Creative Spaces Design Guide

PART 3F
TECHNICAL APPENDIX:
SMALL-SCALE TV AND FILM STUDIO

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: University of York, Heslington East Campus
Credit: Giles Rocholl Photography

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

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 a TV and film studio:

— 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

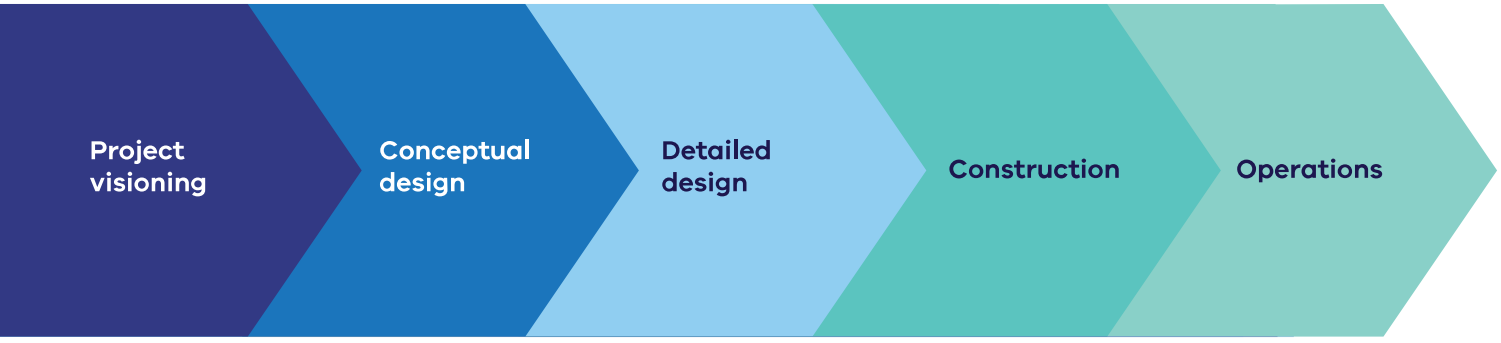
Operational and end-user needs

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.

TV and film studio

Small-scale TV and film studios are used by small professional companies, mixed-media artists, digital content creators and other creative users to record and/or broadcast digital video content.

TV and film studios provide users with a professional, sound-proof and private recording space with technical production equipment to develop and produce their work.

Early engagement with the operator and user groups is necessary to determine the usage of the studio and the required supporting spaces.

Usage profile

A small-scale television and film studio has a range of usage profiles:

— Occupation by a single user group for several weeks, for 5-6 days per week and up to 16 hours per day
— Occupation by a single user group for a single day or a few days at a time, for up to 16 hours a day

Small-scale TV and film studios should be flexible to accommodate both individuals and groups with accessibility requirements.

References:

Film shoot for 'The Retreat', devised and performed by the Sub30 Collective, Western Edge Youth Arts.
Featured artist: Michael Logo
Image: Wāni Le Frère

University of York, Heslington East Campus
Image: Giles Rocholl Photography

Programmatic requirements

A small-scale TV and film studio should provide a main recording space with a suite of necessary ancillary spaces. The recording space should be large enough to accommodate most small-scale professional TV and film production.

Soundproofing and environmental control will be critical to the success of the space. Control rooms, technical spaces and amenities will also be required to support a variety of use cases.

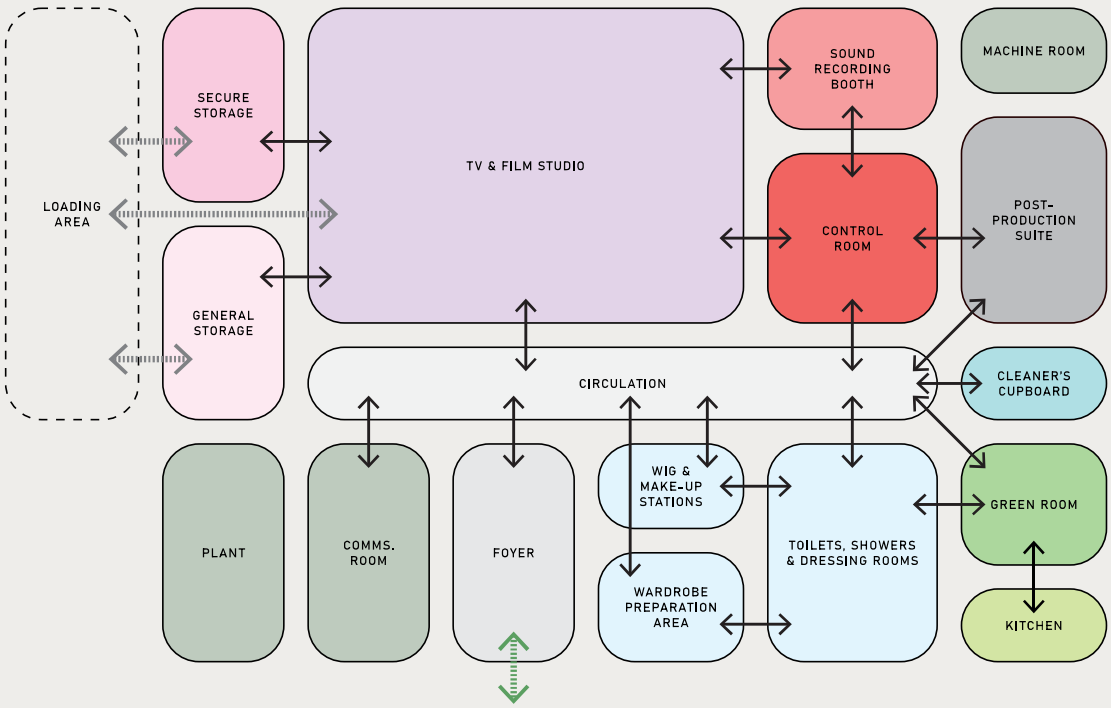
A small-scale TV and film studio should include the following areas:

