

P28

3. STANDARDS The purpose of a 'Standard' is to set the

_____ LEGAL _____ requirements for the design and use of products and provision of services without stifling innovation or placing barriers on trade between enterprises, states or countries. Standards are frequently called up by a _____ Government _____ regulation, and when this occurs they, in fact, become part of the regulation and must be complied with. _____ Penalty _____ apply to those who don't comply.

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4. REASONS FOR THE AS3000

The wiring rules (AS3000) was first published in 1923, and has grown and developed over the last _____ 70 _____ years. There are normally new issues when there is a jump in technology or after an error that results in a death is found. It is compulsory for electricians to carry out work in accordance with the regulations, standards and codes. There are a number of reasons why all electricians follow the AS3000:

- Legal obligation: fines, loss of licence and _____ Penalty _____ time (in case of electrical deaths)
- Cost: to re-do or pay any electrician to redo unsafe or unsatisfactory works, loss of business (due to bad name), loss of livelihood (no licence), increase insurance premiums, and court fees.
- Personal: _____ Injury _____ Properties damage _____ of causing death, fire, etc.
- Advantage of easy determination of appropriate materials, design, estimating, planning and execution.

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Codes of practice

□ An approved _____ industry code of practice is a practical guide to employers and others who have duties under the OHS Act 2000 and the OHS Regulation 2001 with respect to occupational health, safety and welfare.

□ These are issued and administered by _____ authority _____ and apply the wiring rules to particular industries. Relevant electrical industry codes of practice include:

- Code of Practice – Low Voltage Electrical Work
- Code of Practice - Electrical Practice for Construction Work
- Additional requirement to AS 3000

□ Ensure the installation conforms to the requirements of the supply authorities' reticulation system and the supply authority's equipment.

□ Generally do not affect sub-circuit cabling, although local authority rules may still apply (service and metering equipment.)

5. SCOPE OF AS/NZS 3000:2007

The scope of the standard is stated in clause 1.1. Open your book to page 21 and copy the clause to your notes.

1.1 SCOPE

This Standard sets out requirements for the design, construction and verification of electrical installations, including the selection and installation of electrical equipment forming part of such electrical installations.

These requirements are intended to protect persons, livestock, and property from electric shock, fire and physical injury hazards that may arise from an electrical installation that is used with reasonable care and with due regard to the intended purpose of the electrical installation.

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7. STRUCTURE OF THE SECTIONS In simple terms, the AS3000:2007 is, like most books, broken into chapters. However the chapters are called Sections, and each section deals with a particular aspect of the electrical industry.

Open to page 9 of the SA3000 and write down the heading of each section of the wiring rules:

Part 1: Scope, application and fundamental principles

SECTION 1 SCOPE, APPLICATION AND FUNDAMENTAL PRINCIPLES

Part 2: Installation practices—Sections 2 to 8

SECTION 2 GENERAL ARRANGEMENT, CONTROL AND PROTECTION

SECTION 3 SELECTION AND INSTALLATION OF WIRING SYSTEMS

SECTION 4 SELECTION AND INSTALLATION OF ELECTRICAL EQUIPMENT

SECTION 5 EARTHING ARRANGEMENTS AND EARTHING CONDUCTORS

SECTION 6 DAMP SITUATIONS

SECTION 7 SPECIAL ELECTRICAL INSTALLATIONS

SECTION 8 VERIFICATION

APPENDICES

9. TYPEFACE SYSTEM OF THE AS3000

Since the AS3000 is a _____ Rule _____ book under the law of Australia, it is written in legal terms in "lawyers speak". Certain words have a _____ specific _____ legal meaning under the law. No matter what you would like the word to

mean, its' legal meaning will be used in ____practice_____. The same can be said about the typefaces (**bold**, normal, *italic*, etc). Typefaces are how the letters and words are printed on the pages.

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10.FINDING THE RIGHT CLAUSE IN THE RULE BOOK

1.Using the contents

Many electricians prefer to use the _____Index_____ to find the correct clause number and then the necessary information. The contents shows the logical format of the book and can be helpful in increasing your electrical vocabulary. The following steps will assist you in using the contents.

4.Turn to the _____Index _____clause and scan the clauses listed until the specific information required is located.

2.Using the index to find a clause

The index can also be used to find the correct _____Clause_____ related to an installation. The index contains a list of **key words** in alphabetical order. The following steps will assist you to use the index.

P36 to 38

4.What is a *distribution* board?

Clause number:_____

Answer:_____

distribution boards App K3.3, K8.1, K8.2

definition 1.4.46

1.4.46 Distribution board

A switchboard other than a main switchboard.

Distributor, electricity (see Clause 1.4.57 Electricity distributor).

Domestic electrical installation (see Clause 1.4.53 Electrical installation, domestic).

5.What is the general requirement of a main switch?

Clause number:_____

Answer:_____

main switches 2.3.3

2.3.3 Main switches

* 2.3.3.1 Introduction

The following requirements are intended to provide for the—

- (a) efficient and effective isolation of electricity supply from the electrical installation, or part thereof, by persons, including emergency services personnel, in the event of an emergency arising that requires prompt isolation; and
- (b) maintenance of supply to safety services during an emergency that may require, or result in, isolation of supply from other portions of the electrical installation.

6. How should circuit breakers be oriented on a switchboard?

Clause number: _____

Answer: _____

2.5.3.2 Position of overload protective device—General arrangement

In accordance with Clause 2.5.1.3, a device providing protection against overload shall be installed at the origin of every circuit and at each point where a reduction occurs in the current-carrying capacity of the conductors.

7. What is the definition of a *fuse*?

Clause number: _____

Answer: _____

1.4.68 Fuse

A device for protecting a circuit against damage from an excessive current flowing in it by opening the circuit on the melting of the fuse element by such excessive current. The fuse comprises all the parts that form the protective device.

8. What are the requirements for the location of the *earth electrode*?

5.3.6.4 Location

Earth electrodes shall be installed in a location that satisfies the following conditions:

- (a) The electrode maintains effective contact with moist soil that is not subject to excessive drying out.

NOTE: This condition is deemed to be satisfied by locating the electrode—

- (a) external to the building in ground that is exposed to the weather; or
- (b) in other locations where the ground remains moist because of soil conditions or covers that reduce loss of moisture.

(b) The electrode is separated from conductive enclosures of other buried services, such as water, gas, telecommunications and flammable liquid, in order to reduce possible electrolytic action affecting the electrode or the other service.

NOTE: Separation distances are specified in Table 3.7.

(c) The main earthing conductor connection to an electrode is accessible, in accordance with Clause 5.5.1.2.
The location of the earth electrode shall be identified at the main switchboard.

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9. Which section covers testing and verification of electrical installations?

Clause number: _____

Answer: _____

verification 1.8, 8.1.2

Section 8

10. When and why would a visual inspection of an electrical installation be carried out prior to completion of the installation?

Clause number: _____

Answer: _____

8.2.1 General

A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of this Standard.

The visual inspection shall be carried out before, or in association with, testing. The visual inspection should, where practicable, be made before the relevant part of the electrical installation is placed in service.

