviceability of space. Readers of these technical appendices should be mindful of the very specific technical focus of the documents and use them in conjunction with other guidance on the proposed programming, management and operation of the proposed creative space. In particular, these technical appendices should be read in conjunction with **Part 1: Making space for creativity** and **Part 2: Principles for creative spaces** of this document which provide a wider context within which creative spaces are typically conceived and delivered.

These technical appendices are a live document that may be updated from time to time. They do not capture the breadth of all the possible types of creative space. They prioritise spaces that were identified through consultation as being in high demand and low supply. Guidance on other types of spaces are intended to be added in future iterations.

How to use the technical appendices?

The technical appendices to the Creative Spaces Design Guides are intended to provide a preliminary technical brief prior to undertaking design work. These technical requirements include architectural, engineering and specialised design advice. The technical appendices:

— are aimed at providing 'best in class' outcomes and should be considered as a foundation for the development of detailed design briefs with project teams.
— are intended to be a practical resource to inform early planning and design conversations.
— should be used as a tool to facilitate early engagement with operators and user groups. Continued engagement throughout design and delivery is key to the development of fit-for-purpose creative spaces.
— are intended to support understanding and a shared language between stakeholders about the technical requirements for the type of creative space they wish to deliver.
— do NOT substitute specialist design, architectural and engineering advice as would be expected and required on any design and construction project.
— do NOT substitute early engagement with operators and end-users whose specific needs would need to inform project-specific design briefs.

Users of the technical appendices

The intended audience and users of these technical appendices might include (but not limited to):

— Private property developers incorporating creative space into a larger property development.
— Local and/or state government arts and culture agencies that are delivering or supporting the delivery of creative space.
— Arts and creative organisations that are planning to upgrade, deliver or occupy creative space.

Appendix structure

The first section titled **Key principles for designing creative spaces** provides guidance applicable equally across all space types and important considerations that need to be addressed alongside the technical framework of these appendices. These include:

— End-user and operational needs
— Project process
— Procurement
— Code compliance
— Departure guidance

The second section identifies the following technical requirements of an exhibition space:

— Programmatic – key spaces and spatial relationships
— Spatial – key dimensions and spatial relationships
— Technical systems – specialised equipment relevant to functions of the spaces
— Universal design
— Sustainability
— Structural engineering
— Lighting
— Electrical engineering
— Acoustics
— Fire engineering
— Hydraulic engineering
— Mechanical engineering

A glossary section is included for reference.

Key principles for designing creative spaces

Creative spaces are places where people gather, inspire, connect, create and present their work. They are unique and respond to the needs of the environment in which they are located.

Embedding good design in a creative space

These spaces will be used by professional artists, producers, construction and technical production staff and the broader community. It is imperative that good design is at the core of every creative space delivered.

The Victorian Government Architect recognises the critical need for good design. The 'Good design - Issue 1' publication by the Office of the Victorian Government Architect identifies that:

"Good design comes in many forms and is defined by much more than how something looks. It refines the purpose and aspiration of a project, improves how it works, creates additional benefits and elevates how people feel and behave in the final outcome. Good design creates inspiring places and greater, lasting financial value. And of course, good design also looks and feels good."

Incorporating good design in creative spaces includes designing for and understanding:

— User and operational needs
— Project processes
— Efficient procurement of goods and services
— Compliance with codes and standards
— Universal design
— Sustainability
— The local, national and international arts and culture ecosystem

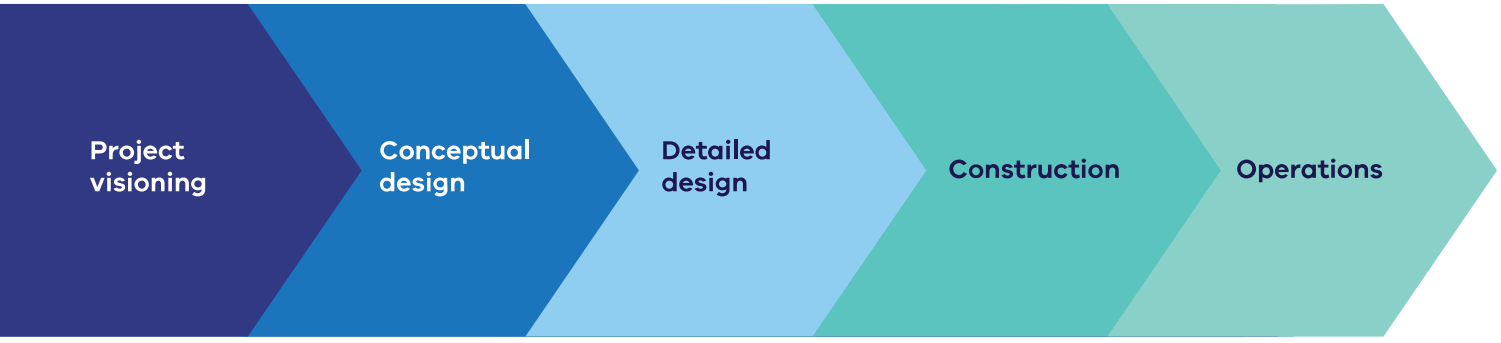
Operational and end-user needs

Early and ongoing engagement with operators, user groups and other stakeholders is a key component in the successful delivery of creative space projects. The establishment of critical success factors with primary stakeholders lays the foundation for the development of spatial, operational and management structures. The conception of a vision, operating models and target markets are all essential to designing creative spaces with a unique identity and place within the arts and cultural ecosystem.

Accordingly, defining operational and end-user needs is often the first step in a project delivery process.

Project process

These technical appendices provide the key requirements for best practice design. However, design itself does not guarantee good project outcomes. Design of creative spaces is part of a bigger 'process' of project delivery, and these technical appendices are a tool to be deployed throughout a project process that can provide differing points of value. The diagram below outlines one possible project process.



Ultimately, the success of the technical appendix will be realised through its application throughout a design and delivery process. The appendix is intended to be used as a reference at different phases of a project, as well as serving as a tool to facilitate collaborative discussions as project details unfold during design and construction. The table below presents some examples of how the technical appendix may be of value at each phase in the project process.

Project visioning – Project inception phase where site is selected, vision and direction of the project is established.

POTENTIAL USES	EXAMPLE OF USAGE
Assist a property developer to determine appropriate creative infrastructure aligned to a development vision	What are the spaces used for and what needs to be built? How does that align with your intended project outcomes?
Assist arts organisations to survey possible options for creative spaces	Your organisation is ready to find a new home – what technical and spatial requirements does the site need and how much might it cost?
Assist with site selection and due diligence by validating if sites can accommodate technical needs	Your arts organisation has found space that could be converted into creative space – does it have the clear height and services on site to support your needs?

Concept design – Project phase in which the creative space is designed fit for purpose to meet user and stakeholder needs.

POTENTIAL USES	EXAMPLE OF USAGE
Assist a property developer to determine appropriate creative infrastructure aligned to a development vision	The technical appendix establishes some primary design requirements to be incorporated into early design – has the design team made the right spatial, structural and services allowances?
A departure point for a design brief which recognises that the technical appendix is 'best practice' and can be de-scoped with the guidance of the consultant/design team	The preferred site and design of an arts organisation cannot achieve the guideline clear height for dance – what are the impacts of a reduced clear height and is this acceptable to the organisation?

Detailed design – Project phase in which technical documents including construction documentation is produced.

POTENTIAL USES	EXAMPLE OF USAGE
Detailed design and engineering requirements to be used as 'basis of design' for project design team	The technical appendix provides a clear set of functional and performance design criteria that needs to be delivered unless otherwise agreed – for example: can the appropriate background noise levels be met against the nominated criteria or has the design team agreed to relax them for this project?

Construction – Project phase in which the creative space is constructed on site.

POTENTIAL USES	EXAMPLE OF USAGE
Provide a reference point for collaborative discussion between stakeholders, designers and builders as projects are being delivered	The technical appendix is a common point of reference for a shared understanding of what is being built and why – for example: does the kitchen have all the facilities that the company requires?

Operation – Ongoing phase that includes operation and maintanence of the creative space.

POTENTIAL USES	EXAMPLE OF USAGE
Post-occupancy validation	Has the intended functionality and performance been delivered?
Real world implementation of technical appendix used to provide lessons learned for future refinement of the technical appendix	Feedback, such as if aspects of the guidance prove to be persistently difficult to practically achieve, can be recorded and submitted.

Procurement considerations

Procurement methodologies – for both design and delivery, should be structured in a way that ensures alignment with, and ability to deliver against, the vision articulated by project stakeholders. The many varied ways that the design and construction of building projects can be procured are beyond the scope of this technical appendix, and each project will require its own specific procurement methodology.

Below are some examples of strategies that might be included within the procurement process to ensure best alignment of the creative space with the vision articulated by project stakeholders:

— A private developer delivering a creative space as part of a construction consent condition might be required to put in place governance structures that ensure stakeholders are consulted and their requirements are demonstrably met.
— Consent authorities should provide incentives to developers to establish and maintain ongoing outcome-oriented relationships with creative arts community members.
— Arts organisations are recommended to engage with specialised consultants at the outset of a project to determine their specific needs, aligned with organisation mission and values, to form the basis of a project brief.
— Arts organisations should be provided with quality advice for the procurement of design and/ or construction services.

Compliance to codes and standards

Any creative space needs to be designed, built and certified in accordance with current relevant statutory regulations. Of particular note:

— The facility is to comply with the National Construction Code of Australia (NCC) and all relevant associated Australian Standards (AS).
— A building regulations consultant and an accessibility consultant should be engaged to provide comprehensive advice and compliance check throughout design and documentation.
— For a change-of-use and/or works within an existing building, the building regulations consultant is to assess the extent of upgrade required for compliance in line with Clause 62 and 64 of the Environmental Planning and Assessment (EP&A) Regulations (NSW) and Building Regulations 2018 (Victoria). This assessment should be carried out in the concept phase of a project (pre development application in NSW).
— In an existing building, input from a fire safety engineer may be necessary to assist in defining the extent of upgrade to meet the required level of safety and assist the consent authority to determine the requisite level of upgrade.
— Part H of the NCC will apply to Class 9b spaces. In Victoria, if the space is a 'Place of Public Entertainment' (as defined in the Building Act 1993 and prescribed in the Building Regulations 2018), then part VIC Part H102 will apply. In NSW, if the space is an 'Entertainment Venue' (as described in the EP&A Regulations), then part NSW H101 of the NCC will apply.