- **TV and film studio** for recording video and audio content
- **Control room** to control production and direct operation
- **Sound recording booth** for recording high quality audio
- **Post-production suite** to process audio and video recordings
- **Machine room** to house technical equipment and racks
- **Dressing room** with makeup and wig stations and a wardrobe preparation area
- **Amenities**, including green room, kitchenette, toilets and showers

Storage areas

- **Loading area and pathways** sized appropriately for incoming equipment and scenic elements
- **Step-free circulation and obstruction free access** at 1500mm minimum width
- **Inclusive and legible wayfinding signage**, including text, pictogram, visual, tactile and audible options

Small-scale TV and film studio – Spatial adjacency diagram



Spatial requirements

A film and TV studio should support simultaneous users, including performers/artists, technical crew/staff, producers, support staff and observers.

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:

TV and film recording space: **100 sqm**, with a **minimum clear height of 5m**
Control room: **25 sqm**
Sound recording booth (optional): **6 sqm**
Post-production suite: **25 sqm**
Machine room: **6 sqm**
Dressing rooms: **4 sqm per person**
Toilets: **as per NCC**
Showers: **as per NCC**
Green room: **10 sqm**
General storage: **15 sqm**
Technical equipment storage: **20 sqm**
Secure storage: **10 sqm**
Cleaner's cupboard: **2 sqm**

All areas above are minimum Net Internal Areas.

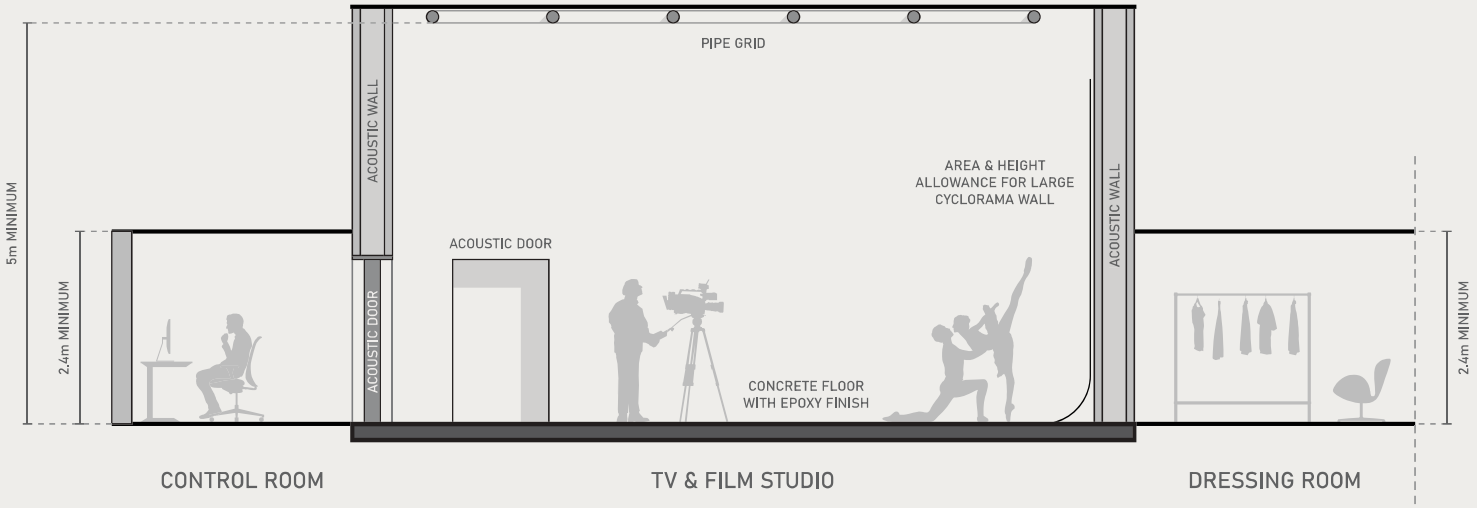
A TV and film studio should be located away from the public eye. Secure, straightforward and controllable access for user groups should be provided from the building exterior, such as an electronic keypad entry or similar.
It is important that all spaces in the TV and film studio are designed to be inclusive and allow participation for all, regardless of an individual's personal identity or circumstances.

