accessible
SCIENTIFIC
LABORATORY
DESIGN

UNIVERSAL DESIGN CONCEPTS FOR SCIENTIFIC LABORATORIES TO CREATE AN INCLUSIVE, SAFE AND FUNCTIONAL ENVIRONMENT FOR ALL.

UNLOCK YOUR FUTURE
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The Commonwealth Disability Discrimination Act (1992) makes it unlawful to discriminate against people with disabilities. As such, it is important that facilities within educational institutions that are used by students and staff be accessible to those who have a disability.

The 1998 Australian Bureau of Statistics survey, Disability, Ageing and Carers: Summary of Findings 4430.0 identified over 19% of the population as having a disability. Of those, almost 9% have experienced a restriction in schooling or employment.

In order that educational facilities and other government and non-government organisations meet access legislation requirements for people with a disability, it is strongly recommended that anyone planning new or upgrading existing laboratories refer to the latest Human Rights and Equal Opportunity Commission Advisory Notes on Access to Premises. These are available from the Human Rights and Equal Opportunity Commission at GPO Box 5218, Sydney, NSW, 1042 or on their website http://www.hreoc.gov.au

Throughout this publication reference is made to the Australian Standards series AS 1428, in particular AS 1428.1 and AS 1428.2, relating to access and mobility for people with a disability. At the time of publication, November 2000, only AS 1428.1 (1998) and some sections of other Standards referenced under the Building Code of Australia (BCA) were mandatory. It should be noted however, that the Australian Standards and the BCA are constantly evolving and should be referred to for any changes to standards cited in this document. It should also be recognised that the Australian Standards for laboratory design, particularly AS/NZS 2982.1 (1977), do not address the specific needs of scientific laboratory design to provide access for staff or students with a disability at the time of publication.

This publication has focused essentially on internal design. Reference should be made to AS 1428.1 (1998) and AS 1428.2 (1992) Design for Access and Mobility, together with AS 1735.12 (1994) Lifts, Escalators and Moving Walkways for access information on getting into buildings and between floors.

This publication goes beyond minimum design for access and attempts to provide design ideas for scientific laboratories which embrace, where possible, the concept of universal design. Universal design attempts to make the environment as useable as possible for as many people as possible in an inclusive (and seamless) manner.
Difficulties have been reported by staff and students when working in scientific laboratories. This publication was developed to identify particular difficulties faced by those using scientific laboratories and to provide a resource for those designing and modifying laboratories to reduce or eliminate identified barriers.

A literature search and review of existing Standards were carried out to establish current theory and practice in laboratory design. In addition, a survey of students with disabilities and staff in teaching laboratories was conducted to identify barriers. The experiences of students and staff formed a valuable platform upon which to develop the design guidelines within this document and their contribution is acknowledged.

Often during the planning of facilities the individual designer or architect responsible may have had little or no contact with people who have a disability. Many designers have never experienced the scientific laboratory environment. Some designers may lack the perception and understanding of the obstacles and problems faced by people with a disability. What may be considered a simple task for an able-bodied person, eg. turning a round doorknob to open a door, may be a very real obstacle for a person with poor grip. In an emergency situation such environmental obstacles may create life-threatening conditions (Mayer, 1995).

Space allocations, fixtures and fittings can no longer be based on standard criteria designed for able-bodied ambulant people. The facility manager and architect must be prepared to modify an entire spectrum of planning standards that affect the three-dimensional space within a building. Virtually all buildings must be designed (or remodelled and renovated) to provide access to, and accommodate, all persons including those with sensory, neurological, physical, psychiatric or other disabilities. (Mayer, 1995).

Teaching laboratories should be planned, designed and constructed to provide a safe working and learning environment for staff and students. They should be designed to demonstrate and encourage safe practices and operations because a disregard or ignorance of safety at the student stage may be carried over into the professional work that follows schooling (Diberardinis et al, 1993).

The design of a laboratory must ensure people with disabilities are able to engage in safe practices eg. reach and access safety equipment.

In the past, some designers have tended to rely heavily on standard layouts, such as the modular design, which may not take into account the needs of students and staff with disabilities.