Departures from the technical advice in these appendices

These technical appendices articulate a set of functional and performance requirements that should be considered in the delivery of a creative space project. However, it is not always possible, or appropriate, to achieve best practice outcomes. The design should principally align with the capability and expectation of key users and stakeholders. Misalignment between design and user/stakeholder expectations may result in creative spaces:

— that are not fit-for-purpose
— that are operationally burdensome
— that don't align to their broader built environment

These technical appendices represent best practice and are intended to be a 'point of departure'. Stakeholders should be empowered to descope from these requirements where appropriate. It is crucial that users are advised by a design, architectural, engineering and consultant team who understands and can explain the implications of descoping these requirements.

DEPARTURE GUIDANCE

Throughout the technical appendix document, there are boxes formatted in this style. These boxes contain commentary on the potential implications of descoping against specific requirements. Please note that descoping can have broader and more/less significant impact than the example given. It is important to gain advice from a professional design and engineering team to help understand these decisions on a case-by-case and project specific basis.

Exhibition spaces

Exhibition spaces display a broad range of creative work. The displayed work may be in physical or digital formats, or a combination of both.

An exhibition space can stand alone, sit within a gallery or museum, or be attached to a creative studio, office space or other building typology. This guide outlines the technical and spatial requirements of an exhibition space, rather than the broader requirements of a gallery or museum.

Exhibition spaces should satisfy multiple user and stakeholder requirements, including but not limited to:

— Functional and aesthetically pleasing visitor experience
— Flexible and highly adaptable spaces to suit multiple artists and different art forms
— Secure and efficient spaces to meet operator demands

The general requirements of an exhibition space are outlined within this guide, with the individual needs of three specific variations indicated below:

Type A: Exhibition space for physical display

An exhibition space that supports the display of physical objects like painting, sculpture, or a historic exhibit.

Type B: Exhibition space for digital, audio-visual and interactive display

An exhibition space that supports various modes digital display including audio-visual and interactive displays.

Type C: Store front exhibition space

An exhibition space that takes the form of a street front display with no visitor entry directly into the space.

Usage profile

Exhibition spaces are normally occupied by a single user-group for an extended period of time – the main user will curate or manage the content within the space.

Building operations may be 16 hours a day, 7 days a week.

The period open to the public will vary, but typically during normal business hours, weekends and some evenings.

References:

University of Melbourne
Science Gallery
Melbourne Connect
Image: Toby Welch, Arup

Allens Arthur Robinson Fitout
101 Collins Street Melbourne
with BVN Architecture
Image: John Gollings
Photography

Programmatic requirements

An exhibition space provides artists and designers a location to display their work. It should be located in a highly visible place and be easily accessible in order to promote creative practices and encourage public engagement.

An exhibition space can take many forms and may include the following areas:

Type A

An **exhibition space**, for display of physical art/media; this space should be fully accessible and free of columns

A **small repair workshop** to make minor repairs or amendments to the artworks

Large secure climate-controlled storage area to house artwork when not on display

Type B

An **exhibition space**, for the display of digital art including audio-visual and interactive display. This space should be fully accessible and free of columns

Large comms. room to house a full height AV rack

Type C

A store front exhibition space, overlooked by a street with high pedestrian traffic

Common to Type A and B:

Front of house area that includes a foyer, a reception/information area, a cloak room, an admin room, toilets and an optional merchandise area

Information/reception area, where staff can easily meet and assist visitors with ticket sales, provide information and perform security bag checks as required.

An **admin room** for staff with workspaces and access to toilets

A **supervised cloak room** for visitors to store umbrellas, bags and raincoats

A **merchandise area** (optional) for additional commercial opportunities. For example: a gift shop or a café

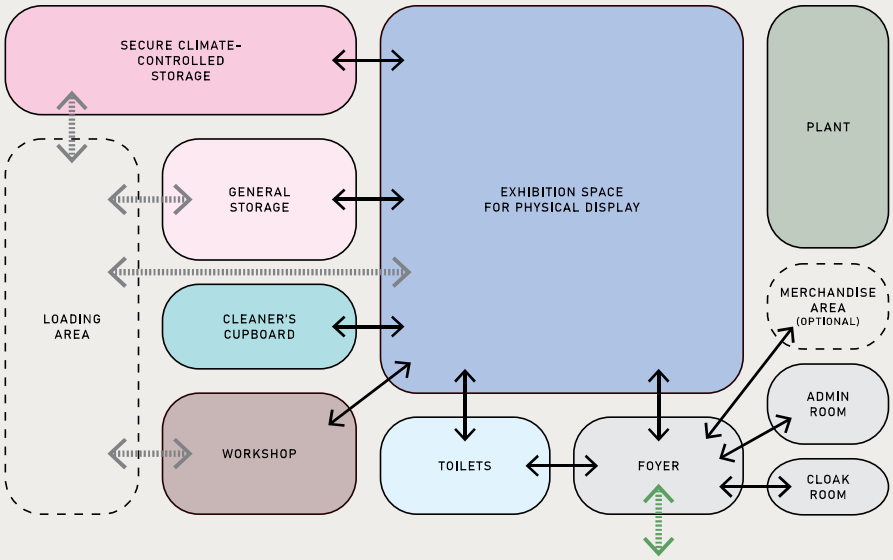
Storage areas connected to the exhibition area

Loading area for incoming physical art display or technical equipment

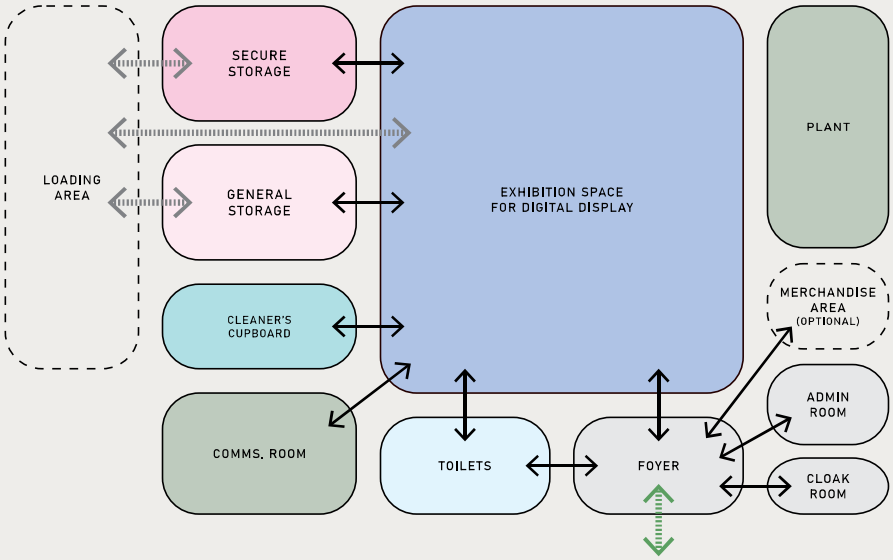
Step-free circulation and obstruction free access, sized at minimum for an elevated work platform from the building exterior

Inclusive and legible wayfinding signage, including text, pictogram, visual, tactile and audible options

Type A: Exhibition Space for Physical Display – Spatial adjacency diagram



Type B: Exhibition Space for Digital Display – Spatial adjacency diagram



Spatial requirements

An exhibition space can take many forms. There is no one-size-fits-all specification that will suit every potential user.

Early engagement with the operator and user groups to determine the usage is key to defining area requirements. The following area allowances have been provided as an early planning guide:

Exhibition area with ample circulation space: **10 to 30 sqm per person**

Secure storage: **10 sqm**

Additional secure climate controlled storage for Type A exhibition space:

— At least **50% of exhibition space area** for permanent exhibitions
— Smaller storage spaces can be provided for temporary exhibitions

Foyer: **1 sqm per person**

Information/reception area: **5 sqm**

Cloak room: **10 sqm**

Merchandise area: **10 sqm**

Toilets: **as per NCC**

General Storage: **15 sqm**

Cleaners Cupboard: **2 sqm**

All area requirements listed above denote minimum Net Internal Area.

Ceiling height requirements:

Type A and B: **minimum 2.7m**; however, in many cases, artists may require higher ceiling heights of up to 6m

Type C: no minimum height requirement; ideally placed at eye level of pedestrian traffic

Type A: Physical display requirements
Exhibition spaces for physical displays need to consider the temperature, humidity and air filtration requirements of the displayed art/media. The space should also have robust mechanical conditioning to balance the constantly changing conditions generated by a flow of visitors. Climatically sensitive displays can have significantly higher operational costs and may require special display boxes.

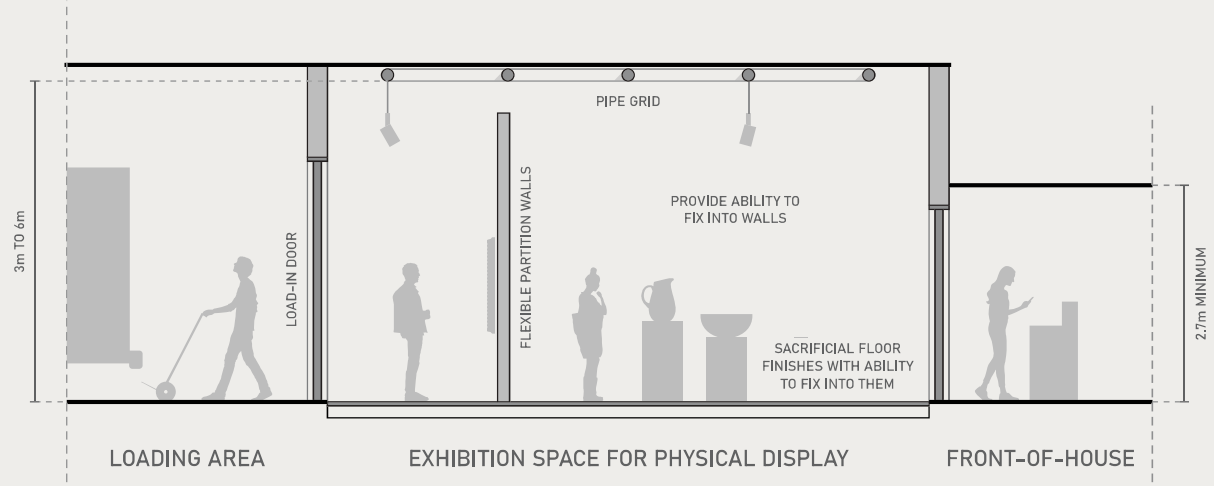
Natural light should be controlled to manage light, heat and ultra violet (UV) radiation as this may impact objects on display.