TV and film studio
The TV and film studio is an open, column-free space that should lend great light and live sound quality to recordings. It should allow for shooting in natural light, as well as provide blackout curtains for flexible lighting and privacy. It should enable multiple performers/crew tracking or speaking simultaneously to produce a well-blended sound within the room. A minimum clear height of 5m AFFL should be maintained in the recording space.

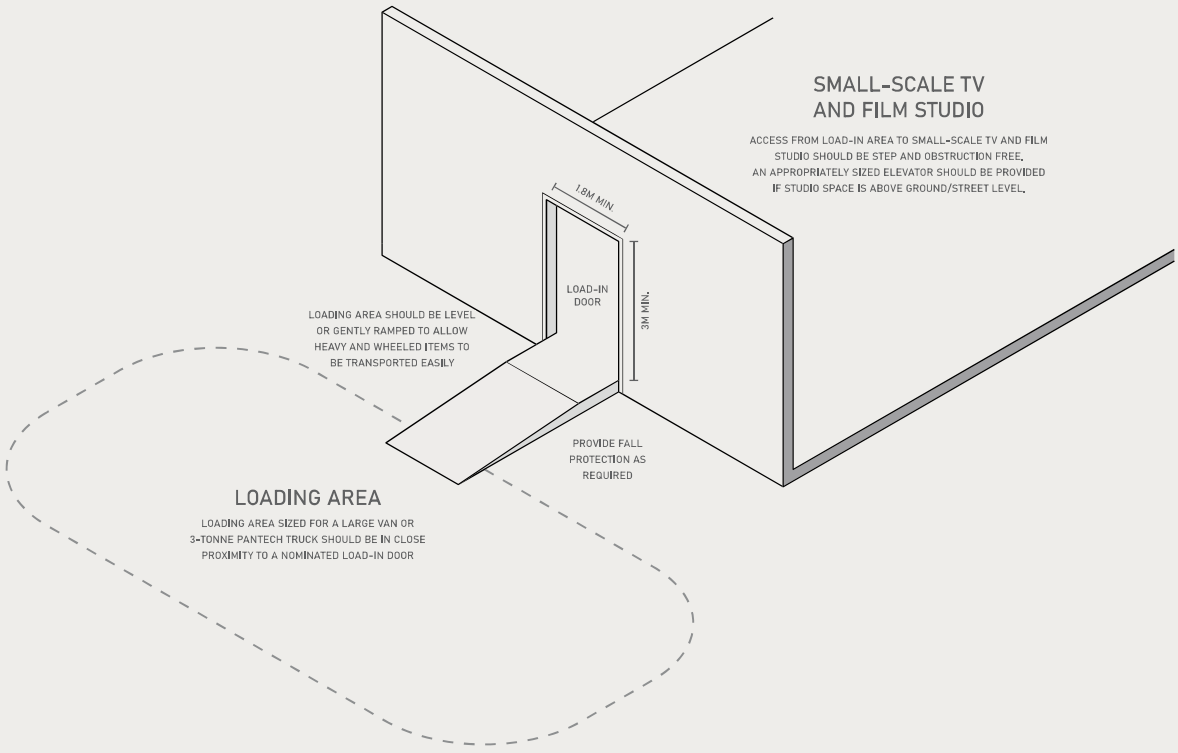
DEPARTURE GUIDANCE
If a reduction in height is considered, please note the impact on functionality of the space. A reduction in height may impact TV and film scenery and rigging capability of the space to accommodate lighting, special effects, etc.

— **Wall and ceiling:** Wall and ceiling finishes should be of a neutral colour, such as white or black. A high grade of finish is required with concealed fixings to achieve a seamless appearance on camera. All walls (both internal and external) and floor and ceiling build-ups are likely to be significant to meet acoustic requirements. Allowances should be made for sound attenuating walls and finishes that facilitate absorption and diffusion. Selected finishes should also include good visual contrast of key surfaces and features and avoid finishes that will cause confusion (e.g. heavy patterns, glare, reflections) to accommodate users with different access needs.
— **Floor:** The floor of the recording space should be of concrete construction with a self-levelling epoxy finish. A seamless floor plane is essential to the operation of the studio, especially if cameras on rolling/wheeled dollies are to be used. The floor should be free of any joins, expansion joints, floor boxes or any other element that may interrupt smooth travel of technical equipment.
— Walls and floors for the TV and film studio should be white, black or neutral in colour for functional purposes. However, please note that some users (e.g. partially sighted people, neurodiverse people, etc.) may find this uncomfortable or difficult to use. A suitable management strategy should be considered to accommodate specific needs - e.g. by providing overlay options to increase contrast between wall and floor.
— **Cyclorama and curtain tracks:** A temporary or semi-permanent cyclorama wall may be required, depending on the operator and end-user requirements. A cyclorama (or an infinity wall) is either a curtain stretched tight or finished plaster board wall used as a background. In both instances the background is formed as an arc which helps create the illusion of an infinite background. It is plain (white or cream) coloured and can be used as a backdrop or be used for coloured lighting or projection effects. Allowance should also be given for a series of curtain tracks along the sides and behind the photoshoot area to support different curtains and backdrops.
— **Green screen:** A green screen should be provided if desired. A green screen is either a green painted wall or a stretched green fabric backdrop that can be used to 'key' in other backgrounds.