Exception: Where the visual inspection of a part of the electrical installation

is not practicable at the completion of the work, e.g. not accessible because of enclosure in the building structure, consideration should be given to inspecting that part during the course of the installation

11. What are the six sub-clause headings from the check list for visual inspections?

Clause number: _____

Answer: _____

8.2.2 Checklist

The following items shall be checked, where applicable during the visual inspection, to assess that the relevant requirements of this Standard are satisfied:

(a) General:

(i) Basic protection (protection against direct contact with live parts), e.g. insulation and enclosure.

(ii) Fault protection (protection against indirect contact with exposed conductive parts), e.g. by the use of automatic disconnection of supply, double insulation or isolating transformers.

- (iii) Protection against hazardous parts, e.g. enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.
- (iv) Protection against spread of fire, e.g. penetration of fire barriers.
- (v) General condition of the electrical equipment, e.g. signs of damage that could impair safe operation, disconnection of unused electrical equipment.
- (b) Consumer mains:
 - (i) Current-carrying capacity.
 - (ii) Voltage drop, e.g. size of conductors.
 - (iii) Underground installation conditions, e.g. enclosure, depth burial, mechanical protection.
 - of
 - (iv) Aerial installation conditions.
 - (v) Connection of wiring.
- (vi) Protection against external influences.
- (c) Switchboards:
 - (i) Location, e.g. access and egress.
 - (ii) Protective devices, e.g. selection and setting of adjustable protective devices for compliance with overcurrent protection, arc fault protection and discrimination requirements.
 - (iii) Isolating devices, e.g. main switches.
 - (iv) Connecting devices, e.g. neutral bars, earth bars and active links.
 - (v) Connection and fixing of wiring and switchgear.
 - (vi) Identification and labelling of electrical equipment.
 - (vii) Protection against external influences.
- (d) Wiring systems:
 - (i) Conductor size, e.g. current-carrying capacity and voltage drop.
 - (ii) Identification of cable cores.
 - (iii) Adequate support and fixing.
 - (iv) Connections and enclosures.
 - (v) Particular installation conditions, e.g. underground, aerial, safety services.
 - (vi) Segregation from other services and electrical installations.
 - (vii) Protection against external influences, e.g. enclosure.
- (e) Electrical equipment:
 - (i) Isolation and switching devices for protection against injury from mechanical movement devices and motors.
 - (ii) Isolation and switching devices for protection against thermal effects, e.g. motors, room heaters, water heaters.
 - (iii) Switching devices for particular electrical equipment, e.g. socket outlets, water heaters, etc.
 - (iv) Particular installation conditions, e.g. locations affected by water, explosive atmospheres, extra-low voltage, high voltage.

- (v) Compliance with required Standard.
- (vi) Connection, support and fixing.
- * (vii) Protection against external influences including ingress of moisture where required by any clause.
- * (viii) Suitability for intended voltage, current and frequency.

(f) Earthing:

- (i) MEN connection.
- (ii) Earth electrode.
- (iii) Earthing conductors, e.g. size, identification.
- (iv) Equipotential bonding conductors, e.g. size, identification.
- (v) Connections, joints and terminations.
- (vi) Protection against external influences.
- (vii) Connection to earthing arrangements for other systems.
- (viii) Creation of earthed situation that may require earthing of additional electrical equipment.

12. What is the *minimum insulation resistance* allowed between live and earthed parts of an electrical installation?

Clause number: _____

Answer: _____

8.3.6.3 Results

The insulation resistance between—

- (a) the conductors of consumer mains and submains; and
 - (b) live and earthed parts of an electrical installation, or parts thereof, including consumer mains and submains,
- shall be not less than 1 M Ω .

13. What is the definition of

a) *Low voltage*? _____

b) *Extra low voltage*? _____

c) *High voltage*? _____

1.4.128 Voltage

Differences of potential normally existing between conductors or between conductors and earth as follows:

- (a) Extra-low voltage Not exceeding 50 V a.c. or 120 V ripple-free d.c.
- (b) Low voltage Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.
- (c) High voltage Exceeding low voltage.

14.What is the general requirement for the electrical connection of conductors?

Clause number:_____

Answer:_____

3.7 ELECTRICAL CONNECTIONS

3.7.1 General

Connections between conductors and between conductors and other electrical equipment shall provide electrical continuity, an appropriate level of insulation and adequate mechanical strength.

The method of joining or connecting cables shall be suitable for the application and ensure that the conductivity of the joint or connection is not less than that of the conductor.

All cables and conductors shall be installed so that there is no undue mechanical stress on any connection.

15.What is an Exposed conductive part?

Clause number:_____

Answer:_____

1.4.62 Exposed conductive part

A conductive part of electrical equipment that-

(a) can be touched with the standard test finger as specified in AS/NZS 3100; and

(b) is not a live part but can become live if basic insulation fails.

5.5.3.5 Unprotected consumer mains

Exposed conductive parts associated with consumer mains not provided with short-circuit protection on the supply side shall be earthed by a conductor or by direct connection to an earth bar such that either has a current-carrying capacity not less than that of the main neutral conductor.

16.Are isolating switches required for an electric motor supply circuit?

Clause number:_____

Answer:_____

Yes

4.13.1.1 Switching devices

Every motor shall be provided with a switching device capable of performing all of the following functions:

(a) Starting and stopping the motor.

(b) Emergency stopping, in accordance with Clause 2.3.5.

(c) Isolating the motor for mechanical maintenance, in accordance with Clause 2.3.6.

17. How is a *damp situation* defined?

Clause number: _____

Answer: _____

6.1 GENERAL

6.1.1 Application

This Section specifies the minimum requirements for the selection and installation of electrical equipment in locations subject to the effects of water or high humidity (damp situations),

18. How must an “Edison Screw” lamp holder be connected to the supply?

Clause number: _____

Answer: _____

4.5.1.2 Edison screw lampholders

Every low voltage Edison screw lampholder shall be connected to the supply so that, where a neutral conductor is required, it is connected to the outer contact.

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12. ELECTRICAL INSTALLATION

A simple _____ is shown in figure 1.1 below, it shows that you need a supply (battery), a circuit protection device (fuse), control device (switch), a load (lamp) and connecting wires.

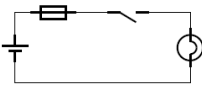
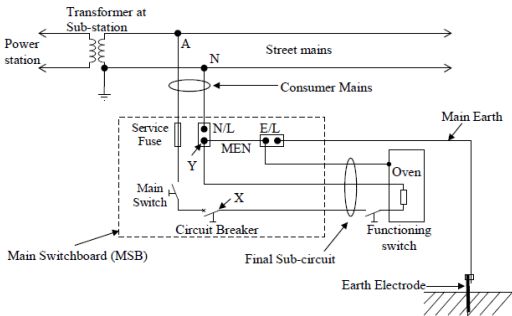


Figure 1.1: Simple Electric circuit

In a _____ installation, these basic parts are changed slightly. Their purpose remains the same but they take on a new form, which can be seen in figure 1.2



Transformer at Sub-station
Power station
Street mains
Consumer Mains
Service Fuse
Main Switch
Circuit Breaker
Main Switchboard (MSB)
Final Sub-circuit
Oven
Functioning switch
Main Earth
Earth Electrode