Repair workshop area should be isolated from the exhibition space. There should be limited exposure of displayed objects to gaseous and particulate contamination.

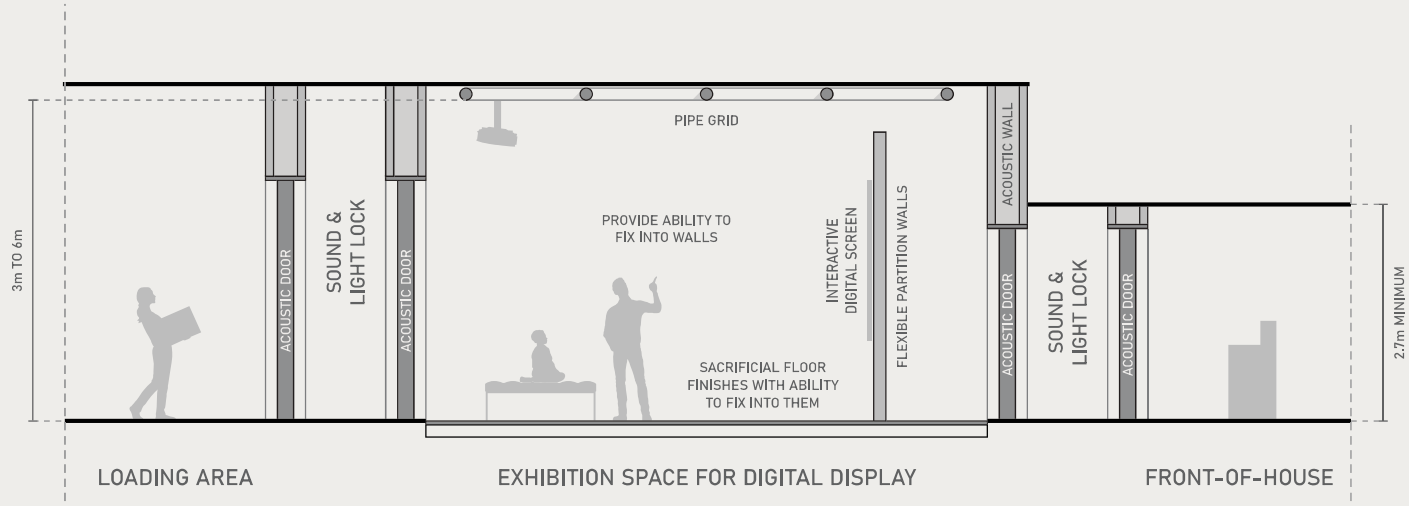
Type B: Digital display requirements
Exhibition spaces with installations incorporating digital displays will require specific conditions (e.g. ability to achieve total blackout from natural light and acoustic separation between display areas). Additional sound and light lock spaces may also be required. These spaces will also have higher information and communications technology requirements, including the provision of a full size AV rack.

Type C: Store front display requirements
Store front displays should have a glazed façade interface between the building and the pavement. Specialist lighting and climate control may be required, depending on the displayed item. Full height access doors into the display space should be provided for the curator through the interior of the building.

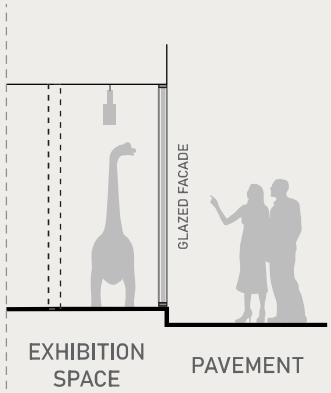
Type A: Exhibition Space for Physical Display – Sectional diagram



Type B: Exhibition Space for Digital Display – Sectional diagram



Type C: Storefront Exhibition Space – Sectional diagram



Common to Type A and Type B

Exhibition space
A positive visitor experience is crucial to the success of an exhibition space. The ability to circulate easily and view exhibits in the best possible environment is key to the core visitor experience. Well-designed entrances, ticket offices, toilets, merchandise areas and spaces for rest and transit all contribute to a strong visitor experience. Some exhibitions may require the ability to close of parts of the exhibition space to protect some viewers from sensitive material.

The following are key spatial requirements for Type A and Type B exhibition spaces:
— Floor, walls and ceilings should be designed for high loads imposed by heavy installation.
— Exhibition spaces should be finished with plain neutral wall and floor colours without distracting patterns or textures to direct the visitors' attention towards the display.
— All wall build-ups should be significant to allow a second skin/ hollow wall construction. The cavity can be used to hide support structure and cable pathways for artwork and installations as required.
— Movable and/or temporary sacrificial walls should be provided for additional/flexible running metres of wall space for display.
— Provide polished concrete floors, or alternatively, provide sacrificial floor finishes that can be fixed into. Power and data points should be recessed with walls and floors.
— Finishes should allow for acoustic comfort. Finishes, fittings and furniture should also include good visual contrast of key surfaces and features. They should avoid finishes that will cause confusion (e.g. heavy patterns, glare, reflections). Fittings and furniture should accommodate a wide range of users with varying access needs.
— Artificial lighting plays a fundamental role in how exhibits are experienced by visitors. However, controlled natural light should also be used where possible to enhance visitor experience.
— Provision for digital/electronic display labels, information screens and Wi-Fi connection. Electronic security alarm systems along with a wide range of surveillance and motion detection systems should also be provided for monitoring both visitors and the exhibition/ storage space itself.

Foyer
The foyer is the primary area for audiences to gather and connect with all spaces they access. The foyer must have direct access to the outside and act as the main entrance point for visitors into the main building. An airlock should be included to provide for dust, vermin and climate control.

DEPARTURE GUIDANCE
A foyer space with an allowance of 1sqm per person is a starting point for design and will evolve as the design process develops. Inadequate foyer space can result in poor visitor experience and loss of revenue generating opportunities.

Admin room
Admin room should be provide for the staff fitted with ergonomically designed workspaces. A director or a conservator room may also be required. The size of the admin room provided will be determined by user and stakeholder needs. A private back of house toilet facility should be provided adjacent to the admin room

Public Toilets
The NCC sets out the ratio of male and female toilets to the number of occupants, and the specifications for toilets.

A minimum clear height of 2.4m AFFL should be maintained in the toilets.

Accessible toilets, showers and changing facilities should also be provided for people with a disability compliant with the NCC and the AS 1428 suite of Standards

It is recommended that both gendered and gender-neutral facilities be provided to accommodate cultural preferences and non-binary gender identity.

Storage requirements
Secure and climate-controlled storage adjacent to or within the exhibition space should be provided, to safely store:
— Technical equipment associated with the room (AV control equipment, etc.)
— High-value items associated with an exhibition

General storage areas adjacent to or in close proximity to the exhibition space should be provided and capable of storing:
— Height access equipment/ machinery, such as a platform ladder, with consideration given to manoeuvring a ladder between storage and the exhibition space
— Loose furniture such as folding tables and chairs
— paint for walls, floors and ceiling
— Secure lockers for high-value items belonging to users of the room
This storage room should also be fitted with a sink and a safe paint disposal system to support the exhibition walls getting painted multiple times in a year.

Technical equipment storage must be provided adjacent to or in close proximity to the exhibition space, and may be used for:
— Lighting equipment
— AV equipment
— Tools and supplies
— Loose cabling

A cleaner's cupboard should be provided adjacent to the exhibition space with the following:
— Mop sink
— Area to hang brooms and wet mops,
— Cupboard to store general cleaning products securely and safely (dustpan and brush, bin liners, cleaning fluids, vacuum cleaner, etc.)

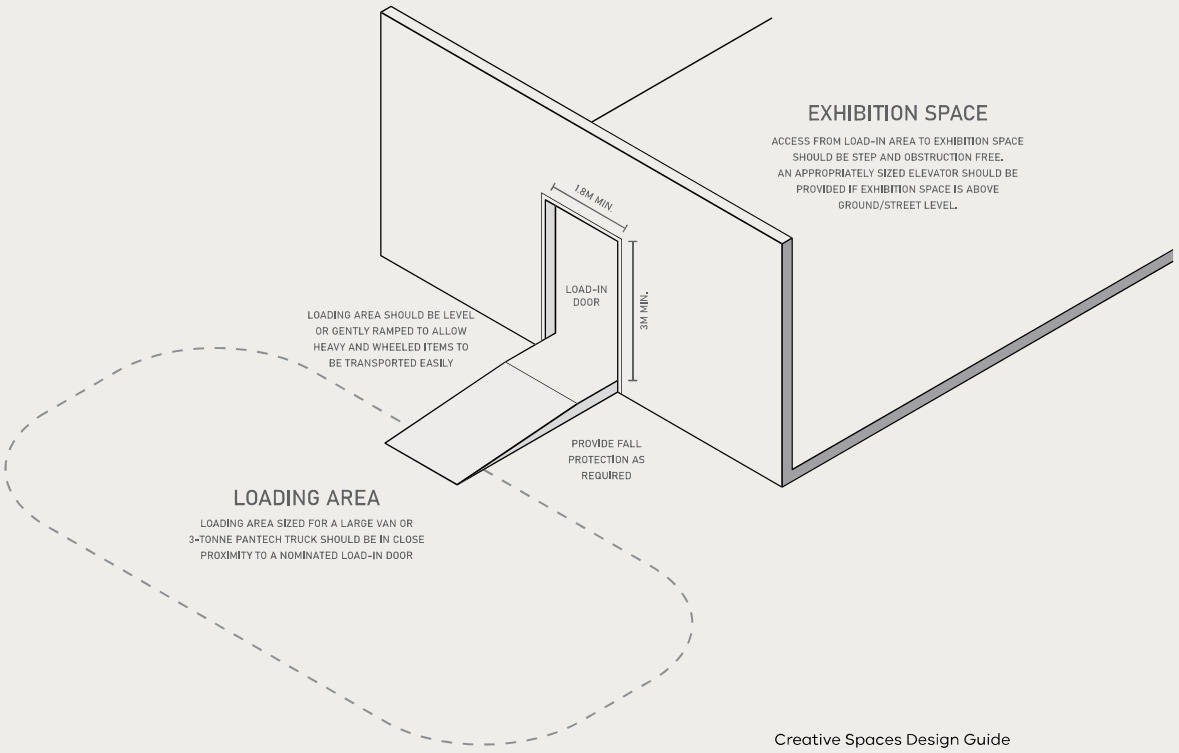
Storage area should not be placed next to public toilets as this will limit staff from moving items during general business hours.