Small-scale TV and film studio – Sectional diagram



Small-scale TV and film studio – Loading diagram



Control room (or production control room)
The control room in a TV and film studio is where the production is controlled and operations directed. The room contains monitors, speakers, live broadcasting capability, effects generators, switching boards and other equipment used to monitor and edit a production as it is being taped in the studio. The room can be arranged such that all technical and programme staff operate in one area or can be separated for vision, sound and post-production.

The room's acoustic design should be developed based on known seating and monitor positions. Generally, a control room should be fitted with a significant quantity of sound-absorbing treatment, with some key reflecting and diffusing surfaces carefully positioned to render details of the sound.

Sound recording booth
If a separate sound recording booth is required, a controlled room response is desirable. The booth should allow for multiple musicians tracking simultaneously to produce a well-blended sound within the room that allows for ambient (distant) mic-ing techniques in addition to close mic-ing. This will require a considered distribution of architectural finishes including absorptive, diffusive and reflective surfaces.

Refer to technical appendix: Sound Recording Studios for detailed requirments if inclusion of sound recording studio is desired by the end-user and the operator.

Post-production suite
Post production suite is used to finalise the production following the capture and recording (of vision and/or sound) in the studio. The suite can be integrated into the control room or can be a separate room. Various systems and specialised suites will be required for video, sound and film editing. The room should be fitted with ergonomically-designed workstations, task lighting and controlled natural light to improve user comfort. A small meeting space can also be included.

Machine room (or master control room)
A machine room should be provided adjacent to the control room to provide a location to house critical technical system infrastructure. The machine room layout should allow for equipment racks with access to the front, side and rear, to install, remove and service the equipment in each rack.

Dressing rooms
Each dressing room should be equipped with clothing racks, wig and makeup station, full length mirror, table with mirror, and lockers for storing clothing and personal belongings. A wardrobe preparation space with laundry and ironing facilities should also be provided.

A minimum of two dressing rooms should be provided capable of accommodating a minimum of four people. Each dressing room should allow a clear space of no less than 4sqm for each occupant and a minimum clear height of 2.4m. Lockers should be well ventilated, accessible and secure. There should also be a clear space of at least 1800mm between rows of lockers facing each other and at least 900mm between lockers and a seat or wall.

Dressing room layout should comply with accessibility standards and best practice, the National Construction Code of Australia (NCC) and the AS 1428 suite of Standards. Layout and design should consider the use of dressing rooms by ambulant disabled people and disabled users, and provide items such as drop-down support rails or a padded tip-up seat which can be fixed to the wall. Gendered and non-gendered options should be provided to accommodate both cultural preferences and non-binary gender identification.

Toilets and showers
Toilets and shower facilities should be provided immediately adjacent to the dressing rooms. Toilets should also be provided adjacent to or in close proximity to the green room for use by staff and crew members working in the studio.

The NCC sets out the specifications for toilets, as well as the ratio of male and female toilets to the number of occupants. Showers should have a floor area of no less than 1.8 sqm. A minimum clear height of 2.4m AFFL should be maintained in the toilets and showers.

Accessible toilets, showers and changing facilities should 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.

DEPARTURE GUIDANCE
Toilets, showers and dressing rooms are not a luxury for a TV and film studio. Activities within the studio can involve heavy physical movement and thus necessitate showers for users. TV and film studios also require discreet dressing rooms to change between daywear to costume as required.

Green room, including kitchenette
A green room should be provided as a quiet and comfortable space for artists and technicians to use when not engaged in activities in the studio. The green room should preferably be lit naturally and fitted with couches, chairs, tables, etc. A kitchenette should be included within or adjacent to the green room. Also consider providing a small private space adjacent to the green room for universal needs - For example: as respite for religious requirements (e.g. praying) or as a sensory break (e.g. for neurodivergent people). A minimum clear height of 2.4m AFFL should be maintained in the kitchenette and the green room.

A kitchenette is intended only for basic meal prep and reheating of pre-prepared meals. Basic provisions to include a large fridge, microwave, sink and instantaneous hot water boiler for efficient tea and coffee preparation. The kitchenette should also allow for food rinsing, utensil washing and the sanitary disposal of associated wastewater. There is no need to provide oven, stove and a dishwasher, unless specified by the operator or user groups. A reasonable amount of bench space and storage should be provided. Dual height counter surfaces should be considered to provide options for a wider range of users (very tall, short statures and seated users). The lower countertop is recommended to be adjustable or at 760mm fixed height.