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Circuit/ Practical

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The _____ difference present between Active and Earth terminals of the single phase AC circuit is usually 240V (the 'nominal' voltage in AS/NZS3000:2007 for Australia is 230/400 V +10% to -6% 1.6.2.(c).(a)). A normal circuit like a 240V 10A socket outlet (power point) is connected with a three wire system (Active, Neutral and Earth)

A domestic circuit consist of:

Item / part	Complete Installation	Final Circuit
Supply	Active conductors (A & N)	Point X(A) & Y(N)
Protective device	Service Fuse	Circuit breaker
Control device	Main (isolating) switch	Functioning Switch

Although figure 1.2 is more complex than figure 1.1, the various parts are the same. The differences are important:

a) The _____ connection between the Neutral link (N/L) and the Earth link (E/L) is the way of providing every installation with thousands of _____ connections, in case of any fault current. By using the MEN connection system, a fault current (in your house) can also travel to 'earth' through the neutral conductor & main earth in the adjacent properties. By having many parallel pathways to 'earth', the overall resistance is greatly reduced to the fault current flowing. Thus keeping touch voltages as low as possible until the protective devices can open circuit, and reducing the operating time for the protective devices.

b) The Installation and the Oven circuit have a protection device and control

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Block Diagram of electrical installation

```

graph LR
    CM[CM] --> MSB[MSB]
    MSB -- SM --> SB[SB or DB]
    MSB -- SC or FSC --> Load1[Load]
    SB -- SC or FSC --> Load2[Load]
  
```

MSB	Main Switch Board
CM	Consumer Mains
SM	Sub-main
SB	Sub-board
DB	Distribution Board
SC	Sub-circuit
FSC	Final Sub-Circuit

Figure 1.3: Block diagram of an electrical installation

13. PROTECTION DEVICES

Protection Devices are designed to create an open circuit, automatically if excessive current flows. Fuses and Circuit breakers are designed to protect the circuit (cable/conductor).

i) Fuses – Re-wireable (known as wired or _____)

- Totally enclosed (known as HRC – High _____ Capacity)

ii) Circuit Breakers – Thermal

- Magnetic
- Thermal/Magnetic

iii) Residual Current Devices – Technology only developed since 1990 - Protects life by detecting the _____ of current (from the active or neutral), which may be passing through the body to earth.

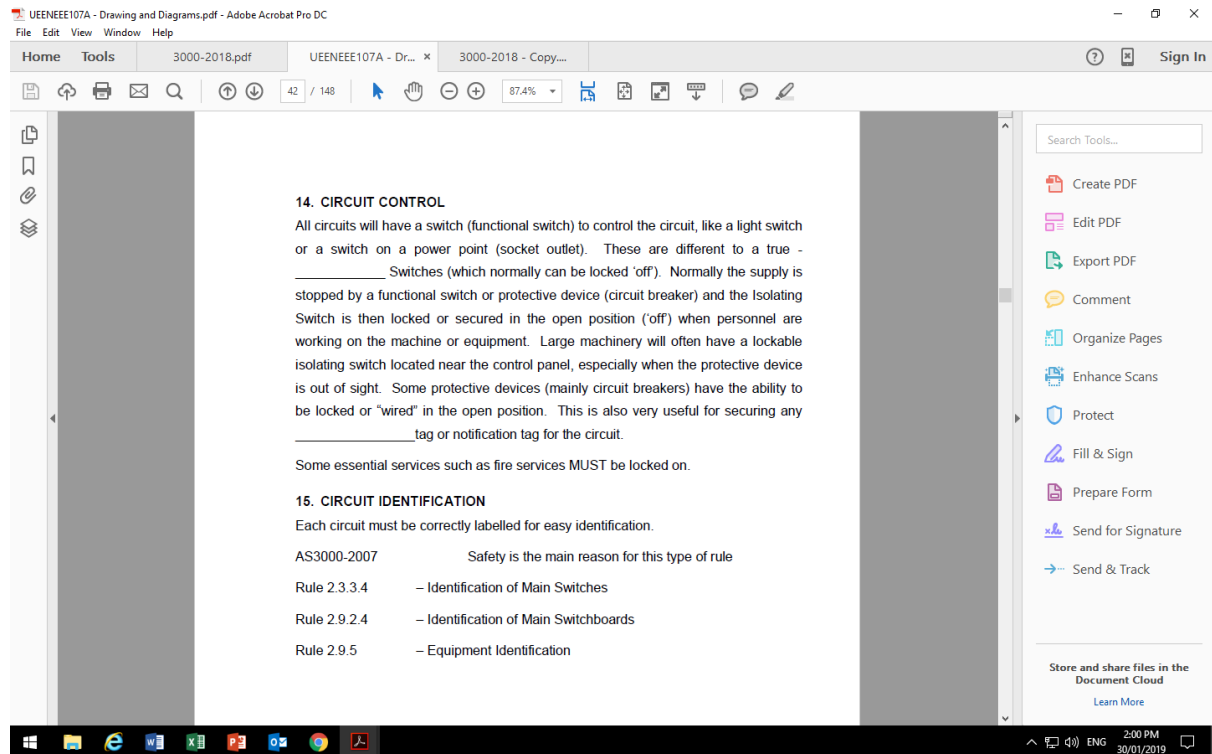
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Semi enclosed / Rupturing, Flow



1.Name one device that can be used for the automatic disconnection of supply for the protection against indirect contact.

_____ AS/NZS 3000 Rule No: _____

2.4.2 Protection by automatic disconnection of supply

Protection by means of automatic disconnection of supply is intended to limit the prospective touch voltage arising between simultaneously accessible conductive parts in the event of a fault between a live part and exposed conductive parts or a protective earthing conductor.

This protection shall be achieved by-

- (a) provision of a system of earthing in which exposed conductive parts are connected to a protective earthing conductor, in accordance with Section 5; and
- (b) disconnection of the fault by an overcurrent protective device or an RCD.

2.4.3 Types of devices

A device used for protection by automatic disconnection of supply shall not be capable of automatically re-closing. The following types of devices may be employed to provide automatic disconnection of supply:

- (a) Enclosed fuse-links complying with the appropriate part(s) of the IEC 60269 series.
- (b) Miniature overcurrent circuit-breakers complying with AS/NZS 60898

series or AS/NZS 3111.

(c) Moulded-case circuit-breakers complying with AS/NZS IEC 60947.2.

(d) Fixed setting RCDs complying with AS/NZS 3190, AS/NZS 61008.1 or AS/NZS 61009.1.

(e) Other devices, with no automatic reclose function, having characteristics similar to any of the devices listed in Items (a) to (d).
Semi-enclosed rewirable fuses shall not be used.

2.What is the maximum permissible percentage voltage drop allowed?

_____ AS/NZS 3000 Rule No: _____

3.6.2 Value

The cross-sectional area of every current-carrying conductor shall be such that the voltage drop between the point of supply for the low voltage electrical installation and any point in that electrical installation does not exceed 5% of the nominal voltage at the point of supply.

3.How can access to live parts of a switchboard be protected against direct contact?