DEPARTURE GUIDANCE
Storage space is often the most overlooked allowance in the design of creative spaces, sometimes sacrificed to increase space for other functional requirements. The saying "you can never have too much storage" is true and failure to provide adequate storage can have a negative impact on the safety, efficiency and operation of a facility.

Loading area and circulation requirements
The loading and unloading of equipment and art into the exhibition space and/or the building in which the exhibition space is housed should be carefully considered. A dedicated loading dock is not required, but a loading zone sized for a large van or 3-tonne Pantech truck should be in close proximity to a nominated 'load-in door'.
The buildings load-in door should be a minimum of 1.8m wide by 3m high to allow for large items and equipment destined for the exhibition space. The load-in area should be level or gently ramped to allow heavy and wheeled items to be safely transported. Ramped routes should have handrails on both sides.

Circulation paths from the load-in area to the exhibition space should be

Exhibition Spaces – Loading diagram



step and obstruction free and have legible way-finding signage. Doorways and accessways should be minimum 1.8m wide. If there is a building level change between the dock and the exhibition space, a goods lift must be incorporated into the building design, sized to accommodate typically large and heavy loads associated with the exhibition space.

The loading area should also be directly connected to a secure, climate controlled storage space. If loading area is not directly connected to the storage space, the circulation route between the storage and the loading area will require climate control

DEPARTURE GUIDANCE
Inadequate loading and circulation requirements can result in: operational inefficiencies, unsafe practices, disturbance to neighbours, potential loss of reputation and revenue. Exhibition spaces will be less desirable to operators if they experience operational inefficiencies. As such, load-in paths should avoid stairs, lifts, excess turns and bends, and uneven surfaces from the loading area to the exhibition spaces or other areas.

Rigging infrastructure
An exhibition space should be fitted with overhead rigging infrastructure to support the installation of exhibits and associated technical systems. The rigging infrastructure should span the entire exhibition space and may be presented as a linear rigging track system, a pipe grid system, a distribution of rigging points, or a combination of multiple systems.

A services zone, where required, should exist above the rigging infrastructure and integrate with production system cabling containment and facility panels. See Technical System and Structural design requirements below.

Technical system design requirements

Key technical system requirements are outlined below:

Early engagement with the operator and user groups to determine the usage is key to defining technical system requirements. The overall design and capacity of the infrastructure or systems should be determined at the start of the design process.

Technical grid
Overhead rigging infrastructure should be provided above the entire exhibition space to support the rigging of creative work and associated production equipment such as lighting fixtures, video projectors, loudspeakers, and curtains. The overhead rigging may include one of or a combination of the following systems:

— **Pipe grid:** A pipe grid suspended from the structure above to allow for efficient rigging of permanent and temporary lighting or equipment. Key design requirements include:
  - arrangement of 48.4mm OD steel pipe
  - nominal 1.5m - 2m spacing in two directions
  - capable of supporting 50 kg per linear meter and/or 100 kg point loads

— **Rigging strong points:** Rigging strong points to host a series of hoisting equipment (e.g. chain-motor or chain block) that is subsequently connected to either suspended objects or a production truss arrangement. The truss can be used to support a range of production equipment for example lighting fixtures, video projectors, LED walls, loudspeakers, curtains and scenic elements. Key design requirements for rigging points are outlined below:
  - Rigging points may be presented as lugs fitted directly to building trusses or ceiling slabs.
  - Rigging points should be capable of individually supporting up to 200kg. Simultaneous loading of multiple points to support a distributed load will be required pending detailed design

— **Building structure:** Any steel building structure within the exhibition space should expose steel members (such as universal beams and steel trusses) that can provide temporary rigging support for point loads via temporary means (such as beam clamps and wrapped slings).

  Please refer to the Structural design requirements section.

Curtain system
Hand-operated curtain track systems should be considered to control natural light.

Exhibition track lighting
Temporary exhibition track lighting should allow users the capability to suspend and control temporary lighting fixtures with infrastructure at floor and ceiling levels. Connections to dimmer racks and lighting control will be managed by wall and floor facility panels.

Production infrastructure
Facility panels will be required, mounted to the ceiling, wall and floor to interconnect the different production audio/video/lighting systems across the rehearsal space. Facility panels provide an identifiable connection point for analogue and/or digital signal cables between various systems and locations within the room.

Overhead access
Overhead production equipment may be accessed via:
— A suitable platform ladder,
— Lightweight portable scaffold tower, or
— Height access machinery, such as a vertical lift or scissor lift

Height access requirements should be assessed with operators and end users to determine the method of height access required. The assessment will need to consider the operational impact, risk profile, user needs and use-cases, frequency of use, adequate floor loading criteria, storage areas and access paths.

It will be important to consider technical spaces in relation to universal design. This may include rethinking technical roles and their associated spaces, and automating/ remotely controlling activities (which may reduce some of the historic need for heavy lifting and work at height).

For example, to achieve an accessible lighting grid, consider moving-head lights to minimise the work that needs to be done at height, and automate or motorise as many features as possible. On the grid itself, consider whether wheelchair access can be provided with wider, level routes.

Universal design considerations

Universal design acknowledges human diversity and difference through design that is user-centred and responsive to people's needs, enabling people to participate equally, confidently and independently.

Creative spaces should work for everyone, but too often they fall short of this ambition. For a creative space to be inclusive, it must reflect and respond to the widest range of people's requirements, enhance visitor and user experience providing equal opportunities to access the space and use its facilities/services.

The key principles and goals of universal design are outlined below.:

— **Equitable use:** creating welcoming and accommodating spaces that offer equality in experience for different users, regardless of personal circumstance or identity
— **Flexibility in use:** creating spaces that can offer choice in use and adapt to future changes and requirements and reasonable adjustments based on user needs.
— **Simple and intuitive:** creating spaces that are intuitive to use
— **Appropriate size and space:** providing appropriate size and space for approach, circulation and use
— **Perceptible information:** effectively communicating information to all users, considering the needs of users and the constraints that the environment may place on communication

Universal design should be considered at every stage of the project lifecycle. By considering this earlier in the design phase, expensive late-stage alterations can be avoided, and the cost of management and maintenance can be lowered.

For universal design to be integrated into a creative space, compliance is required with the following codes:

The access provisions of the NCC
The DDA Access To Premises Standard
The local council's DCP relating to Access for People with a Disability
AS 1428 suite of Standards
AS 2890.6 for car parking

It is recommended that universal design considerations extend beyond compliance with codes and should respond to other areas including but not limited to:
— Provision of different sanitary facilities (i.e. accessible, ambulant accessible, gendered and non-gendered facilities)
— Provision of reflection and prayer rooms; these areas should be designed to be calm avoiding bold patterns which can be confusing for some neurodiverse users
— Equitable circulation around spaces by providing circulation paths of at least 1500mm (1800mm preferred) clear of obstructions from furniture or any door swings
— Step free vertical transportation across exhibition spaces
— Inclusive wayfinding consider all users with a particular focus on blind or partially sighted users, those where English may not be a first language, wayfinding should be simple and intuitive allowing all to navigate spaces successfully.
— Egress for all – considerations for an evacuation strategy that allows everyone to evacuate in a safe and equitable manner
— Inclusive presentation of information providing options for visual, audible and tactile means

Sustainability considerations

Every industry is able to influence emissions and its own sustainability performance.

Sustainability and climate change are increasingly front of mind for the general public and inform and impact consumer decisions. Effective sustainability approaches should apply systems thinking by considering the project holistically from its conception (e.g. "do we need to create something new, or will repurposing something we already have suffice?") to its end-of-life.

Sustainability considerations for exhibition spaces are arranged within key themes below:

Greenhouse gas emissions
Victoria has a goal of being net zero by 2050. Exhibition spaces should aim to reduce greenhouse gas emissions to support this goal:

— Understand and quantify Scope 1, 2 and 3 greenhouse gas emissions for the space over its lifetime, including a clear definition of the emissions reporting boundary for the space in line with Climate Active or other credible guidance.
— Develop emissions reductions targets, targeting net zero emissions that are in line with or more ambitious than Victoria's emissions reduction targets

Energy usage
Reducing energy usage and selecting a low emissions source of energy can significantly reduce greenhouse gas emissions. Potential sustainable energy strategies include:

— Using energy efficient appliances with an Energy Rating label, economy mode
— Obtaining an energy rating for the space or meet energy rating requirements if rating is not available (NABERS Tenancy Energy Rating, Green Star)
— Exceeding National Construction Code Section J Energy Efficiency requirements
— Monitoring energy usage through use of on-site energy metering,
— Evaluating applicability of use of data centres, cloud storage and other means as an alternative to in-house comms rooms. Where these options are deemed feasible evaluate their operational energy approach using the energy hierarchy below.
— Ensuring energy efficiency through design, including:
  • Use of programmable Building Management Systems
  • Insulation to reduce heating and cooling loads
  • Passive lighting and temperature control
  • Specification of LEDs
  • Specification of solar hot water and electricity panels

If space is to be leased within a broader commercial building context, ensure landlord has an energy rating for the base building:

— NABERS Base Building or NABERS Whole Building targeting 4.5 star (without green power) for existing buildings and 5 stars (without green power) for new buildings, and/or
— Green Star Buildings v1 rating (minimum targets for new and existing building may be informed by Property Council of Australia guidance) and/or
— A reasonable equivalent rating

Energy source

— Minimise natural gas usage, replacing gas with electricity for cooking and heating wherever possible.
— Strategic energy procurement for the operation of creative spaces should be considered by applying the energy hierarchy outlined below when selecting a provider. Selection of energy source can contribute to ratings such as NABERS and Green Star and should be considered in concert with energy efficiency measures.

Energy hierarchy

HIERARCHY	ENERGY MEASURE
1	**Sustainable energy production** — Renewable energy from sun, wind, waves, tides or rainfall, geothermal — Bio-energy from combustion of biomass — Includes off-site renewable energy generation, Power Purchase Agreements (PPAs) and other renewable energy options from energy suppliers
2	**Low carbon generation** energy sources or generation that makes use of carbon capture and storage to reduce emissions from generation
3	**Offsetting** emissions from energy usage using certified additional emissions offsets

Water management
Reduction of water usage overall and use of non-potable water sources where possible contribute to sustainability performance and may contribute to sustainability ratings for the space.