Storage requirements
General storage areas adjacent to or within the TV and film studio should be provided and capable of storing:
— Height access equipment/ machinery and platform ladder, with consideration given to manoeuvring this equipment between storage and the studio
— Loose furniture such as folding tables and chairs

Secure storage adjacent to or within the studio should be provided, to safely store:
— Technical equipment associated with the room (recording equipment, AV control equipment, etc.)
— Tools and loose equipment associated with operation of the room
— High-value items belonging to users of the room

Technical equipment storage must be provided within or adjacent to the studio, and may be used for:
— Lighting equipment
— Audio equipment
— Video equipment
— Loose cabling

A cleaner's cupboard must be provided adjacent to or within the studio 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.)

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
The loading and unloading of equipment into the TV and film studio and/or the building in which the studio is housed should be carefully considered. A dedicated loading dock is not required to support this type of space, but a loading area sized for a large van or 3-tonne Pantech truck should be in close proximity to a nominated 'load-in door'.

The building's load-in door should be a minimum of 1.8m wide by 3m high to allow for large items and equipment destined for the TV and film studio. The load-in area should be level or gently ramped to allow heavy and wheeled items to be safely transported.
Circulation paths from the loading area to the TV and film studio should be step and obstruction free and have legible wayfinding signage. Doorways and accessways should be a minimum 1.8m wide. An appropriately sized elevator will be provided if the TV and film studio is situated above ground/ street level.

DEPARTURE GUIDANCE
Inadequate loading and circulation requirements can result in operational inefficiencies, unsafe practices, disturbance to neighbours, and loss of reputation and revenue. As such, load-in paths should avoid stairs, lifts, excess turns and bends, and uneven surfaces from the loading area to the studio or other areas.

Technical system design requirements

Key technical system design considerations and 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.

It will be important to consider technical spaces in relation to inclusion. 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, for 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.

Curtain system
Hand-operated curtain track systems should be provided around the perimeter of the studio. Black wool drapes with fullness should be provided to reduce the reflection of light and to aid acoustic control within the room.

Technical grid
Overhead rigging infrastructure should be provided above the entire rehearsal space to support the rigging of production equipment such as lighting fixtures, video projectors, LED walls, loudspeakers, curtains and scenic elements brought in for a particular production. These systems will be reconfigured regularly as per each individual user's requirements. 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 to 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, such as 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 500kg. Simultaneous loading of multiple points to support a distributed load will be required pending detailed design.

— **Building structure:** Any steel building structure within the TV and film studio should expose steel members (such as universal beams, steel trusses, etc.) 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.

Production infrastructure
Facility panels will be required, mounted to the ceiling and wall to interconnect the different production audio/ video/lighting systems across the studio. Facility panels provide an identifiable connection point for analogue and/or digital signal cables between various systems and locations within the room.
— Lighting: The production lighting system should enable the suspension of temporary lighting fixtures and associated temporary cabling to operate or control the fixtures via a system of dimmable and nondimmable channels to create a distinctive look for each shoot. The overall design and capacity of the infrastructure or systems is to be determined during the design phase in consultation with the operator, end-users and the lighting consultant.
— Video: Temporary production video system should include ceiling and wall-mounted infrastructure to support temporary video installation and control.

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

DEPARTURE GUIDANCE
The ability to easily access overhead rigging systems for hanging equipment (lights, drapes, scenery, etc.) allows for efficient bump-in and bump-out of rehearsals. If the structure of the building does not have adequate rigging features, it can introduce inefficiencies and complexities for temporary rigging of equipment and therefore make the space less desirable for users.

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.

Universal design considerations

Universal design acknowledges human diversity and difference. Universal design is user-centred, responsive to people's needs and enables 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, adapt to future changes and requirements and allow 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 by 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 current National Construction Code (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, designed to be calm and which avoid bold patterns that 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 door swings
— Inclusive presentation of information including options for visual, audible and tactile means
— Egress for all: considerations for an evacuation strategy that allows everyone to evacuate in a safe and equitable manner
— Provisions to allow a range of users to operate equipment in the studio (e.g. seated users operating TV cameras by providing height adjustable equipment)

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 small-scale TV and film studios are arranged within key themes below:

Greenhouse gas emissions
Victoria has a goal of being net zero by 2050. Small-scale TV and film studios should aim to reduce greenhouse gas emissions to support this goal by:

- Understanding and quantifying 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.
- Developing emissions reductions goals 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 and 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 where possible
— Minimising natural gas usage, replacing gas with electricity for cooking and heating wherever possible
— 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-stars (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
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 better sustainability performance and may contribute to sustainability ratings for the space.

Water management in small-scale TV and film studios should consider:
— Use of efficient fixtures and fittings with a WELS rating
— Monitoring water usage through on-site metering
— 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

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

Waste management
Waste is a source of greenhouse gas emissions and its disposal can result in costs for small-scale TV and film studios. Management of waste can reduce both emissions and costs, as well as improve operational efficiency. Waste includes single use items, food waste, waste associated with the fit out of the space and waste associated with the processes undertaken in the space.