1)_____ 2)_____ 3)_____
4)_____ AS/NZS 3000 Rule No: _____

1.4.38 Contact, direct

Contact with a conductor or conductive part that is live in normal Service

1.5.4.2 Methods of protection

Basic protection shall be provided by one or any combination of the following methods:

- (a) Insulation, in accordance with Clause 1.5.4.3.
- (b) Barriers or enclosures, in accordance with Clause 1.5.4.4.
- (c) Obstacles, in accordance with Clause 1.5.4.5.
- (d) Placing out of reach, in accordance with Clause 1.5.4.6.

RCDs are not recognized as a sole means of basic protection against contact with live parts but may be used to augment one of the above methods.

4.What is the recommended colour for an active conductor?

_____ AS/NZS 3000 Rule No: _____

3.8.3.3 Active and neutral conductors

An active or neutral conductor need not be coloured in accordance with the colours specified in Table 3.4 where—

- (a) insulated conductors within a multi-core cable, provided they are not yellow, have each core clearly identifiable by means of numbering,

lettering or equivalent means;

* (b) conductors of flexible cords and flexible cables, provided they are not yellow, are identified by alternative colours in accordance with Clause 3.8.3.4; or

(c) the neutral conductor of an insulated aerial conductor is identified by multiple longitudinal ribs around the circumference and length that clearly distinguish it from the other conductors.

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171 AS/NZS 3000:2018

SUPERSEDED AS/NZS FLEXIBLE CORDS FUNCTION EUROPEAN CABLES AND CURRENT AS/NZS FLEXIBLE CORDS, FLEXIBLE CABLES AND EQUIPMENT WIRING

Red	Active.....	Brown
Black	Neutral.....	Light blue
Green	Earth.....	Green/yellow

FIGURE 3.1 SINGLE-PHASE CABLES

CURRENT AS/NZS CABLES FUNCTION EUROPEAN CABLES

Red	Phase/Line 1.....	Brown
White	Phase/Line 2.....	Black
Blue	Phase/Line 3.....	Grey
Black	Neutral.....	Blue
Green/Yellow	Earth.....	Green/yellow

FIGURE 3.2 MULTIPHASE CABLES

NOTES TO FIGURES 3.1 AND 3.2:

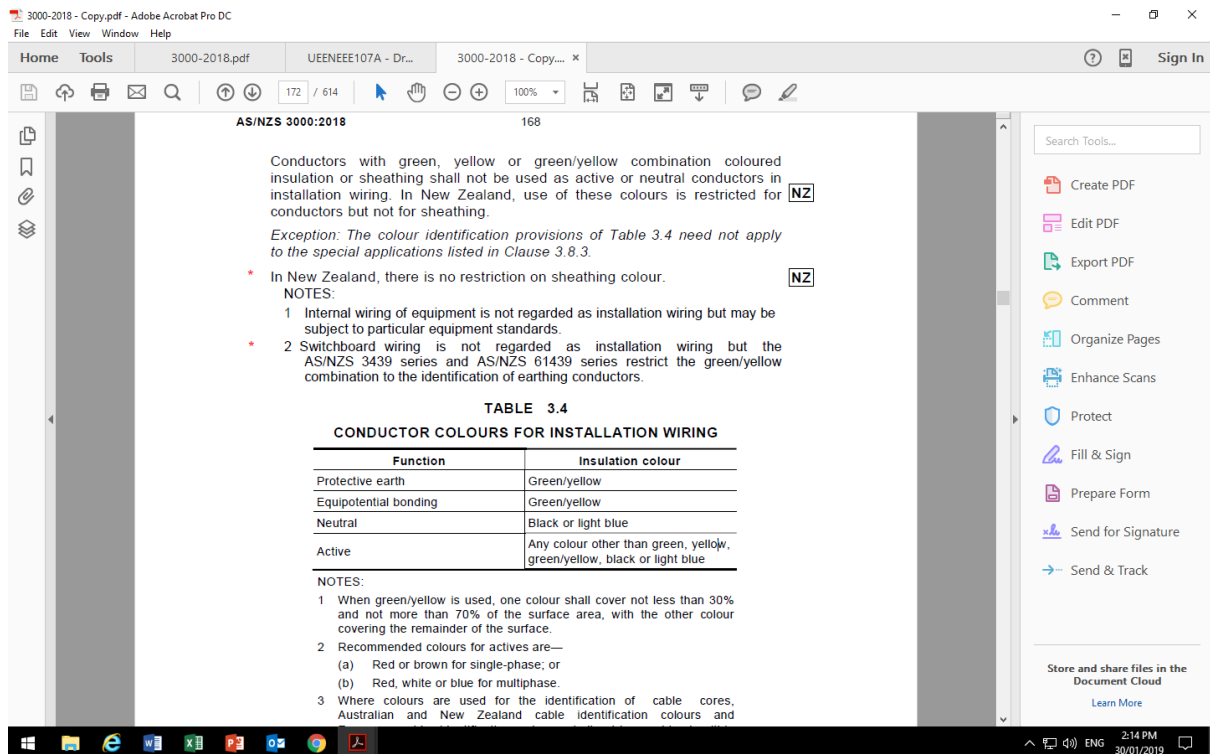
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5. How close to a cooking appliance should a functional switch be installed?

AS/NZS 3000 Rule No: _____

4.7 COOKING APPLIANCES

4.7.1 Switching device

The switch shall not be mounted on the cooking appliance.

NOTE: The switch should be mounted within 2 m of the cooking appliance.

The switch shall not be mounted in such a position that the user must reach across the open cooking surface to operate it

6. Is it necessary to provide an earthing conductor at each lighting point?

AS/NZS 3000 Rule No: _____

5.4.3 Lighting points

A protective earthing conductor, connected to a terminal or suitably insulated and enclosed, shall be provided at every lighting point, including transformers supplying ELV lighting systems.

7. How shall main switches be identified on a switchboard?

AS/NZS 3000 Rule No: _____

2.3.3.5 Identification

Main switches shall be identified as follows:

- (a) Each main switch shall be marked 'MAIN SWITCH' and shall be readily distinguishable from other switchgear by means of grouping, contrasting colouring or other suitable means to provide for prompt operation in an emergency.
- (b) Where there is more than one main switch, each main switch shall be marked to indicate the electrical installation or portion of the electrical installation it controls.
- (c) Where the opening of a main switch brings into operation or isolates an alternative supply, a notice shall be provided to indicate the position of the main switch controlling the alternative supply.

8. What is the operating temperature of V 75 thermoplastic cables for normal use?

AS/NZS 3000 Rule No: _____

3.4.2 Operating temperature limits

The operating temperatures of conductors shall not exceed the limits given in Table 3.2.

Polymeric cables with normal use temperatures below 75° C (see Notes to Table 3.2) are deemed not suitable for Australian or New Zealand conditions.

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TABLE 3.2
LIMITING TEMPERATURES FOR INSULATED CABLES

Type of cable insulation ⁽¹⁾	Operating temperature of conductor, °C		
	Normal use ⁽²⁾	Maximum permissible ⁽²⁾	Minimum ambient ⁽²⁾
Thermoplastic ⁽⁴⁾			
V-75	75	75	0
HFI-75-TP, TPE-75	75	75	-20
V-90	75	90	0
HFI-90-TP, TP-90	75	90	-20
V-90HT	75	105	0
Elastomeric			
R-EP-90	90	90	-40
R-CPE-90, R-HF-90, R-CSP-90	90	90	-20
R-HF-110, R-E-110	110	110	*
R-S-150	150	150	-50
Cross-linked polyethylene			
X-90, X-90UV, X-HF-90	90	90	*
X-HF-110	110	110	*
MIMS ⁽⁵⁾	100	250	(6)
Other types			
PE, LLDPE	70	70	*

* Refer to manufacturer's information.