Planning criteria mandated or implied by accessibility regulations and standards affecting space allocations may include:

- Access to emergency eye and face washers, deluge showers, fire blanket cabinets and fire extinguisher locations.
- Clearances between work benches, equipment and aisle widths between modular and rolling storage shelving units.
- Hallway widths, ramps, stairs, lifts, horizontal and vertical egress, railing heights, dead-end limitations and areas of refuge.
- Types of doors (swinging, sliding), clearances, corridor/hallway rest areas, approach and access to doors, door openers and closers, door assist mechanisms and types of door hardware.
- Heights of workbenches, equipment (fume hoods, biosafety cabinets, autoanalyzers, etc), wall shelves, desks, filing cabinets and other furniture. Not all people with a disability use wheelchairs. Certain disabilities preclude the person from assuming a seated position because of leg braces, back pain and other factors. There should be a choice of workspaces for those who sit or stand.
- Protruding objects, overhead hazards, overhanging objects, drinking fountains, hallway and lobby display cabinets and fire extinguishers can be a danger for general flow of traffic and for those with diminished vision.
• Reach extension for persons in a wheelchair or with other disabilities.
• Wheelchair manoeuvring clearances, accessible routes, corridor/hallway resting spaces or alcoves and lifts (Mayer, 1995).

Internal organisation of a laboratory building is comprised of six major patterns of spatial definition:
• Circulation of people and materials
• Generic laboratory modules
• Distribution of mechanical equipment and services
• Structural system
• Site regulations
• Building enclosure configration (Diberardinis et al, 1993).

A comprehensive concept is needed to fulfill building program requirements to optimise function, safety and flexibility. Health and safety issues of circulation are primarily concerned with:
(a) emergency egress of building occupants and
(b) access to the building and its internal parts by emergency personnel.

Access and Emergency Evacuation
Special attention should be given to ease of access and emergency evacuation for people with a disability. No architectural barriers should be designed and constructed at main entrances to buildings, other doorways, public toilets, lifts, drinking fountains or public telephones. Alarms, warnings, and controls detectable by all people are required (Diberardinis et al, 1993). Both auditory and visual alarms are required to ensure those with vision or hearing impairments can detect a warning.

The laboratory layout is critical for the efficient use of space and the safety of laboratory personnel. This includes provisions for entry and egress, furniture and equipment locations and access for people with a disability. Consideration of safety issues in the planning and schematic design phases of a project saves owners and users from the cost of corrective modification during or after construction or from living with the continued liability of built-in safety hazards. Neglect of safety considerations in design phases can lead to laboratories containing needless hazards to health and safety (Diberardinis et al, 1993).

Internal Layout
The design team establishes zones in a laboratory by the way the benches, utilities and major fixed equipment are located. Laboratory benches, desks and other furnishings must be designed and located to facilitate ease of egress and ease of travel within the laboratory. (Diberardinis et al, 1993).

Formulation of the internal organisation of the laboratory building begins with a decision on the dimensions of the laboratory module. Time/motion studies (Nuffield, 1961 cited in Diberardinis et al, 1993) have led to specifications for optimal dimensions for a standard laboratory aisle that were derived from ergonomic factors related to reaching across and above work surfaces. The laboratory aisle is a space, usually flanked by an array of work surfaces, equipment, benches and utilities, where laboratory personnel have access to the work area (Diberardinis et al, 1993).

The above specifications do not, in the main, take into account people with disabilities.

Teaching laboratories, wet or dry, require a maximum number of workstations in a minimum area. In spite of the pressure to maximise use of all available space, benches should be located so that easy, multidirectional movement and egress are maintained. Ease of movement is needed to facilitate getting to and from supply points or rooms, shared instruments and fume hoods. In addition, staff must be able to move about freely, to see all areas, and to provide quick response to emergency situations. Wall benches and island benches permit such movement. Island benches for teaching laboratories are recommended for classes of twelve or more (Diberardinis et al, 1993).

Research from the United States of America shows 3 square metres per student is an absolute minimum for a teaching laboratory. This does not take into consideration students who may be in a wheelchair (see later dimensions considered appropriate for accessibility). This minimum should only be considered when other aspects of the design allow ideal placement of fume hoods, adequate circulation when the room is fully occupied and rapid and easy egress in case of emergency. Consideration must also be given to adequate areas for storage and clean up.
Dibardinis et al (1993) states that by the time floor space per student reaches 6.5 square metres there is room for design flexibility. Once again, students or staff in wheelchairs were not considered when determining these dimensions.