Waste management in small-scale TV and film studios should consider:
— Application of circular economy principles in line with the Victorian DELWP's Recycling Victoria A new economy Plan:
  • Design to last, repair and recycle
  • Use products to create more value
  • Recycle more resources
  • Reduce harm from waste and pollution
— Obtaining a waste rating for the space or meet waste rating requirements if rating is not available (NABERS Waste)
— Setting targets to reduce waste production overall, from both construction and operation of the small-scale TV and film studio. This can be achieved through achievement of or alignment with Green Star Buildings v1 Operational Waste and Upfront Carbon Emissions credits
— Minimising hazardous waste (i.e. 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.
— 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
  • Having specific waste recycling or disposal options identified for non-standard materials used in the creation and production of artwork or sets
  • Educate staff on waste sorting
  • Providing signage and nudge mechanisms for staff, visitors and clients to promote waste sorting.
— Implementing 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.

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

Filming and set resources
Building temporary scenery and providing props and wardrobe can be very resource-intensive and can result in excessive waste and greenhouse gas emissions. A strategic approach to planning filming can improve operational efficiency and reduce the emissions and waste associated with each production.

Strategies to improve sustainability with respect to production or shoot materials include:
— Prioritise modularity and reusability for set construction, including walls, signage, hanging materials, floor coverings and lighting, to minimise waste generated and the need for virgin materials. Where possible, share set constructions and materials over several shoots or productions to maximise reuse
— Ensure that the studio's technical grid is adaptable to a diversity of uses
— Select set and costume materials for durability, reusability and recyclability, and ensure that adequate disposal options are available for materials that cannot be reused to achieve landfill diversion targets outlined above
— Select 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 considerations and requirements are outlined below:

Future flexibility
As defined in universal design considerations, flexibility of use of space is integral to the design of small-scale TV and film studios. 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 changing production setups
— Additional penetrations to allow for change of use and services reticulation without future structural implications

Floor loading
Load allowances for the small-scale TV and film studio 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.

Suggested overhead rigging 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 TV and film studio:

— Imposed load of 1 kN concentrated load per meter (in each direction) or
— Imposed load of 1 kPa uniformly distributed
— Imposed load of 5kN concentrated point load at any individual rigging point (simultaneous loading of multiple points to be rationalised and agreed during detailed design)

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 capacity should allow for rigging equipment and/or connections for aerial performances. Floors should allow for loads such as large set constructions, and should also allow for the concentrated loads of elevated work platforms for rigging point access.

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.

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 TV and film studio.

A column free space may be required to maximise flexibility 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.

Floor loading guidelines

USE OF SPACE	PERMANENT SUPERIMPOSED DEAD LOAD (kPa)	IMPOSED LOAD	
		UNIFORMLY DISTRIBUTED LOAD (kPa)	CONCENTRATED LOAD (kN)
Film studio, sound recording and control room	2.0	5.0	4.5
Comms. and storage	2.0	5.0	4.5
Plant	4.0	5.0	4.5
Post-production	2.0	3.0	2.7

Notes:
1. 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 typical lightweight partitions, finishes and typical services. Further allowances should be made if heavier finishes, partitions, etc. are desired in the space.

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.

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

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 of floor-to-floor heights is required to ensure services reticulation at high levels can pass under the floor structure above.

General guidance for penetrations through structural elements include:

- 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, 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.

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 floorplate when subject to an average person's walking frequency.

— **Walking frequency:** It is important to consider the spatial arrangement of the floorplate 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 could experience many uninterrupted steps compared to an area with regular obstacles such as desks and seats. Future flexibility of the photography studio 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
  - **Stairs:** 2.5–4 Hz
  - **Studio:** 2–2.5 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 an RF 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
Studio space	RF = 4

It should be considered in the design that more sensitive areas may suffer excessive vibration caused by vigorous walking in adjacent walkway or corridor areas. 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 studio areas with sensitive equipment to have limits on acceptable vibration levels.

Lighting design requirements

Key lighting design considerations and requirements are outlined below:

— Provide for shooting in natural lighting but allow for blackout curtains for flexible lighting. Studio should be located away from the public eye.
— Lighting should be controlled via DMX control system.

Lighting design
— Lighting system must be flicker-free to ensure flicker-free broadcasting.
— All luminaires must be supplied with electronic ballasts that enable smooth, flicker-free dimming.
— Colour temperature of fixtures should be 3000K or 4000K and consistent throughout. Lighting for broadcast presenters to be 5000-6000K.
— Luminaires should be concealed where possible and have a Unified Glare Rating (UGR) of 19 or lower.
— Colour Rendering Index (CRI) of luminaires should be 90 or higher.
— Luminaires should have a minimum offset of 1000mm from glazing between internal spaces, and narrow beam angle should be used to minimise glare and reflections and maintain visibility between spaces.

Lighting controls
— All lighting should be dimmable, with smooth fading from 0-100%.
— A local control or override should be provided so that creative teams can dim or black-out room lighting.
— Room lighting should be coordinated and controllable from the Building Management System.

Emergency lighting and exit signs
— AS2293 and NCC Section E4 compliant 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.