NOTES:

1 The types of cable insulation given in Table 3.2 are included in relevant specifications, i.e. the AS/NZS 5000 series, AS/NZS 3191, AS/NZS 3808 and AS/NZS 60702.1.

2 Lower maximum temperatures will apply where materials used in the construction of the cables or in association therewith, such as coverings, sheathings, insulating sleeving on connections and sealing compounds, have maximum operating

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75 Deg C

9. Is it permissible to join aerial cable by soldering if subject to tension?

AS/NZS 3000 Rule No: _____

3.7.2.9 Aerial conductors

3.7.2.9.1 Joints and connections

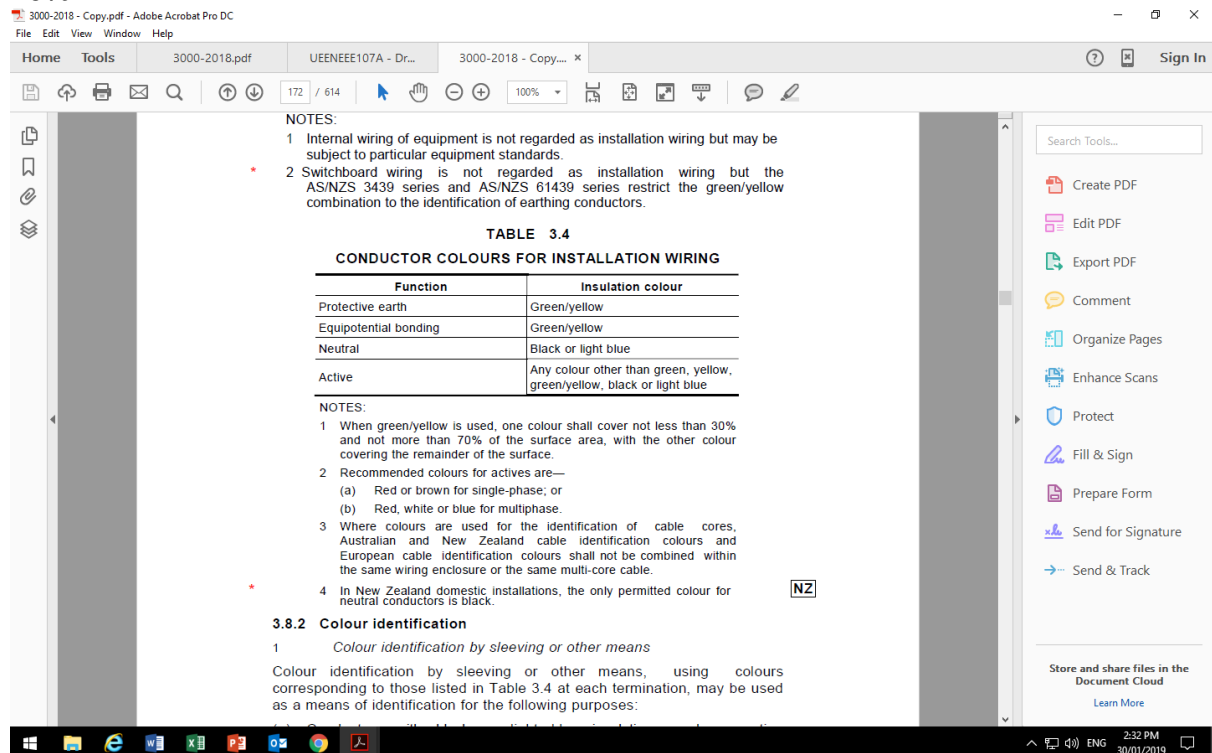
The following limitations and additional requirements apply to joints and connections in aerial conductors:

- (a) Connections or joints in aerial conductors in tension shall be made without soldering.
- (b) Connections to aerial conductors shall be reliable and adequately protected against the effects of movement, exposure to direct sunlight and entry of moisture, and shall be as short as practicable.
- (c) Where conductors of dissimilar metals are joined, means shall be taken to prevent galvanic action by the use of appropriate connecting devices.

10. What are the percentages of green and yellow in an earth conductor?

AS/NZS 3000 Rule No: _____

70%



11. What is the rating of an RCD used to protect a socket outlet in residential installations?

AS/NZS 3000 Rule No: _____

2.6.3.2.2 Domestic and residential installations—Australia only

Additional protection by RCDs with a maximum rated residual current of 30 mA shall be provided for all final subcircuits in domestic and residential electrical installations.

Where protection of final subcircuits is required, RCDs shall be installed at the switchboard at which the final subcircuit originates.

These installations include but are not limited to—

- (a) individual domestic electrical installations;
- (b) residential areas of electrical installations;
- (c) multiple residential electrical installations that are provided for common use; or
- (d) external lighting installations in common areas of multiple residential electrical installations.

Exception: RCD protection need not apply to repairs undertaken in accordance with Clause 2.6.3.2.6.

P58

Job Specifications.

These questions will help you revise what you have learnt in Section.

1. Briefly describe the purpose of job specifications? _____

Job specifications relate to the work we do. As electricians, someone makes a decision on what work they want, we send them a quote, and if successful, go and do the job. This someone is usually the customer however larger jobs including government tenders use different engineering departments, quantity surveyors, estimators and other very specific people to assist in preparing tenders and Job specifications. As subcontractors, we have to quote on the electrical aspects of the tender to win the job. The purpose of using job specifications in addition to drawings, diagrams, codes and standards is to ensure we give the customer what they have asked for.

2. List 4 people who may have an interest in Job Specifications? _____

Designers, clients, certifying authorities, estimators, tenderers, contractors and sub-contractors, contract administrators, legal representatives, project managers, construction managers and facilities managers all have an interest in the specifications.