**Benches**

Centre room benches may be of the island type with aisles on all sides making it possible for personnel to move around the bench quickly to reach emergency equipment or an exit (Dibardinis et al, 1993). Educational laboratories often have island work benches, generally with a sink at one or both ends. Depending on room size, a peninsula arrangement could save considerable cost with no loss in efficiency (Rosenlund, 1987). Ease of access is required for those with mobility impairments in which case a peninsula arrangement may not be ideal if alternative work areas are not provided.

Laboratory benches should be made of sturdy materials that have finishes that can be repaired easily. AS/NZS 2982.1 states that benches be finished with a material that is smooth, impervious, resistant to chemicals used in the laboratory, scratch resistant, easy to clean, anti-static where appropriate, glare resistant and free of joints where possible or with joints sealed. Bench tops should be level and stable for the heavy equipment and instruments that may be placed on them.

**Aisles**

Major aisles between benches or equipment should have adequate space to allow for safe passage. (Nuffield, 1961, cited in Dibardinis et al, 1993). Distance between benches when students work back to back must be greater otherwise safe circulation is not possible for students and staff who might be carrying chemicals, equipment or other materials. Major aisles between equipment or benches should be aligned in the direction of egress (Dibardinis et al, 1993).

Knee spaces should be provided along laboratory benches to permit students or staff to sit comfortably and safely for long periods. With this arrangement, their feet can be placed on the floor or on a foot ring of a stool to maintain a balanced, upright posture while working. A person seated with knee space provides more area behind for people moving in the aisle, and when empty, the chair or stool can be pushed all the way into the knee space to further reduce aisle obstruction.

**Fume Hoods and Equipment**

The most important consideration in the layout of a general laboratory, such as chemistry, is safely locating the number and sizes of chemical fume hoods required. In laboratories where multiple fume hoods are needed, a side by side arrangement at the rear of the laboratory should be considered. If only two fume hoods are needed, one hood on each sidewall toward the rear of the laboratory would be acceptable. To reduce traffic in front of the hoods, commonly used instruments, supplies, and less hazardous resources should be located at the ends of benches toward the instructor's demonstration table. This arrangement increases student circulation in the less hazardous sector of the laboratory (Dibardinis et al, 1993).

**Storage**

Base storage units that are secured to the bench on cantilevered or suspended frames should be secured so that they will not move when carts or equipment make contact against them. Base storage units that are mounted directly on the floor are more stable and do not amplify floor vibrations to the bench top.

Equipment and materials in most teaching laboratories are used by more than one group of students. Materials from one class are generally cleaned up and stored, the benches cleaned and the area set up for the next class. Therefore, providing adequate secure and safe storage is a particularly significant issue for teaching laboratories (Dibardinis et al, 1993). However, if students are required to access and set up equipment themselves, storage needs to be easy to access for those with disabilities.

**Working Heights**

For people with disabilities working in a laboratory, some accommodations in working height and storage components may be required. Hand wash sinks that meet accessibility standards should also be made
available in laboratories (Diberardinis et al, 1993). At least one seated workstation is recommended in every laboratory. Seated work areas should be especially considered in laboratories where microanalytical techniques are used. With the increased use of microchemistry analytical techniques, careful consideration should be given to individual student workstations. For example, workstations are better designed for the student to be seated rather than standing where greater manual precision is needed. A seated position with both feet on the floor improves balance, postural stability and manual precision. When workbenches are low, to permit work while seated, the aisle should be wide enough for students seated back to back to push back their chairs and still leave room for staff and other students to pass. The aisle needs to be wide enough for a wheelchair to be pushed back from the bench which takes a greater amount of space than a standard stool or chair.

A variety of surface heights are suggested, as not only those in a wheelchair require a seated position.

Doors

There are many specific requirements for laboratory entry and egress. The safest arrangement for a laboratory is for each required exit to open into a separate fire zone and for each to be located so that the internal pathways to it are separated. Exit doors should swing in the direction of egress because persons being pushed against them by those in a panic cannot block an outswinging door. To make certain that egress corridors will not be blocked by open doors, outswinging doors should be recessed sufficiently so that the door does not protrude more than 18mm into the clear width of the corridor when fully open. There should be a minimum of two exits from each teaching laboratory, with each exit opening into a separate fire-safe egress.