Electrical design requirements

Key electrical design considerations and requirements are outlined below:

Electrical requirements

— Incoming power supply to the TV and film studio and power supply authority power metering requirements to be developed based on incoming power supply to the building and as per local power supply authority requirements
— A dedicated distribution board must be provided for the TV and film studio 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 or adjacent to the studio to connect all specialist equipment and outlets
— General power outlets to be provided for the user ports and cleaners' outlets as required
— Facility panels including GPOs at grid level
— Distributed power and data (wall mounted)
— Separately metered power supply to be provided for the TV and film studio or adjacent to the studio as required
— Power provisions to be provided for the foyer, AV racks, toilets and other general areas as required
— Redundant/backup power supply provisions to be provided for specialist equipment and ICT services 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, flexible conduits or steel conduits to be used
— 24/7 access through electronic security
— Fit out with necessary technical equipment and infrastructure and connected to services including three-phase power and high-speed internet

The small-scale TV and film studio will require:

10A DGPOs distributed along the perimeter of the venue, and any mezzanine areas, for specialist production equipment
Facility panels, including GPOs at grid level with some 3-phase/single phase power provisions
Technical earth/clean power system for typical audio circuits
Lighting grid with power distribution • DMX distribution • HDMI, data, power • LCD screens • Mobile prompter monitors and camera
Clean power/technical earth system for all outlets in TV and film studio.

DEPARTURE GUIDANCE

As well as ensuring adequate electrical supplies, the distribution of power supplies is critical to success for small-scale TV and film studios. 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; and 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 in the sound recording space.

The small-scale TV and film studio will require:

High speed internet with separate appropriately sized communication rooms
Dedicated AV/comms. rack, switch and adequate data storage capability
Data outlets distributed throughout the venue
Internet connection to the AV/comms. 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 min. — External DBs: IP56 min.
Consumers mains	AS/NZS 3000 AS/NZS 3008.1	— Voltage drop: max. 2% — Max. 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 2.5mm² min. — Lighting 2.5mm² 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° — 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
— Room acoustics (e.g. reverberation, etc.)
— Internal acoustic separation, including spatial planning and physical isolation

DEPARTURE GUIDANCE
Low-noise environments are vital to the success of a TV and film studio. Building envelope design should avoid noise ingress from external noise and vibration sources and internal partitions often require heavy-weight/high performance construction to control noise transfer.

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 natural ventilation
Internal background noise and vibration levels	— Criteria relate to the noise and vibration in the space, excluding occupant activity — Subject to the broadcast/film video/audio standards/formats intended, specific acoustic targets and acoustic treatments maybe required. For general guidance, internal background noise levels, from both environmental noise intrusion and internal plant and equipment, should not exceed: • **Studio/control room/sound recording booth/post-production suite:** the lower bound design sound level range in AS/NZS 2107:2016 by more than 5dB. Refer to Studio Buildings > Film or Television Studios occupancy/activity in Table 1. • **Other spaces:** the lower bound design sound level range in AS/NZS 2107:2016 by more than 5dB. — Internal background vibration is not to exceed the maximum levels in British Standard BS 6472:2008 — Noise and vibration from lighting and camera equipment, if expected to be typical, should be considered
Internal acoustic separation, including spatial planning and physical isolation	— Noise control and privacy should be considered for internal partitions — Where the space is located above or below other tenancies, floor/ceiling sound insulation and footfall impact control measures must be considered. A box-in-box construction may be required. — Isolated constructions will be required between the studio, control room, sound recording booth and post-production suite to minimise both airborne and impact noise transfer between spaces. Where glazing is required, such as between the control room and studio, a higher level of sound transfer is expected. — Sound locks should be provided for all doorways to the studio, control room and sound recording booth — Masonry is recommended for live rooms for low frequency noise control — If glazing is required between above spaces, an angled double window is recommended for sound isolation and control of sound reflection — Cross-talk via building services systems must be controlled
Room acoustics	Subject to the broadcast/film video/audio standards/formats intended, specific acoustic targets and acoustic treatments may be required, including combination of absorption, diffusion and reflective surfaces. Requirements relating to finishes, layout and room shaping would require close coordination with the architect. General guidance includes: — **Studio/control room/sound recording booth/post-production suite:** in accordance with AS/NZS 2107:2016. Refer to Studio Buildings > Film or Television Studios occupancy/activity in Table 1. — For recording spaces, room acoustic requirements will be dependent on the type of sound recorded. For general guidance, reverberation times should not exceed: • **Music:** Curve 2 of Appendix A, AS/NZS2107:2016 • **Speech:** Curve 1 of Appendix A, AS/NZS2107:2016 — **Other regularly occupied spaces:** 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. Soft floor covering should be considered to reduce sound of movements in the sound recording booth, control room and post-production suite.

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 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.
— Consider high-temperature sprinkler heads where located around studio equipment with high heat output to limit risk of false activation.
— Where theatrical smoke may be used, the impact of false alarms due to a smoke detection system is to be considered. Isolation of a smoke detection system is non-compliant and would need to be supported via a Performance Solution which outlines an alternative strategy for detection of a fire and meets the Performance Requirements of the NCC. The impact of isolating the detection system would need to consider occupant evacuation, management procedures and initiation of active fire safety systems, such as smoke exhaust, that are required to be operated by smoke detection.
— 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 if provided.
— It will be important to consider the inclusiveness of the evacuation strategy, 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 service design considerations and requirements are outlined below:

— Domestic water and sanitary drainage are to be provided to any kitchens, showers and amenities, art sinks 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.
— As the kitchen will not be producing hot food, a trade waste grease arrestor is not required.
— 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 studio, sound recording booths, control rooms, machine rooms, post-production areas and any spaces likely to store sensitive 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 studio, sound recording booths, control rooms and post-production areas. Where this is not possible, acoustic treatment should be considered and pipework located in a way to avoid acoustic impact during routine maintenance or repair.