3. List the 4 types of job specification clauses and give examples of each.

1st Clause: _____

Description: _____

2nd Clause: _____

Description: _____

3rd Clause: _____

Description: _____

4th Clause: _____

Description: _____

TYPES OF SPECIFICATION CLAUSES

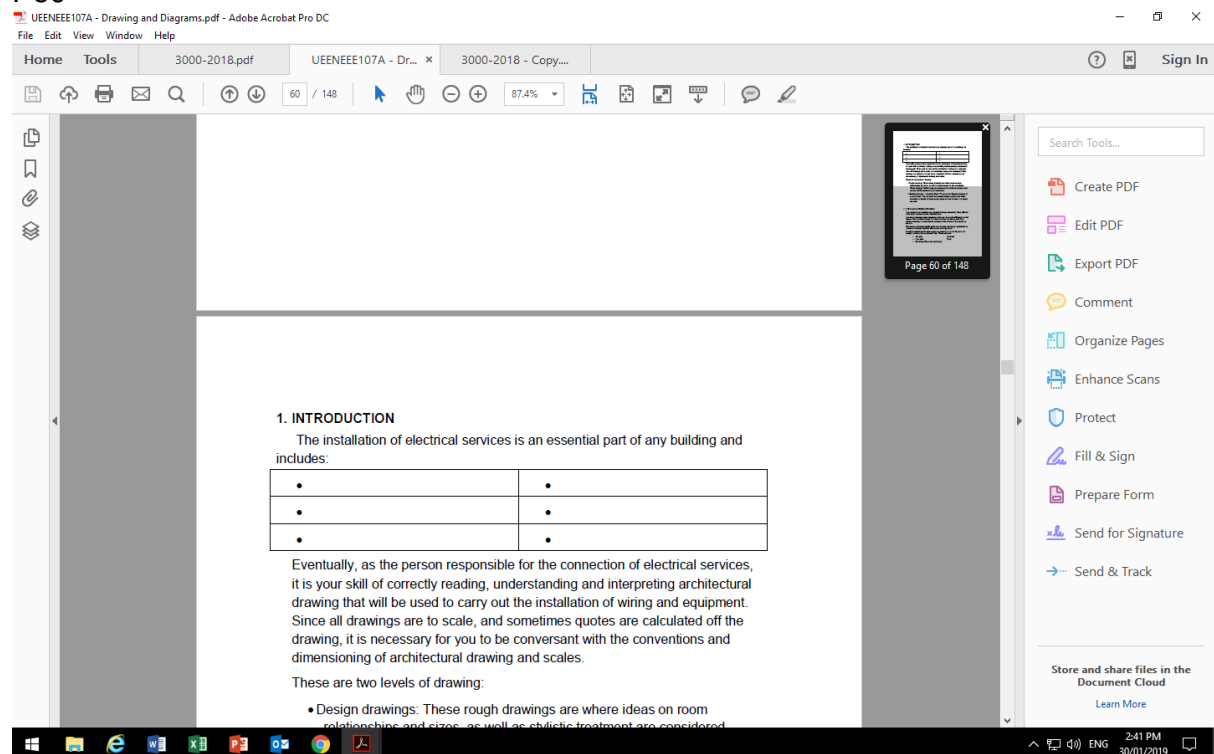
Descriptive – describes in detail the material, workmanship and installation required to be used by the contractor or tradesperson. For example; Piping – 3mm diameter beads with core.

Reference – to a published document, with which process and products must comply. It is incorporated by a reference to the title or other identification of the document which may be a standard or a manufacture's manual. For example; Grading – DD to AS/NZS2269.0, Bond type A.

Performance – specifies an item in a construction project by prescribing a desired end result and the criteria by which the result will be judged for its acceptability. For example; Pole Taper – maximum 1 in 120.

Direct/Proprietary – specification clauses nominate an item in a construction project by reference to a proprietary trade name. For example; Coating Systems –apply Dulux paints coating systems to the Exterior painting schedule and theInterior painting schedule

P60



Floor plan, Skeleton diagram, Circuit diagram, Installation diagram, Switch schedule, Lamp schedule

P62

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In order to avoid congestion and possible confusion by superimposing electrical symbols over building fittings, a separate **electrical floor plan** is usually prepared.

Other trades, for example plumbers, will often be supplied with a separate drawing as well.

List 2 advantages of knowing exactly where sinks, tubs and vanities are to be installed.

1. _____

2. _____

Elevations
Drawings of the various sides of a building viewed at right angles (usually only four views). The views are mostly named in relation to their geographic orientation, e.g. *North Elevation*. They show:

- Overall shape of the dwelling

or arches, sub-roof and/or roof structures, etc.).

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In order to avoid congestion and possible confusion

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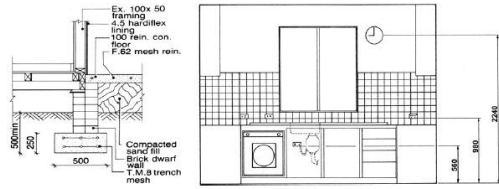
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or arches, sub-roof and/or roof structures, etc.).

Detail drawings
These are larger scale drawings, used to clearly show details of specific areas of construction where greater detail needs to be shown, for example the footings and installation of electrical accessories.



Ex. 100x50 framing
4.5 ha/diflex lining
100 mm con. pipe
P.82 mesh rein.
500mm
250
500
Compacted sand fill
Brick dwarf wall
T.M.B trench mesh

2240
910
500

Answer the following:
The kitchen detail drawing above, assists us to determine the location and placement of how many electrical accessories/items?

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500

Compacted sand fill
Brick dwarf wall
T.M.B trench mesh

Answer the following:
The kitchen detail drawing above, assists us to determine the location and placement of how many electrical accessories/items?

What height is the single power point on the splashback installed?

The detail drawing indicates that the splashback wall will have what type of finish?

3. ARCHITECTURAL CONVENTIONS
Certain conventions (symbols) are used to illustrate the constructional features on a floor plan. For example:

6, 980mm, 560mm
Ex. 100x 50 framing
4.5 hardiflex lining
P66

6, 980mm, 560mm

Ex. 100x 50 framing
4.5 hardiflex lining
P66

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Note: Care should be taken when scaling from a plan. The plan may have been reduced or enlarged thus giving a false measurement when transferring it to the actual job.

Student exercise 1
The lines shown in the table represent dimensions from a drawing. For each line, measure the length in millimetres between the dimensioning symbols then determine the actual size of the dimensions.

No.	Dimensioned line	Scale		
		1:50	1:100	1:20
1				
2				
3				
4				
5				

Student exercise 2
Determine the scale size of the dimension given in the table for the scale specified.

No.	Length dimension	Scale	Scale size
1	10500	1:100	
2	890	1:10	

Measure the length of the line by ruler then multiply with the scale

$1/10500 / 100 = 105\text{mm}$
Do 2,3,4,5

Do the scaled lengths

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SCALE 1:100

Student exercise 4

From the floor plan above (scale 1:100) determine the location of the first 10 power outlets shown numbered. List and record in table 1 on the following page the following information for each outlet:

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LIGHTING			
Incandescent	1	Luminaire – general symbols or luminaire outlet	
	2	Luminaire fixed to a wall	
	3	Number & power of lamps in a group may be specified	3 x 15W
	4	Spot light	
	5	Flood light	
	6	Signal Light	
Fluorescent	7	Tubular Fluorescent Luminaire – one Lamp	
	8	Tubular Fluorescent Luminaire – two Lamp	
	9	Discharge Lamp – general symbol	
SWITCHBOARD	10	General symbol: within the symbol the type of switchboard should be nominated. MSB = Main Switch Board MB = Meter Board	
APPLIANCE	11	General symbol: within the symbol is placed the accepted abbreviation for the appliance. HSW = Hot water system EF = Exhaust fan	
	12	Air Conditioner (an example of Number 11)	