Water management in exhibition spaces should consider:
— Use of efficient fixtures and fittings with a WELS rating,
— Monitoring water usage through on-site metering,
— If space is to be leased within a broader commercial building context, ensure landlord has a water rating for the base building:
  • NABERS Office Water 4 star for new buildings, and/or
  • A Green Star Buildings v1 rating that includes achievement against Water Use credit, and/or
  • A reasonable equivalent rating
— Obtaining a water efficiency rating for the space or meet water rating requirements if rating is not available (NABERS Water, Green Star),
— Ensuring water efficiency through design, including use of recycled water, reticulated wastewater, rainwater capture.

Waste management
Waste is a source of greenhouse gas emissions and its disposal can result in significant costs for exhibition spaces. Management of waste can result in both emissions and cost reductions and can improve operational efficiency. Waste includes single use items, food waste, waste associated with the fit out of the space and waste associated with the creative processes undertaken in the space.

Waste management in exhibition spaces should consider:
— Application of circular economy principles in line with the Victorian DELWP's Recycling Victoria A new economy Plan
— Obtaining a waste rating for the space or meet waste rating requirements if rating is not available (NABERS Waste),
— If space is to be leased within a broader building context, ensure landlord has a waste rating for the base building:
  • NABERS Waste, and/or
  • A Green Star Buildings v1 rating that includes achievement against Operational Waste credit, and/or
  • A reasonable equivalent rating
— Setting targets to reduce waste production overall, from both construction and operation of the Creative Office Space. This can be achieved through achievement of or alignment with Green Star Buildings v1 Operational Waste and Upfront Carbon Emissions credits.
— Setting targets to maximise diversion of waste from landfill and aligning with Victoria's target of 80% diversion by 2030. Strategies may include the following and should be captured in an Operational Waste Management Plan:
  • Having separate collection for multiple waste streams, including organics waste, and adequate space to accommodate these waste streams,
  • Educate staff on waste sorting,
  • Provide signage and nudge mechanisms for staff, audiences, and clients to promote waste sorting.
— Minimise the use of hazardous waste, that is waste that has the potential to harm humans or the environment, in the construction and operation of the space, and provide adequate and safe storage and disposal options for hazardous waste where use of hazardous materials is unavoidable. For workshop hazardous waste may include waste disposal into sewer may require special permitting.
— Implement a sustainable procurement policy that guides procurement decisions during operation with the aim of reducing waste overall, reducing hazardous waste, increasing reuse and recyclability, and integrating circular economy and whole of life principles into procurement evaluation.

Exhibition resources
Exhibition curation can be very resource-intensive, resulting in excessive waste and greenhouse gas emission generation. A strategic approach to planning exhibitions can result in operational efficiency and a reduction in the emissions and waste associated with mounting an exhibition.

— Transportation of artworks can be emissions-intensive and may be addressed by:
  - Minimising the weight and footprint of shipped items through strategic selection of items and efficient packaging
  - Selecting transport options with lower environmental impact, such as ground or sea transport, as opposed to air transport
  - Strategic planning of transportation of artworks and materials to maximise efficiency of transportation, minimise travel legs and transportation distances

— Exhibition materials can also be emissions-intensive and may be addressed by:
  - Prioritising modularity and reusability for exhibition construction, including walls, signage, hanging materials, floor coverings and lighting in order to minimise waste generated and the need for virgin materials
  - Selecting materials for durability, reusability and recyclability, ensuring that adequate disposal options are available for materials that cannot be reused and allowing achievement of landfill diversion targets outlined above
  - Selecting materials for reduced environmental impact, aligning with materials selection criteria outlined in Green Star Buildings v1 Exposure to Toxins credit

Structural design requirements

Key structural design requirements are outlined below:

Future flexibility
As defined in Inclusive Design Considerations, flexibility of use of space is integral to the design of the exhibition space. Creating spaces that offer choice in use and adaptability to future changes should be a key consideration in the structural design. This includes considering:

— Designing for higher floor loadings to allow for change of use without future structural strengthening of the floor
— Geometry of structure including column layout, beam layout and slab set-downs to allow for changes to exhibition layout
— Additional penetrations to allow for change of use and services reticulation without future structural implications

Floor loading
Load allowances for the exhibition space should consider the intended use and future flexibility of the space and comply with structural design actions specified in AS1170.1:2002 Specific loading areas are to be assessed on a case-by-case basis to meet the relevant Australian standards. However, as a guideline, refer to the table below.

The concentrated imposed loads referenced above account for heavy equipment or exhibition objects. However, special consideration for the allowance of concentrated point loads should be made for heavy items if they exceed the above allowances. Egress routes for these items will also need to be established and the loading capacity of these routes should be designed to facilitate the temporary loads.

The exhibition floor should also have the capacity to support concentrated and uniformly distributed loads for temporary equipment (e.g. elevated work platforms) to facilitate access to the overhead structure for operation and maintenance, as well as installation of heavy gallery objects. Concentrated point loads from the legs or wheels of these temporary vehicles will be assessed based on the specified load rating of the machinery. The floor structure should be designed to accommodate these loads if they exceed those specified in the table above.

Floor loading guideline

USE OF SPACE	PERMANENT SUPERIMPOSED DEAD LOAD (kPa)	IMPOSED LOAD	
		UNIFORMLY DISTRIBUTED LOAD (kPa)	CONCENTRATED LOAD (kN)
Exhibition space	4.0 (including 40mm sacrificial slab)	5.0	4.5
Workshop	2.0	5.0	4.5
Plant	4.0	5.0	4.5
Storage	2.0	5.0	4.5

Notes:
1. It is important to note that these loads are provided as a guide and should be reviewed on a case by case basis and in accordance with relevant Australian Standards.
2. Superimposed dead loads are provided as a guide for a typical lightweight partitions, finishes and typical services. Further allowances should be made if heavier finishes, partitions, etc. are desired in the space.

Overhead rigging suggested allowances
Refer to the Technical Grid section of the Technical System Design Requirements for suggested overhead rigging requirements. Where overhead rigging is specified, the following load allowances should be designed for in the structural floor or roof above the exhibition space:

— Imposed load of 1 kN concentrated load per meter (in each direction) or; Imposed load of 1 kPa uniformly distributed,
— Imposed load of 2 kN concentrated point load at any individual rigging point (simultaneous loading of multiple points to be rationalised and agreed during detailed design)

All fixings and fixing locations into the structure above (either pipe grid or direct rigging) are to be agreed and coordinated with the structural engineer. Any items supported from the rigging equipment that are sensitive to vibration (e.g. lighting, sound, projectors etc) or have specific performance requirements should be specified for consideration in the design of the overhead rigging support structure as vibrations from the structure above may transmit to the hanging supports.

DEPARTURE GUIDANCE
A building that does not have adequate floor or ceiling/roof loading capacity could significantly impact the functionality of spaces; ceiling/roof loading should allow for the rigging equipment and/or connections for aerial performances; floors should allow loads such as large set constructions; floor should also allow for the concentrated loads of elevated work platforms to allow access to rigging points.

Structural system and column grid
Specific to new construction projects, careful consideration into the structural system and column grid should be made to balance structural efficiency and flexibility of the exhibition space.

A column free space may be required to maximise flexibility of the exhibition space which will increase the span of the structure. Longer spanning structural systems will require additional structural depth to the floor structure above (and potentially below). Greater floor to floor height may be required to accommodate the additional structural depth.

The preferred framing system (e.g. flat plate, band beams, composite structure etc) and construction type (e.g. concrete, steel, timber etc) should be determined on a project by project basis considering floor to floor heights, proposed grid, services coordination and construction constraints.

Allowance for services penetrations
Penetrations required through horizontal and vertical structural elements for services ducts, cables and pipes should be coordinated on a case by case basis and will be dependent on the structural system of the building. Careful consideration into floor-to-floor heights is required to ensure services reticulation at high level can pass under the floor structure above.

General guidance for penetrations through structural elements are noted below.

— Both vertical and horizontal penetrations should not pass through beams. This includes partial penetrations for floor boxes.
— Floor penetrations should be limited around columns to avoid punching shear
— Large floor penetrations (for services, stairs, atrium etc.) may require additional trimming structure

Amenities areas will require multiple floor penetrations with limited layout flexibility. These should be carefully considered and coordinated with the floor structure at an early stage in the design.

An allowance for future penetrations should also be considered and allowed for where possible.

Serviceability requirements
A structural engineer should carry out design checks for all relevant service conditions in accordance with the governing Australian Standards to ensure the structure will adequately perform for its intended function and purpose.

Footfall vibration performance criteria
The design of the structural floor should consider the vibration induced by typical foot traffic through the space. The aim of conducting a footfall analysis is to capture the dynamic performance of the floor plate when subject to an average person's walking frequency.

— **Walking frequency:** It is important to consider the spatial arrangement of the floor plate as this helps to determine the walking speed and the number of steps that will be input into the vibration analysis.

  Walking frequency is dependent on the expected length over which a person could walk without interruptions. For example, long straight corridors or exhibition spaces could experience many uninterrupted steps compared to a space with regular obstacles such as desks, seats, partitions etc. Future flexibility of the exhibition space should also be considered when analysing the vibration of the structure due to footfall.

  For design purposes, the following walking frequencies are proposed:
  - Corridors and circulation zones: **2.5 Hz**
  - Exhibition spaces: **2-2.5 Hz**
  - Stairs: **2.5-4 Hz**

— **Damping:** Due to the extent of fitout, 1-2% damping is deemed appropriate

— **Response Factors (RF):** Vibration criteria for floors with people walking are typically quoted in terms of a response factor or multiplier on the threshold of human perception.

  The level of excitation of the structural floor should be within the acceptable limits for the specific function of the space. The accepted level of response should be defined and agreed with the client, but compliance with ISO 10137 2007 (Basis of design of structures) can be used as a preliminary guidance.

  Maximum response factors summarised below are a good guidance for preliminary design:

AREA	MAXIMUM RF
Workshop space	RF = 4
Exhibition space	RF = 4

More sensitive areas may suffer excessive vibration caused by vigorous walking in adjacent walkway or corridor areas, this should be considered in the design. For example, more stringent criteria is required in seated areas as the perception of vibration is heightened when seated. It may also be desirable for exhibition areas with sensitive equipment or objects to have limits on acceptable vibration levels.