Additionally, 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
— 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 regulations and any fire engineering requirements
— 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	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

— For mechanical sizing, internal gains within the space should be based on metabolic rates to reflect predicted activity level within the space.
— 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.
— 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.
— Openable windows should be incorporated for passive temperature control where possible to allow for natural ventilation in low-load scenarios when the external temperature is acceptable.
— For spaces with a floor-to-ceiling height of 4–6m, minimum air change rate of 6 air changes per hour to 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).
— Mechanical system should be designed to meet acoustic requirements of the space.

Studio and green room

— A separate mechanical system should be provided to serve the TV and film studio and supporting rooms. The system should be activated as required to avoid unnecessary energy usage. Operation of the mechanical systems should be either programmed/manually activated (for the larger spaces) or based on occupancy sensing (for green room and smaller rooms).
— Mechanical systems should maintain an environment within specified values during times of use:
  • Temperature: 21°C to 24°C, with ability to change temperature criteria depending on space use to increase occupant comfort or 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)
— 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.
— All ductwork within studio to be above rigging zone or can be wall mounted as long as clashes with other services/uses do not occur.
— Ensure access to ductwork is maintainable, taking into account rigging infrastructure and associated production equipment 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.
— Air supply should be 'low velocity' to reduce noise, avoid drafts and avoid moving drapes/curtains
— Diffusers to be high induction to reduce drafts in space.
— The mechanical system requires appropriate treatment to meet acoustic requirements. The TV and film studio is an acoustically sensitive space so close coordination with the acoustic consultant is required.

Sound recording booth

— The Sound Recording Booth requires specific acoustic treatment to meet recording standards. The requirements of this room should be well-coordinated with the acoustic consultant.
— The following criteria applies:
  • Temperature: 21°C to 24°C, with ability to modify temperature criteria
  • 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)
— The HVAC system will need to accommodate the typical heat-loads generated by technical equipment in the space.
— Air conditioning system to provide comfortable conditions to occupants within recording booth. Due to size of the booth, select appropriate air-off temperatures for cooling and heating to ensure optimum comfort in the both (for high-level air supply, suggest minimum air-off in cooling of 14°C in small areas <10sqm).
— Consider displacement ventilation if sufficient floor void for enhanced acoustic performance and occupant comfort. Appropriate supply air temperatures with low dT should be selected to prevent occupant discomfort

— Close coordination with acoustic consultant to ensure HVAC system meets noise criteria. Review NC requirements of room and select appropriate equipment and provide acoustic treatment to meet target NC requirements.
— Fans should be selected to operate at lower turndowns to minimise noise regeneration.
— Diffusers should be selected to reduce regenerated noise.

Green room and kitchenette
— Provide sufficient exhaust ventilation to offset small heat gains from food preparation and dishwasher.
— If users require increased cooking facilities, consider provision of dedicated kitchen exhaust for grease and odour removal. Exhaust intake and discharge to be in line with AS1668.2 requirements.

Post-production suite, foyer, circulation, control room, machine room, dressing room
— Mechanical systems should maintain an environment within 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)
— 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 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 light objects within the space.
— Diffusers to be high induction to reduce drafts in space
— Dressing rooms should be adequately ventilated to dissipate glues, hair spray and other contaminants within the space. Dressing rooms should be negatively pressurised.

Storage spaces
— Storage rooms which house high value equipment and instruments may require humidity control, to be confirmed by major stakeholders, operators and user groups. Humidity and temperature sensors may be required for redundancy to ensure minimal deviation in room conditions. 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 to AS1668.2).
— Appropriate grilles and access panels should be incorporated if required within high value secure storage areas to maintain security.
— Major stakeholders to confirm plant redundancy requirements, temperature and RH conditions and maximum temperature/RH fluctuations allowed within storage rooms. Refer to AICCM (Australian Institute for the Conservation of Cultural Material) guidance as a baseline. Suggested 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°C to 25°C
  • RH to maintain 45% to 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% to 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 enclosed spaces. If the loading area is under cover, ventilation should be provided in line with AS1668.2.

Other areas
— Cleaner's cupboard to be exhausted directly to outside in line with AS1668.2 requirements.
— Ventilation of toilets and dressing rooms to be in line with AS1668.2 requirements (dressing rooms may be conditioned by a small FCU/PAC if desired to provide additional comfort for occupants). It is recommended that 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

ITEM	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): 35k Pa

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 100m
110	Chain saw at 1m
100	Inside disco
90	Heavy trucks at 5m
80	Sidewalk of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
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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