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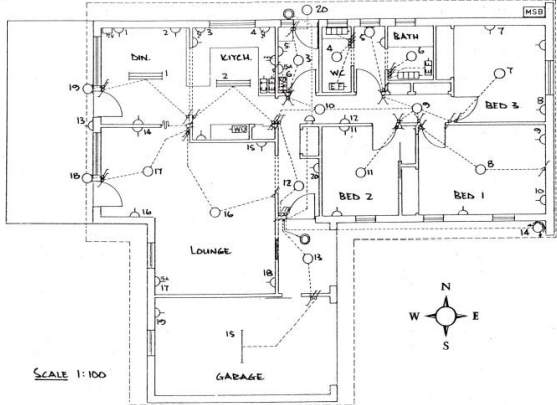
P71 to 78
Class Exercise

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SCALE 1:100

Student exercise 4
From the floor plan above (scale 1:100) determine the location of the first 10 power outlets shown numbered. List and record in table 1 on the following page the following information for each outlet:

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Table 1 – Socket outlet details

Outlet no.	Outlet details	Room in which outlet is located	Location details
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Table 2 – Light point details

Point no.	Switching details	Room in which point is located	Location details
1			
2			
3			

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Student exercise 6

From the same floor plan (scale 1:100) determine the location of the hot water service, 3 exhaust fans, 2 heaters, cook top and the wall oven. List and record in table 3 below the required information for each point:

- Point type (eg. HWS)
- Room in which the point is located (e.g. lounge, kitchen, bedroom 1 etc)
- Location details (e.g. south wall)

Point type	Room in which point is located	Location details

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Student exercise 7

Step 1 - Freehand drawing

At the end of this section is an A4 drawing sheet with border and title block. On it, draw a free hand sketch of the house plan below.

Be sure to make the plan as big as possible as you will be using it in future exercises.

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Step 2 - Lighting Points and Switching Positions

1. On the floor plan that you have just drawn, draw the locations of all lighting points and switching positions as detailed in the lighting schedule provided.
2. When locating symbols make the centre line of the symbol correspond to the centre line of the lighting point.
3. Show switching positions for all lighting points, taking into account the type of switching required according to the schedule and the practical location for switches.

Room	No of Points	Switching	Location Details
Porch	2	one-way	wall brackets each side of door
Living	1	two-way	room centre
Dining	1	one-way	room centre
Kitchen	1	two-way	room centre
Family	1	two-way	wall bracket, centre western wall
Terrace	1	one-way	terrace centre
Carport	1	one-way	carport centre
Toilet	1	one-way	room centre
Bath-laundry	1	one-way	room centre
bedroom 2	1	one-way	room centre
bedroom 1	1	one-way	room centre

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Step 3 - Power Outlets

1. On your floor plan draw the locations of all power outlets as detailed in the electrical schedule below.
2. When locating symbols make the centre line of the symbol correspond to the centre line of the outlet.
3. Be sure to correctly distinguish between single and double 10A outlets and 15A outlets, by the use of appropriate symbols.

Room	No of Outlets	Type	Location Details
kitchen	1	double 10A	southern wall 300mm from SE corner
	1	double 10A	southern wall 300mm from SW corner
	1	single 10A	centre northern wall
dining	1	single 10A	eastern wall 500mm from NE corner
living	1	single 10A	southern wall 300mm from SW corner
	1	double 10A	western wall 450mm from SW corner
	1	double 10A	northern wall 300mm from NW corner
family	1	single 10A	northern wall 300mm from NE corner
	1	single 15A	western wall 300mm from NW corner
	1	single 10A	eastern wall NE corner
bedroom 1	1	single 10A	western wall 300mm from SW corner
	1	double 10A	centre eastern wall
bedroom 2	1	single 10A	western wall 500mm from NW corner
	1	double 10A	centre southern wall
Bath-laundry	1	single 10A	centre northern wall
carport	1	double 10A	centre eastern wall
	1	single 15A	western wall 300mm from NW corner