According to American guidelines, glass panels of 0.8 square metres or less are permissible in B-labelled fire-rated laboratory exit doors, normally used in one hour fire-rated corridor patterns. Glass panels in doors help prevent collisions of persons entering and exiting. The glass should be placed low enough that persons of less than standard height or those in wheelchairs can be seen from the other side of the door (Diberardinis et al, 1993).

Standards concerned with removal of architectural barriers in buildings specify lever action handles for workplace doors because levers are easier to activate than round doorknobs in emergencies. Furthermore, the firm downward motion to release the latch does not require the use of hands. Standards also limit the pressure required to open doors (Diberardinis et al, 1993).

The minimum width dimension for exit doors is 850mm but to facilitate the movement of equipment and trolleys in and out of laboratories, wider doors are suggested.

Safety

A laboratory safety station is an arrangement, and installation of, safety and emergency response equipment that is designated for each laboratory. The emergency eyewash fountain, deluge shower, fire extinguisher, fire blanket, safety goggles and protective glove dispensers, shoe cover and protective garment supply, chemical spill kit, first aid kit and assisted respiratory apparatus are some of the items that a laboratory safety station may accommodate. The laboratory safety station also has a bulletin board or other place dedicated for display of safety regulations and announcements. A safety station location that is consistent from laboratory to laboratory offers greater security to laboratory staff and improves emergency response time and effectiveness. The primary laboratory entry is an excellent location for the safety station because of the high visibility of that location where laboratory users pass by it daily (Diberardinis et al, 1993). All students and staff need access to the safety station and its contents including those with disabilities. Placement of items must be within reach of someone of short stature or in a wheelchair.

If a person with a disability works, studies, or teaches in a laboratory, all parts of the laboratory and its emergency equipment should be accessible.
current laboratory designs
in educational settings

The following photographs illustrate various laboratory designs.

Bench too high, inadequate under bench depth for footplates, inaccessible sink, cupboard handles difficult to operate.

No under bench access, some controls out of seated reach range.
INACCESSIBLE EQUIPMENT INCLUDING SAFETY EQUIPMENT.

POOR SEATING, INACCESSIBLE EQUIPMENT FOR WHEELCHAIR USERS, BENCH TOO HIGH.

BENCH TOO LOW FOR STANDING WORK, INACCESSIBLE UNDER BENCH SPACE FOR SEATED USER.
current laboratory designs

LEFT: INACCESSIBLE TAPS AND WORKBENCH FOR SEATED PERSON, POOR SIGNAGE. INADEQUATE WHEELCHAIR FOOTPLATE ACCESS.

ABOVE: COMPUTER WORKSTATIONS AND BENCHES ARE NOT WHEELCHAIR ACCESSIBLE DUE TO HEIGHT AND FOOTPLATE CLEARANCE.

A MORE MODERN LABORATORY. LEVER TAPS BUT SINK INACCESSIBLE FOR A WHEELCHAIR. ADJUSTABLE HEIGHT SEATING BUT THE BENCH FRAME PREVENTS WHEELCHAIR FOOTPLATE ACCESS. SOME CONTROLS ON THE BENCH OUT OF REACH RANGE FOR A SEATED PERSON.
**staff & student survey of laboratory difficulties**

Students with a disability at the University of Western Australia who used scientific laboratories were surveyed to identify particular difficulties they experienced. Participation was voluntary and only those students registered with the disability office were included. The type of disability varied and was considered representative of the population of students with disabilities at the university.

Laboratory technical staff who have contact with students with a disability were also surveyed. Staff surveyed had the opportunity to observe situations that repeatedly caused difficulties. The laboratories represent a range both in age of the facility and in design, from zoology to chemistry and engineering. Eight types of laboratories were included.

### Laboratory difficulties

The following are the major difficulties identified. *(Students: n = 19) (Staff: n = 16)*

1. **Moving About the Laboratory**
   - **Students:** 5% had difficulty.
   - 10% had difficulty but managed if adjustments were made.
   - **Staff:** 63% of staff replied they had observed problems with students moving around the laboratory.
   - 30% attributed it to overcrowding.