Lighting design requirements

Key lighting design considerations and requirements are outlined below:

Lighting control and lighting operations
Provision for linear track lighting and track hanging systems
Provide exit lights and only allow controlled natural lighting.
Dim and colour temperature control
Controlled natural light (indirect and filtered)
Black out curtains for AV display if needed

Lighting design
— Exhibition spaces should have good general lighting throughout.
— Average general horizontal illuminance level should meet 600 lux as a base illuminance level.
— Colour temperature of the space should be tunable white fittings (2700K - 6000K) to allow for colour temperature control.
— Colour Rendering Index (CRI) of the work lighting and house lighting luminaires should be 90 or higher.
— Interchangeable beam angles to suit displays should be considered.
— Control of natural light with blinds/ shutters/drapes should be provided on all windows and glass surface.
— Exhibition space Types A and C should have track lighting to allow for flexibility and changing displays.
— Allow for different sized fixtures with different beam angles and lumen packages, within tracks, to provide flexibility with exhibit.

Lighting control
— All lighting should be dimmable, with smooth fading from 0-100%.
— Task lighting will be required in multiple locations throughout the exhibition space. Preprogrammed lighting scenes should be provided with different illuminance levels based on the type of activity being undertaken.
— Motion sensors and lighting timers should be considered to turn off the lighting and conserve energy when space is not in use.
— Exhibition space Type B should allow for audio-visual scene to enable safe movement.
— Coordinate with house and AV lighting.
— Provide track lighting to allow for flexibility and changing displays in exhibit.
— Lumen output varies:
  - Colour temperature: tunable white (2700-6000K)
  - Dimensions (in mm): Varies
  - Lead times: 6-12 weeks

Beam angles
Having various beam angles will allow for more flexibility with changing exhibits.

Refer to https://www.arup.com/-/media/arup/files/publications/m/museums_and_galleries_brochure.pdf

Emergency lighting and exit signs
— AS2293 and NCC Section E4 compliance emergency lighting and exit signs should be provided throughout as required.
— Consideration should be given to incorporate integrated emergency lighting into the general lighting within the space.
— Exit signs should be able to operate at minimum brightness allowable for exit signs to eliminate glare and light spill during a black out.

Electrical design requirements

Key electrical design requirements are outlined below:

Electrical requirements

— Incoming power supply to the exhibition space and the power supply authority power metering requirements to be developed based on the incoming power supply to the building and as per local power supply authority requirements.
— A dedicated distribution board must be provided for the exhibition space with separately metered power and lighting as required by NCC, for ESD purposes and for subleasing (if required)
— A separate clean earth distribution board complete with a technical earth connection directly from the building main earth bar to be provided within the technical areas within exhibition space to connect all specialist audio and video equipment and outlets.
— General power outlets to be provided for the user ports and cleaners' outlets as required.
— Power provisions to be provided for Foyer, AV racks, workshops, reception, toilets and other technical and general areas as required.
— Power provisions to be provided for all mechanical and hydraulic services equipment and to be coordinated with mechanical and hydraulic services installations.
— Cable reticulation to be coordinated with acoustic requirements of the floor/wall build up. To maintain the required acoustic performance based on the installation requirements, rigid conduits or flexible conduits or steel conduits to be used.
— Digital display tags for art/display.

The exhibition space will require:

Facility panels with single phase and three phase power outlets for production systems within exhibition and technical spaces
10A DGPO's and cleaners outlets distributed along the perimeter of the venue
Technical earth/clean power system for typical audio circuits

DEPARTURE GUIDANCE
As well as ensuring adequate electrical supplies, the distribution of power supplies is critical to success for an exhibition space. Electrical supplies should be 'clean' and free from noise generated by inductive loads; design of earthing systems should avoid potential for 'earth loops' which can cause hum in sensitive equipment; power should be distributed liberally with outlets mounted to every wall and associated with all potential equipment locations.

Communications requirements

Incoming communication services requirements to be developed based on the building/space requirements. Minimum 10pair Cat 5 cabling connection to be installed from the building distributor to the floor distributor together with minimum 6 core single mode fibre optic connection.

The exhibition space will require:

A dedicated AV/comms rack and switch
Data outlets distributed throughout the venue
Specialty technical system interconnections between typical control location and exhibition space
Building wide comms, paging and relay systems
Internet connection to the AV rack/ switch
Wi-Fi network connection provisions

Electrical design standards and system criteria
Relevant electrical design standards and system criteria are outlined below:

ITEM	STANDARDS	CRITERIA
Supply conditions	Supply Authority service rules	— 400V 3-Phase nominal — 50Hz
Main switchboard	AS/NZS 61439 AS/NZS 3000	— 25% spare space or one spare space (whichever is greatest) for each frame size excluding main switch(es) — Main busbars 125% initial load
Distribution boards	AS/NZS 61439 AS/NZS 3000	— Form 2 unless stated otherwise — 30% spare space or minimum 18 poles (whichever is greatest) for each frame size excluding local main control) — Local main control required — Fault interrupt capacity of circuit breakers minimum 6kA — Provide fault current limiters or use higher fault interrupt capacity circuit breakers as required — Internal DBs: IP52 minimum — External DBs: IP56 minimum
Consumers mains	AS/NZS 3000 AS/NZS 3008.1	— Voltage drop: max. 2% — Maximum demand + 25% capacity (current carrying and voltage drop) — Fire rate where required to AS3000 — At least 100% neutral. Provide oversize neutral where harmonic currents are expected to be high
Submains	AS/NZS 3000 AS/NZS 3008.1	— Voltage drop: 1% — Maximum demand + 20% (current carrying and voltage drop) — Fire rate where required for Fire and Life Safety Services — At least 100% neutral; provide oversize neutral where harmonic currents are expected to be high
Final subcircuits	AS/NZS 3000 AS/NZS 3008.1	— Voltage drop: max. 2%. — Power: 2.5 mm^2 min. — Lighting: 2.5 mm^2 min. — Max 80% utilisation to AS 3000
Lighting	AS/NZS 1680	— Use long life, energy saving lamps such as LEDs; use tungsten and tungsten halogen only to approval — Allow overall depreciation factor of 0.8 for clean, air conditioned areas, 0.7 for clean, non-air conditioned areas and 0.6 for dirty areas
Communications	AS/NZS 11801	— Provide Cat 6 UTP cabling — Contain Cat 6 cable route length to <90m — Cross power cables only at 90° — The maximum fill of a cable tray should not exceed 50%
Electrical metering and EMS system	NCC Section J6 Supply authority standards	— Meters and CTs should comply with NCC and supply authority standards

Acoustic design requirements

Acoustic outcomes will be influenced by the site location, internal design and interface with surrounding development. The key design factors include:

— Environmental noise and vibration emission
— Internal design noise and vibration levels
— Environmental noise intrusion
— Building services noise and vibration control
— Internal acoustic separation, including spatial planning and physical isolation
— Room acoustics (e.g. reverberation, etc.)

DEPARTURE GUIDANCE
The level of acoustic design treatment for an Exhibition Space will vary depending on how spaces are used and the specific collections or exhibits to be displayed, which may be noise sensitive, or loud. Building envelope design should avoid noise ingress from external noise and vibration sources, internal partitions are required to mitigate noise from BOH or to sensitive spaces and internal design noise levels should be established to aid critical listening where required.

Design criteria and management requirements

ITEM	CRITERIA AND REQUIREMENTS
Environmental noise and vibration emission	— Minimum requirements will be according to council consent requirements and will be dependent on surrounding or adjoining development. Due regard must be given to any requirements or expectations for ventilation, including external plant, exhausts or intakes. — The design must be based on the full operating hours of the space and maximum noise and vibration levels potentially generated by the use. — The acoustic design requirements will be heavily influenced by the proximity and sensitivity of nearby or adjoining receivers. Site location will be critical to minimising design requirements and maximising operational flexibility.
Internal background noise and vibration levels	— Criteria relate to the noise and vibration in the space excluding occupant activity. — Internal background noise levels, from both environmental noise intrusion and internal plant and equipment should not exceed the lower bound design sound level range in AS/NZS 2107:2016 by more than 5 dB. Refer to Public Buildings>Exhibition Area in Table 1 of AS/NZS2107:2016. This would typically be assessed with any operable windows closed. — Internal background vibration not to exceed the maximum levels in British Standard BS 6472:2008. — If the exhibition space may be affected by vibration sources, vibration limits for the fragile artefacts should be considered.
Internal acoustic separation, including spatial planning and physical isolation	— Vibration and structure borne noise from equipment (e.g. sub-woofers, workshop equipment) and activities within exhibition space must be factored into the building design and siting. — Where the space is located above or below other tenancies, the floor/ceiling sound insulation and footfall impact control measures should be considered. — Sound isolated wall/door between exhibition spaces and other spaces should be considered to control the noise break-in and break-out. — Where sub-division of the exhibition space is intended, the space should be designed to allow temporary acoustic partition/door/vestibule to be built.
Room acoustics	— Reverberation should be designed: • Exhibition space Type A: reverberation control is not typically required. However, some sound absorptive finishes to the ceiling are recommended for acoustic comfort, guided tour and/or occasional functions. • Exhibition space Type B: subject to the content of the exhibition, the reverberation time should not exceed Curve 1 (Speech) or Curve 2 (Music) of Appendix A, AS/NZS2107:2016. • Other spaces: design in accordance with AS/NZS2107:2016. In the absence of specific recommendations in AS/NZS2107:2016, reverberation times should be minimised for noise control, occupant comfort and space functional requirements.