2. **Bench Heights**
   - **Students:** 31% experienced some problems.
   - The situation would be remedied if bench heights were adjustable.
   - **Staff:** 63% of staff have observed some difficulties.
   - 38% have made alterations to equipment.
   - The most common problem stated was that benches were not adjustable.

3. **Seating**
   - **Students:** 47% of students commented that chairs/stools were not adjustable.
   - Most students indicated that ergonomic chairs would be preferable.
   - **Staff:** 44% said that adequate seating was a problem.
   - 43% had adjustable chairs for their students or were upgradiing to more suitable seating in the near future. Most staff indicated that ergonomic chairs would be preferable.

4. **Taps/Sinks**
   - **Students:** 21% had difficulty turning taps on/off.
   - 2 students had problems reaching taps (i.e. in wheelchairs).
   - Difficulty with turning taps on/off was mostly due to pain or dexterity problems.
   - **Staff:** 56% of staff commented that taps were not levered. Of these;
   - • 25% said equipment was suitable for the laboratory.
   - • 50% had problems with sinks.
   - Sinks were found to be too high, small or hard to access.
5. Getting/Setting up Equipment and/or Instruments

Students: 47% had some difficulty getting equipment. Of these;
• 66% required assistance.
• 42% experienced problems setting up equipment.

Of these;
• 25% had problems with fine motor skills.
• 25% said that trolleys would be beneficial.

Staff: 25% of staff encountered problems with students getting equipment.
38% said that the type of laboratory reduced the number of problems (eg. whether it was an agriculture laboratory with permanently set up microscopes or biology laboratories with all microscopes stored in underbench cupboards).
31% of staff mentioned that assistance was available upon request. Problems with getting/setting up equipment were generally related to the weight or position of equipment.

6. Using Equipment

Students: 32% of students had difficulties of some nature when using equipment. Problems mainly concerned microscopes and (lack of) fine motor skills.

Staff: 37% had observed or could foresee difficulties with use of equipment. Of these;
• 52% mentioned dexterity as the cause.
• 35% were problems related to use of microscopes.
Problems were with microscopes and (lack of) fine motor skills.

7. Viewing Demonstrations

Students: 10% commented that they were unable to sufficiently observe demonstrations. The problem was with small laboratory size and/or large number of students.

Staff: 25% had experienced some difficulties with students being unable to see demonstrations. One technician overcame the problem by using closed circuit video to show demonstrations. The problem was with large numbers of students.

8. Managing Information: Seeing/Hearing Instructions

Students: Only one student surveyed had a problem (laboratory was very large).

Staff: None observed.

9. Managing Information: Writing

Students: 47% experienced difficulty writing. Of these;
• 44% only had difficulty if writing for a long period of time.
• Other students had difficulty keeping up with instructions.

Staff: None observed.

10. Provided Assistance

Students: Not applicable. This question was misinterpreted, as it was intended to identify if the students HAD received assistance. Disability Officers reported they had arranged assistance for students including one to one demonstrators.

Staff: 31% had made some alterations/adjustments to equipment in the laboratory to assist students.
staff & student suggestions
for improved design

1. Design Ideas/Suggestions

Students: The following suggestions were made;
- adjustable/ergonomic chairs (53%)
- adjustable benches (21%)
- levered taps/other equipment (21%)
- wider aisles between benches (16%)
- trolleys to move equipment (15%)
- more bench space (10%)
- microscope design (angled eye pieces) (10%)
- lifts for accessibility (5%)
- fatigue matting for standing work areas (5%)

Staff: The following suggestions were made;
- adjustable benches (44%)
- installation of ramps (31%)
- widen doorways/automatic doors (31%)
- wider aisles between benches (15%)
- shelving insufficient/too high (19%)
- laboratory space/ventilation (19%)

2. Other Comments

Students: The following comments were made;
- demonstrators are not willing to change.
- adjustable equipment must be anchored for safety reasons.
- some departments have ergonomic furniture and others do not.

Staff: The following comments were made;
- are accessible toilets really accessible?
- lift access is a necessity.
- modifications need to be utilised by all students.
- laboratories are generally not set up for students with disabilities.
**Doorways**

Doorways should have a minimum clear opening space of 850mm. Doors should be clearly defined by contrasting frame or trim. (AS 1428.2 Clause 11.5.1)

There should be no thresholds at doorways.