Fire safety design requirements

Key fire safety design considerations and requirements are outlined below:

— Fire safety design requirements from the base building are to be incorporated in addition to requirements triggered by the new space.
— Fire exits exit width, and egress routes are to be in accordance with the requirements of the NCC. Where temporary equipment or props are expected, management provisions are to be implemented to prevent blocking of the exits and egress routes.
— Fire safety systems (e.g. fire sprinklers, hydrants, hose reels, fire detection and alarm systems, portable fire extinguishers and blankets) are to be provided in accordance with the requirements of the NCC.
— The use of a gas suppression system vs. sprinklers is to be considered for protecting sensitive display items.
— Audibility of the Occupant Warning System is to be considered. Competing sound systems are to shut down in accordance with AS1670.1–2018 clause 3.22.3. The placement of occupant warning speakers is to consider any sound-proofing measures within the facility.
— Visual warning devices are to be located in areas where portable sound systems may be used.
— Linings are required to meet the Fire Hazard Property requirements outlined in C1.10 of the NCC. This requirement is to be considered in conjunction with any acoustic or sound proofing linings.
— The use of an exhibition facility as an Entertainment Venue should be clarified in the Design Brief, as this is likely to change the NCC Classification and fire safety requirements. If an exhibition facility is proposed to operate as an Entertainment Venue or Assembly Building, the following should also be considered:
  - The use of staging/exhibitions or seating is to be identified in the early stages of design, along with proposed layouts. This applies to both temporary and permanent staging and seating. The layout of temporary staging/exhibitions and seating layouts will need to form part of the approvals documentation to ensure that NCC requirements are maintained during event layouts.
  - The design of fire safety systems is to consider the presence of any temporary staging/exhibitions or seating, particularly in relation to fire system coverage, and exit signage layouts.
  - If a smoke exhaust system is required, smoke is to be exhausted at high level and make-up air introduced at low level. Where a smoke exhaust system is required, it is recommended that it be designed on a Performance basis by a Fire Safety Engineer.
  - The design of an Entertainment Venue can often benefit from a Performance Based Fire Safety Strategy, carried out by a Fire Safety Engineer. Designing in accordance with the prescriptive NCC requirements, whilst possible, may prove restrictive to the space. A Performance Based design, considering the Fire Safety Strategy as a whole, can often lead to a more usable (less restrictive) outcome.
— It will be important to consider how inclusive the evacuation strategy is, including plans for people who may require step-free routes (e.g. use of evacuation lifts for older people, disabled people, etc.) or who require particular features to help with the evacuation (e.g. audible alarms for blind and partially sighted people, visual alarms for D/deaf and hard of hearing people, etc.).

Hydraulic design requirements

Key hydraulic services provisions that should be considered as part of the design are outlined below.

— Domestic water and sanitary drainage is to be provided to any showers and amenities, and cleaners sinks which are part of the space.
— Where the space forms part of a shared building, domestic water services should be metered separately from the base building supply to allow landlord billing of water use.
— Mechanical condensate should drain to the sanitary system via a trapped tundish.
— Domestic hot water should be generated local to the space and consider the frequency of use.
— Where spaces are used infrequently, instantaneous electric hot water generation is preferred to avoid energy associated with heat losses. Where the space is used daily, electric storage, heat pumps or a combination of both may be more appropriate.
— Reticulation of wet hydraulic services should be avoided in exhibition spaces and rooms likely to store sensitive artwork or technical equipment. Where this is not possible, leak detection or leak management should be considered with the stakeholders to avoid risk of water damage.
— Reticulation of hydraulic services should be avoided in exhibition spaces. Where this is not possible acoustic treatment should be considered and pipework located in a way to avoid impact on the space during routine maintenance or repair.

In addition, the design should meet all requirements of national and local Statutory Authorities and should be in accordance with the following:
— Relevant Australian Standards
— BCA/National Construction Code (NCC) 2019 Amdt 1
— Plumbing Code of Australia
— EPA regulations
— Worksafe regulations
— BCA/Building Surveyor requirements
— Manufacturer's guidelines
— AGA and Jemena requirements (where gas is provided)
— Water Supply and Drainage Authority Requirements
— Fire Rescue NSW regulations and any Fire Engineering
— Electrical Supply Authorities
— Applicable ESD Requirements
— Applicable acoustic requirements

Hydraulic design criteria
The Hydraulic Services design is to be based on the following design criteria.

SYSTEM	STANDARDS	DESIGN CRITERIA
Domestic hot, cold and recycled water services	NCC AS/NZS 3500.1 AS/NZS 3500.4 AS/NZS 2500.3	— Cold water average supply temp: 14°C — Hot water storage: 60°C to 65°C — Hot water distribution: 55°C to 60°C — Amenities (visitor and non visitor): 43°C — Utility rooms (bin stores, kitchens, non ablution areas, etc.): 55°C to 60°C — Max. velocity: 2.4m/s externally and in ground — Max. velocity: 1.5m/s in risers, BOH spaces — Max. velocity: 0.8m/s in acoustically sensitive spaces — Min. operating pressure: 250kPa — Max. operating pressure: 500kPa
Sanitary plumbing and drainage	NCC AS/NZS 3500.2	— Min. grade: 2.5% for 40–65mm, 1.65% for 80–100mm and 1% for 150mm pipelines — Sanitary stacks design capacity: 22% to 33% full — Drainage design capacity: max. 70 % full — Velocity: 0.75m/s to 1.2m/s
Building rainwater drainage	NCC AS/NZS 3500.3 Australian Rainfall and Runoff Guidelines Local council requirements	— Flat roofs, box gutters: 5min 1% AEP — Eaves gutters: 5min 5% AEP — Climate change allowance: +10% — Full capacity overflows to be provided to all building rainwater drainage catchment areas — Velocity: 0.75m/s to 1.2m/s — Siphonic drainage velocities TBC by hydraulic calculation; insulation where required to limit noise in noise sensitive areas

Mechanical design requirements

Key mechanical design considerations and requirements are outlined below:

General mechanical requirements

— Relevant ASHRAE and CIBSE external design criteria should be used. Consideration should be given to future climate change and resultant elevated ambient design temperatures.
— Increased outside air (50% above code minimum is recommended) in normal operation
— CO_2 sensors should increase the outside air proportion to the space in response to high CO_2 levels. Mechanical equipment should be sized to maintain internal temperatures and deliver increased outside air at high ambient temperatures.
— Wall-mounted temperature and CO_2 sensors should be installed at 1500mm AFFL inside the space and in areas that will be representative of the conditions inside the space.
— Mechanical system should be variable volume and respond to temperature and CO_2 levels within the space.
— If system supplies >1000 L/s, economy mode should be provided in line with NCC 2019 Section J requirements. Economy mode should be offered with smaller units to achieve energy reductions.
— For spaces with a floor-to-ceiling height of 4–6m, minimum air change rate of 6 air changes per hour should be achieved.
— For spaces with >6m floor-to-ceiling height, minimum air change rate of 8 air changes per hour should be achieved.
— When determining airflow and mechanical equipment sizing, consideration should be given to uplighting vs. downlighting so that the mechanical system is not oversized (a proportion of high-level lighting and equipment load will not land in the space so does not require direct air conditioning).

Type A & B exhibition space

— There are no ASHRAE or CIBSE requirements for close-control environments within the exhibition space.
— The mechanical systems serving the exhibition space should maintain an environment within the following specified values during times of use:
  - Temperature: 21°C to 24°C, with ability to widen temperature criteria depending on space use to increase occupant comfort and save energy
  - Humidity: 40% to 60% (note: this will not be directly controlled but will naturally fall into this range as a result of the air conditioning)
— Mechanical system should be designed to meet acoustic requirements of the space. Coordinate mechanical systems with acoustic consultant to meet specific noise criteria for the exhibition space.
— All ductwork should be above rigging zone OR wall mounted OR low-level as long as it is not covered by furniture/exhibits/drapes and does not clash with other services/uses. Return air should be high level to ensure good air quality in space.
— Ensure access to ductwork is maintainable and takes into account lighting and equipment rigging within the space.
— Consideration should be given to performance of diffusers in heating mode, especially for spaces with high floor-to-ceilings (more than 3.2m).

— If extensive lighting and equipment is used, make allowance for mechanical system to offset expected maximum lighting and equipment loads.
  - Type A (physical display): mechanical system to offset external gains, ventilation, occupant, lighting and equipment loads
  - Type B (AV display): mechanical system to offset external gains, ventilation, occupant, lighting and equipment and AV loads
— Air supply should be 'low velocity' to reduce noise, avoid drafts and avoid moving drapes/curtains.
— Diffusers should be high induction to reduce drafts in space.

Workshop (Type A)/comms. (Type B)
This area may be conditioned or ventilated based on user preference and expected usage of the space.
— If the space is to be used interchangeably as a workshop/ comms. room, it should be provided with air conditioning. Refer to **Storage spaces: Type B Comms**.
— If there is no future comms. cooling requirement within the space, workshop may be provided with ventilation only. Provide sufficient ventilation to remove contaminants from the space in line with AS1668.2 requirements. The space will be conditioned with tempered air returning from adjacent conditioned spaces.

DEPARTURE GUIDANCE
Agreement between exhibition space provider and exhibitors should include appropriate agreed internal temperature and humidity ranges. If increased levels of control are required, temporary conditioning or specialist display boxes should be provided.

Type C exhibition space
— If located internally or enclosed, the exhibition space should be have mechanical systems to provide cooling and heating.
— The mechanical systems should maintain an environment within the following specified values during times of use:
  - Temperature: 21°C to 24°C, with ability to widen temperature criteria depending on space use to save energy
  - Humidity: 40% to 60% (note: this will not be directly controlled but will naturally fall into this range as a result of the air conditioning)
— Mechanical system should be designed to meet acoustic requirements of the space. Coordinate mechanical systems with acoustic consultant to meet specific noise criteria for the exhibition space.
— If extensive lighting and equipment is used, make allowance for mechanical system to offset expected maximum lighting and equipment loads.
— Air supply should be 'low velocity' to reduce noise, avoid drafts and avoid moving drapes/curtains.
— Diffusers should be high induction to reduce drafts in space.
— If located externally, ensure maximum temperature within occupied spaces is not in exceedance of NCC 2019 requirements.

Storage spaces, Type B comms.
— Storage rooms which house high value equipment may require humidity control, requirements to be confirmed by major stakeholders, operators and user groups. Humidity and temperature sensors may be required to be redundant to ensure room conditions deviate minimally. Rooms requiring close control of conditions should be located internally and not against the façade or adjacent to unconditioned spaces. They should be served by dedicated units and utilise code minimum outside air to reduce temperature deviations (refer AS1668.2).
— Appropriate grilles and access panels (if required) should be incorporated within high value secure storage areas such that the security of the area is maintained.
— Major stakeholders to confirm plant redundancy requirements, temperature & RH conditions and maximum temperature/ RH fluctuations allowed within the storage rooms. Refer AICCM (Australian Institute for the Conservation of Cultural Material) guidance as a baseline. Suggesting starting point is as follows:
  - Short term fluctuations of no greater than 4°C for ≤24 hours duration within the total temperature range of 15–25°C
  - RH to be maintained 45–55% for the majority of the time for Sydney's temperate climate. Short term, ±5% fluctuations ≤24 hours duration into the outer limits of the total RH ranges (i.e. can swing 40–60% RH for ≤24 hours)

— Rooms should be provided with outside air in line with AS1668.2, or battery ventilation in line with AS2676 if housing any type of batteries.
— If actively cooled by an air conditioning unit, the unit should be dedicated and be provisioned in a duty/standby arrangement if required by the owner/operator of the space.
— If the unit is a direct expansion (DX) unit, design and installation is to be in line with AS5149

Loading area
The loading area should be adequately ventilated to prevent ingress of vehicle fumes into the enclosed spaces. If the loading area is under cover, ventilation should be provided in line with AS1668.2.