Circulation spaces of doorways need to comply with AS 1428.1 except 100mm should be added to all length (L) values and 50mm to all width (W) values to meet AS 1428.2 Clause 11.5.2 enhanced standards.

Reference should be made to AS 1428.1 Figure 12 as the specific dimensions vary depending on the orientation of the door. An example is a latch side approach to a hinge door opening towards the user. The clear space length into the room would be 1670mm, width of 660mm on the hinge side and 860mm on the latch side.

Double leaf doorways need one leaf that complies with the opening space (850mm) and be an active leaf. (AS 1428.2 Clause 11.5.3)

**Doors**

**Door Glazing**

Glazing in joinery or flush doors should be not less than 300mm and not more than 1000mm above the finished floor surface. The upper edge of the glazing should not be less than 1600mm above the bottom edge of the door. In width, the glazing should not extend more than 200mm from the latch edge of the door and be not less than 150mm wide. Glazing is useful for people with disabilities as it provides a view of someone approaching the door from the other side and vice versa. The lower perimeters of the glazing are to prevent the footplate of a wheelchair contacting the glass. (AS 1428.2 Clauses 11.6.1, 6.2)

**Door Controls**

Door handles must comply with AS 1428.1. They should be mounted 900 - 1100mm from the finished floor surface (1000mm preferred).

Operating mechanisms - unlocking/locking and opening of the door - must be operable with one hand and not require tight grasping, pinching or twisting of the wrist. Lever handles are preferred. Handles shall be clearly identified by colour contrast to the door with a luminance contrast of not less than 30%.

Where an outward opening door is not self closing, a horizontal hand rail or pull bar should be fixed on the closing face of a side hung door. Unless required by a regulatory authority, door closers should not be used. The problem posed by door closers is the initial resistance at the commencement of door opening. Where a regulatory authority requires door closers, delayed action closers and rising butt hinges are recommended (AS 1428.2 Clause 23). Where door closers are installed the force to operate shall not exceed 19.5N to initially open the door, 6N to swing the door and 7.5N to hold the door open (AS 1428.1).

Electronic door openers or electronic push button/ touch pad over-ride devices to manual doors are preferable.
Circulation Spaces Within The Laboratory

Note: AS/NZS 2982.1 (1997) Laboratory Design and Construction Part 1: General Requirements, minimum width for working spaces does not provide for a wheelchair user. The following are the minimal requirements to accommodate wheelchair users or those using certain other mobility devices. The following is based on AS/NZS 2982.1 (1997) in combination with circulation spaces from AS 1428.1.

For students to access a sink or equipment at the end of a work bench in an aisle, i.e. a 360 degree wheelchair turn, 2250mm by 2250mm space is required. For access between work benches, 2070mm is required. This provides for through traffic when a wheelchair user is working under a bench with or without through traffic or with or without an ambulatory person working opposite, and also allows for a 180 degree turn (AS 1428.2 Clause 6).

Circulation spaces should be free of obstructions.
key design features

BENCH HEIGHTS FOR SEATED OR STANDING WORK
(cited from AS 1428.2, 1992)

Bench Heights

No individual bench top will suit all people. A laboratory should, however, offer bench space suitable for wheelchair users or other users who for various reasons need to sit at a non-standard desk height bench. An adjustable height bench is preferable. Adjustment mechanisms and fully adjustable height desks, which can have customised sized tops, are available from office furniture manufacturers. These can be manually or electrically operated.

AS/NZS 2982.1 suggests a work surface height of between 700 - 750mm for seated work and 900 for standing work.

The seated height however is not suitable for a wheelchair, which requires a height to the underside of the bench of 730mm to 870mm depending on the wheelchair (AS 1428.2). As can be seen there is quite a range required. This is the reason for an adjustable surface in each laboratory. Note: these heights are from the floor to the underside of the bench. For a wheelchair user the under bench width for leg space is 800mm and depth is 640mm minimum (AS 1428.2 Clause 24.1.4).

Storage

AS/NZS 2982.1 suggests the height of the top shelf not exceed 1700mm and top of a cupboard not exceed 2200mm. Depth of storage cupboards should not exceed 500mm.

The range of reach for a person in a wheelchair where there is no clearance under a shelf for a forward reach i.e. requiring a sideways reach is 230mm to 1170mm from the floor surface. This is the maximum range for a person without upper limb impairment (AS 1428.2 Clause 22). The upper height range for AS/NZS 2982.1 exceeds the reach range for a seated person.