Other areas
— Cleaners store to be exhausted directly to outside in line with AS1668.2 requirements
— Ventilation of cloakroom, toilets and change rooms to be in line with AS1668.2 requirements (change rooms and cloakroom may be conditioned by a small FCU/PAC if desired to provide additional comfort for occupants). It is recommended extract ventilation is 200% of code minimum to ensure odours are effectively removed from the space

Fire engineering/smoke control
If smoke exhaust is required, all components are to be compliant with AS1668.1 requirements and Spec E2.2b of the NCC, except where deviated by a Performance Based Fire Engineering strategy developed by a Fire Safety Engineer.

Design criteria

EXTERNAL DESIGN CRITERIA	ASHRAE OR CIBSE CURRENT GUIDANCE
General ventilation	AS 1668.2:2012
Smoke control ventilation	AS 1668.1:2015
Battery ventilation	AS 2676.1:2020
Refrigerant	AS 5149:2016

In addition, the design should be compliant with the following codes and standards:
— 2019 National Construction Code/ Building Code of Australia (BCA)
— Building Permit conditions
— AS1668.1 (2015) – Fire and Smoke Control in Multi-Compartment Buildings (Amendment 1)
— AS1668.2 (2012) – Mechanical Ventilation in Buildings (Amendment 1 and 2)
— AS1668.4 (2012) – Natural Ventilation of Buildings
— AS 1940 (2004) – The Storage and Handling of Combustible Liquids
— AS/NZS 2107 (2000) – Recommended Design Sound Levels and Reverberation Times for Building Interiors
— AS 3000 – Electrical Installations
— AS 3500 – National Plumbing and Drainage Code
— AS 3666 (2011) – Air-handling and Water Systems of Buildings – Microbial Control
— AS 4254.1 (2012) – Ductwork for Air-Handling Systems in Buildings – Flexible Duct
— AS 4254.1 (2012) – Ductwork for Air-Handling Systems in Buildings – Rigid Duct
— AS/NZS 5601.1 (2013) – Gas Installations – General Installations
— AS5149.1-4 (2016 + latest amendments) – Refrigerating Systems and Heat Pumps
— All other applicable Australian Standards
— WorkCover requirements
— OH&S Regulations
— Safe Work Australia
— Electricity Supply Authority requirements
— Fire brigade requirements
— Australian Gas Authority requirements
— All local council regulations
— Fire engineering report

Pipework velocity and pressure drop
The following values should not be exceeded:
— Pipework pressure drop: 300 Pa/m
— Pipework velocity:

DIAMETER (mm)	VELOCITY (m/s)
25	1
50	1.1
100	1.25
150	1.5
200	2
250	2.2
300	2.5

Ductwork velocity and pressure drop
The following values should not be exceeded:

— Ductwork velocity: Variable Volume Systems (Final velocity to be agreed with Acoustic Consultant depending on acoustic requirements of the space)
  - Risers and plant rooms: 7.0 m/s
  - In ceiling secondary ductwork: 5.0 m/s
  - In ceiling tertiary ductwork: 3.5 m/s
  - Flexible ductwork: 2.5 m/s
  - General duct discharges: 6.0 m/s
  - Louvres: 2.5 m/s face velocity

— Ductwork pressure drop
  - General ductwork: 0.8 Pa/m
  - Transfer ducts: 12 Pa
  - Riser take-offs: Kt £ 0.89
  - Bends: Kt £ 0.25
  - Rectangular contractions: Kt £ 0.19

Where the total pressure loss through the fitting is defined as Pt = Kt × Pv:

— Pt = Total pressure loss through fitting (Pa)
— Kt = Loss coefficient
— Pv = Velocity pressure (Pa)

Mechanical equipment and accessories pressure drops
The following values should not be exceeded:

— Sound attenuators: 50 Pa
— Louvres: 20 Pa
— Cooling coils (airside): 150 Pa
— Cooling coils (waterside): 35 kPa

Glossary

Access To Premises Standard
The Disability (Access to Premises – Buildings) Standards 2010 (Premises Standards) is legislation under the Disability Discrimination Act 1992. The purpose of the Disability Standards for Access to Premises is to make sure: people with disability and their family members, carers and friends, have equal access to public buildings; and building certifiers, developers and managers fulfil their responsibilities to people with disability under the Disability Discrimination Act 1992.

AFFL
Above Finish Floor Level

AISC
American Institute of Steel Construction

Amdt
Amendment

amp
Ampere

AS
Australian Standards are published documents setting out specifications and procedures designed to ensure products, services and systems are safe, reliable and consistently perform the way they are intended to. They establish a minimum set of requirements which define quality and safety criteria. Standards Australia develops internationally aligned Australian Standards.

AS/NZS
Australian/New Zealand Standards. Joint standards developed by Standards Australia and Standards New Zealand

ASHRAE
American Society of Heating, Refrigerating and Air-Conditioning Engineers

AV
Audio Visual

back of house (BOH)
A term used to refer to the support spaces for the stage, most often immediately adjacent to the stage. This includes dressing rooms, storage rooms, loading dock. This term can also be used to refer to the rear of the auditorium.

BCA
Prior to the creation of the NCC, building was regulated by the Building Code of Australia (BCA), and had been since 1992. The BCA was the first collection of nationally-consistent building regulations. The BCA was superseded by NCC.

catwalk
A steel structure over the stage, audience area, or both, used by stage personnel to cross from one side of the house to the other, often used to support lighting instruments.

CISBE
Chartered Institution of Building Services Engineers

CNC
Computer Numerical Control router

control room
The dedicated zone or room from which the lighting, sound and AV equipment is operated during a performance.

CT
Current Transformer

DB
Distribution Board

dB(A)
The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

DCP
Development Control Plans. DCPs provide detailed planning and design guidelines to support the planning controls in the Local Environmental Plan.

DDA
Disability Discrimination Act

decibel
Measure of loudness of sound (pressure) level. For convenience, this is calculated on a logarithmic measurement scale.

DGPO
Double General Power Outlets

DMX
Digital Multiplex, a standard for digital communication networks that are commonly used to control stage lighting and effects

DSP
Digital Signal Processor

DX
Direct Expansion
EP&A Regulations
Environmental Planning and Assessment Regulation. The EP&A Regulation contains key operational provisions of any local or state planning system.

ESD
Environmentally Sustainable Design

FCU/PAC
Fan Coil Unit/Packaged Air Conditioning Unit

fire curtain
A non-flammable, vertical travel curtain immediately behind the proscenium, contained in the smoke pocket, used to protect the audience from possible smoke and fire originating from the stage. It is typically rated for 30 minutes of protection.

frequency
The subjective equivalent of frequency in music is pitch. Higher frequency sounds have a higher pitch. The unit of frequency is the Hertz (Hz). Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used.

front of house (FOH)
A term typically used to collectively refer to the support areas immediately adjacent to the auditorium. This includes the lobbies, restrooms, cloak check, gift shop and box office.

GPO
General Power Outlets

Green Star
A Green Star rating provides independent verification that a building or community project is sustainable. Undertaking voluntary Green Star certification demonstrates leadership, innovation, environmental stewardship and social responsibility.

Hz
Hertz

IP
Ingress Protection rating

ISructE
Institution of Structural Engineers

l/s
Litres per Second

LED
Light Emitting Diode

loudness
Loudness provides for an exciting and dramatic aural experience and allows the musical director maximum dynamic range. The loudness of sound varies throughout an auditorium, and is equated to the distance from the stage to a listener.

m
Metres

m/s
Metres per Second

NABERS
National Australian Built Environment Rating System (NABERS). NABERS is a simple, reliable sustainability rating for the built environment. This helps building owners to understand their building's performance versus other similar buildings, providing a benchmark for progress.

National Construction Code (NCC)
The National Construction Code is Australia's primary set of technical design and construction provisions for buildings. As a performance-based code, it sets the minimum required level for the safety, health, amenity, accessibility and sustainability of certain buildings. The Australian Building Codes Board, on behalf of the Australian Government and each State and Territory government, produces and maintains the National Construction Code.

Noise Criteria (NC)
The Noise Criteria (NC) curves are commonly used to define building services noise limits. The NC value of a noise is obtained by plotting the octave band spectrum on the set of standard curves. The highest value curve which is reached by the spectrum is the NC value. Shown below is a plant noise spectrum that is equivalent to NC 40.

OH&S regulations
The Occupational Health and Safety (OH&S) Regulations build on the OHS Act. They set out how to fulfil duties and obligations, and particular processes that support the Occupational Health and Safety Act.

Preferred Noise Criteria (PNC)
A set of curves, similar in principle to NC curves, but considered to correlate better to subjective acceptability in very low noise areas such as music auditoria.

reverberation
The principal, subjective acoustic quality perceived by the majority of listeners in an auditorium is reverberation. This is most commonly experienced at the end of stop chords as the sustained sound that rings in the space. Reverberance assists the sustain of musical instruments and the blending of the orchestra sections. It also contributes to the feeling of envelopment, i.e. that the sound comes from all around you.

RMS Compressor
Root Mean Squared compressor

sqm
Square metre

typical noise levels
Some typical noise levels are given below:

NOISE LEVEL DB(A)	EXAMPLE
130	Threshold of pain
120	Jet aircraft take-off at 300 ft
110	Chain saw at 3 ft
100	Inside disco
90	Heavy trucks at 15 ft
80	Sidewalk of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 3 ft
40	Living room
30	Movie Theatre
20	Remote countryside on still night
10	Sound insulated test chamber
0	Threshold of hearing

UDL
Uniformly Designed Load, a force that is applied evenly over the distance of a support

UTP
Unshielded Twisted Pair Cabling

WELS
Water Efficiency Labelling and Standards (WELS). WELS is Australia's water efficiency labelling scheme that requires certain products to be registered and labelled with their water efficiency.

wings
Areas on stage left and right of the proscenium opening edge not in direct view of the audience. The wings are used as a space for actors or scenery waiting to go on stage.

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