Retrieving items from under bench cupboards is extremely difficult for many people with a disability - not just those in wheelchairs. A solution is to have deep slide out drawers to reduce bending and reaching. Drawers and cupboards should have easy to use handles such as large 'D' shaped handles.
key design features

Sinks

A clear space under the sink of 500mm from the front of the sink is required for wheelchair footplates at a height of 290mm from the floor. The top of the sink should be 800mm from the floor and the distance from the front of the sink/bench to the rear of the sink or wall/bench, 500mm (AS 1428.2 Clause A5).

NOTE: EQUIPMENT MAY BE LOCATED WITHIN THE BROKEN LINE.

(cited from AS 1428.1, 1998)

LEVER HANDLE SINK TAP SET. LABORATORIES ARE REQUIRED TO HAVE SEPARATE HOT AND COLD TAPS.

A CUPBOARD WITH DEEP PULL OUT DRAWERS CAN READILY BE INSTALLED IN LABORATORY UNDERBENCH STORAGE SYSTEMS.
key design features

SAFETY EQUIPMENT
CONTROLs WITHIN REACH OF A SEATED PERSON
(Dimensions adapted from AS 1428.2, 1992)

Taps
Taps shall be capstan or lever style. Lever is preferable for those with limited hand function.

Fume Hoods
Fume hoods should have a clear space underneath for wheelchair footplates and be at a height suitable for a seated person to use, i.e. between 750mm and 850mm to the underside from the floor. If a number of fume hoods are in a laboratory one accessible for a seated person should be adequate. Bench top fume hoods that can be mounted on adjustable tables to provide flexibility are available.

Other Controls
Consideration should be given to mounting controls on the front of the bench or within the forward reaching range of less than 550mm from the front of the bench. Ease of grip and strength required to use the controls should be also considered.

Safety Equipment
Safety equipment such as eyewash and safety showers should be between 800mm and 1100mm from the floor (AS 1428.1) and within reach of a person in a wheelchair or someone of short stature.
key design features

Alarms
Fire and other alarms should be both visual and auditory to accommodate those with a vision or hearing loss. Whilst students are unlikely to be in laboratories alone, graduate researchers and staff are likely to be working alone or out of hours (AS 1428.2 Clause 18).

Lighting
AS/NZS 2982 recommends lighting according to AS 1680.1.
AS 1680.2 suggests 200 lx without glare for countertops and up to 300 lx for general displays. For fine or precision work to accommodate those with some vision impairment, 250 lx to 300 lx is suggested.

Signage
It is recommended that signage follow the suggestions in the publication 'This Way: Guidelines for Effective Signage in Public Buildings' by Jaye Johnson, Published by the City of Joondalup, Western Australia, 1999.

Key Points To Consider
- Signage style - ease of readability eg. font, size, colour.
- Use of symbols - can enhance signage effectiveness.
- Shape of signs - preferred width to depth ratio between 1:1 and 3:5.
- Lighting - well lit and non reflective.
- Position - oriented at key points of travel, decision making junctions or gathering of people.
design of an accessible laboratory

This laboratory design for 33 students illustrates good circulation space, various work heights, accessible sinks with lever taps, accessible fume hood, accessible safety equipment. It also illustrates a solution to improve student's observation of demonstrations with the lecturer on a raised area and camera projection of the activity.
circulation spaces
summary

As can be seen, current texts and standards on laboratory design pay little or no attention to the provision of access for students, teachers or other employees who have a disability. Over 19% of the population have a disability and the recent demographic study of students with a disability in post secondary education indicates the numbers of students with a disability in both secondary and post secondary education are increasing.

It is a requirement that staff and students who wish to participate in laboratory activities have access to all facilities. Although the current AS 1428.1 states students must have access to one of each type of laboratory, rescheduling of classes is not always possible. It is far preferable that in the initial construction of laboratories, the design be flexible enough to accommodate the needs of all future users. It is well documented that in the construction stage this need not necessarily add to the cost. Modification of an inaccessible laboratory after construction can, however, be both expensive and structurally difficult.

Good design not only accommodates the particular needs of people with a disability, but also vastly improves the useability of the laboratory for all.

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references