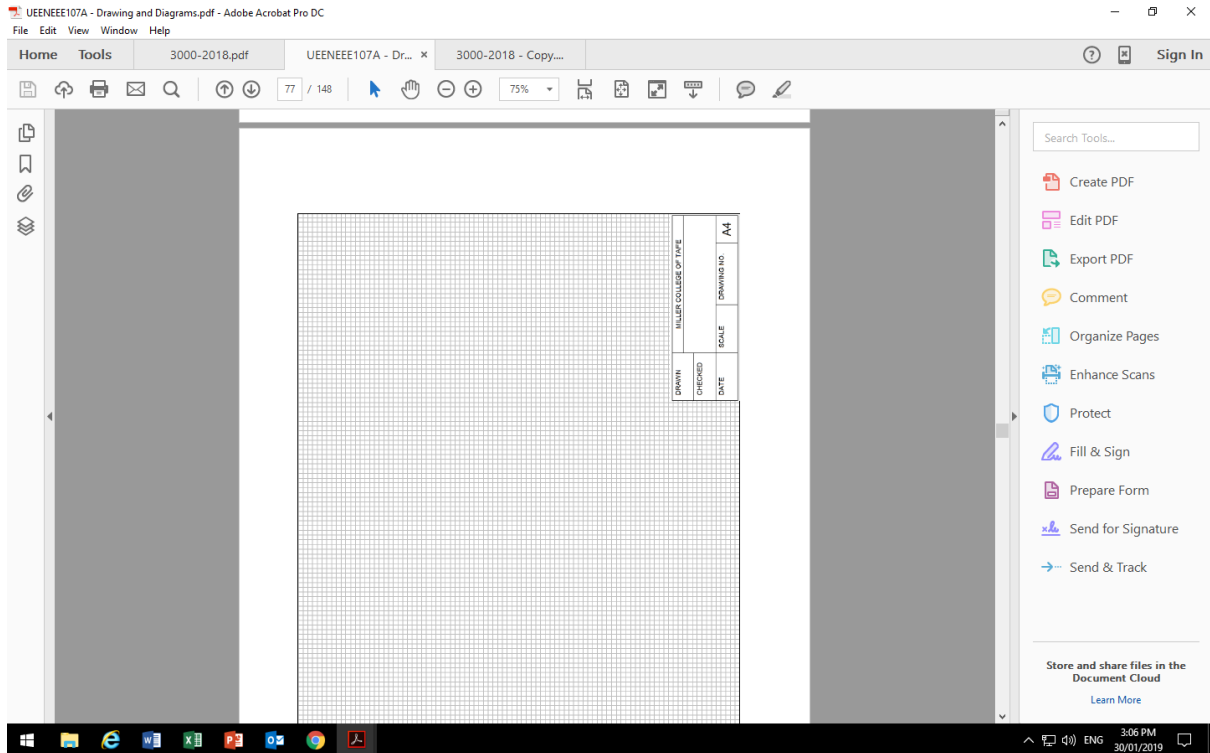
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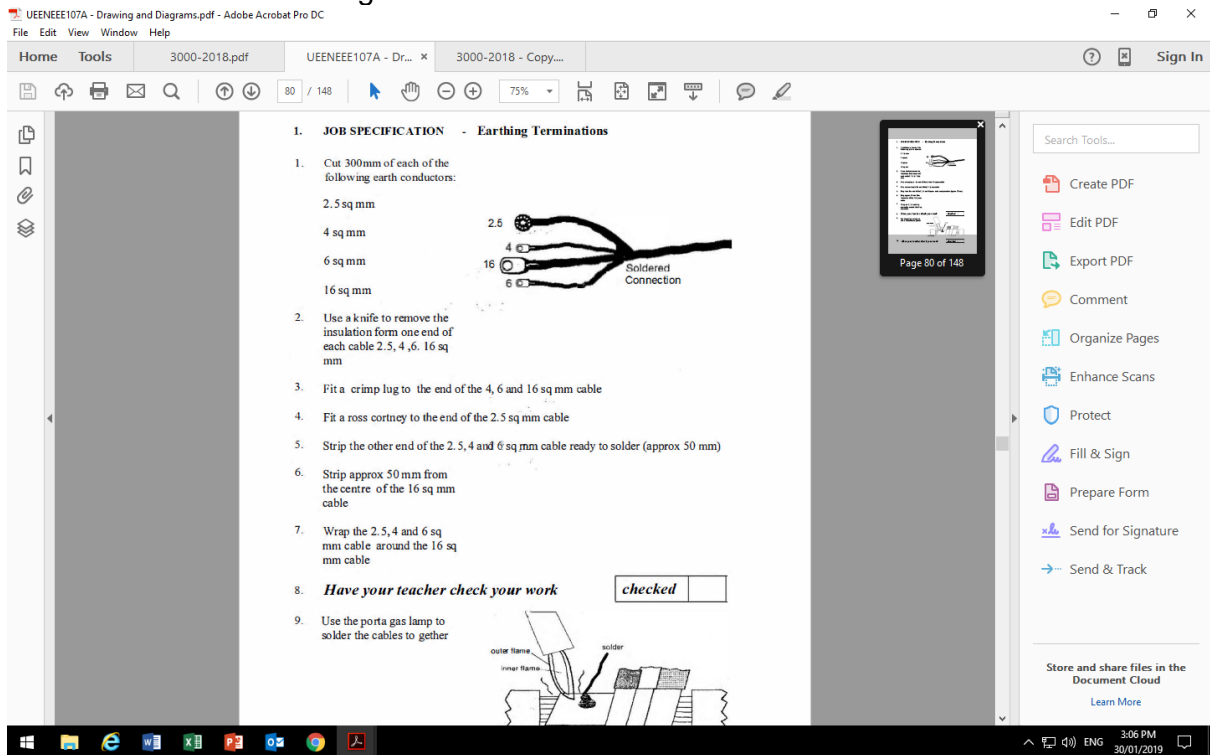
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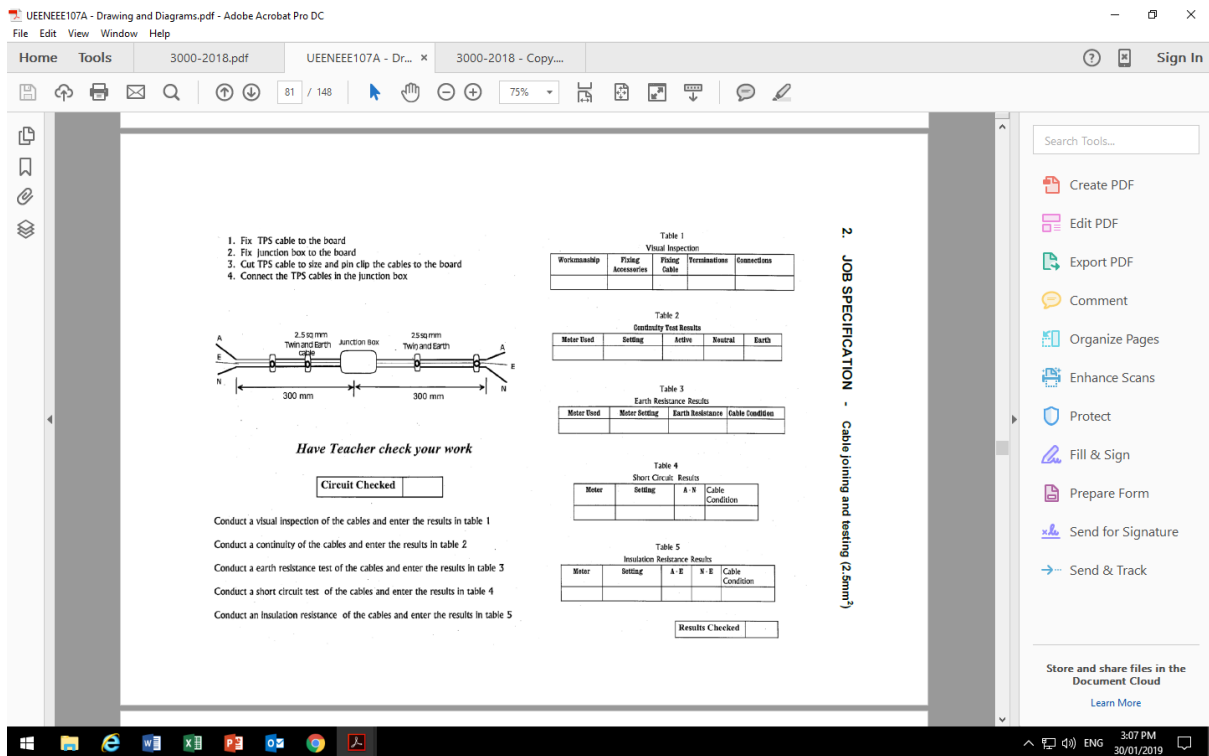
Step 4 - Appliances

1. On the floor plan provided in Fig.2 draw the locations of the following appliances:
 - a) range - located in kitchen on the northern wall in the NW corner
 - b) hot water service - located in kitchen under sink
 - c) door bell - located in family room, operated by an illuminated pushbutton at the front door



P80+81 Practical Task together with G106





Architectural Drawings.

These questions will help you revise what you have learnt in Section.

1. Briefly describe the difference between a site plan and a floor plan.

THE SITE PLAN

The site plan shows the outline of the building lot and the position (orientation) of the building on the lot.

The external walls are shown in heavy outline with the eaves marked with a dashed line. Typically shows details such as:

- ☐ Scale of the plan
- ☐ Surveyors datum location
- ☐ Northerly direction (orientation)
- ☐ Land contours
- ☐ Street name
- ☐ Lot number and the numbers of adjacent lots in order to clearly identify the correct site on which to construct the building.
- ☐ Deposited plan (DP) number.
- ☐ Exterior building dimensions and distances from the property lines.
- ☐ Site coverage of building(s).
- ☐ Location and dimensions of any easements.

The Floor Plan

This is a drawing of the house, viewed from above, with the roof, ceiling and part of the walls removed. It shows the outline and shape of the building and the position of all the internal walls.

Floor plans are the most useful drawing to an electrician, and a detailed floor plan will generally show:

- All dimensions
- Type of wall construction and thickness
- Position of windows, doors and archways.
- Width of openings
- Position of electrical accessories, appliances and other equipment
- Position of kitchen, laundry and bathroom fittings.
- Location of eaves, steps and downpipes

Any existing buildings on the site.

2. Briefly describe the function of a detailed drawing. Relate the answer to the installation of electrical services.

Detail drawings

These are larger scale drawings, used to clearly show details of specific areas of construction where greater detail needs to be shown, for example the footings and installation of electrical accessories

3. Draw a diagram showing the method used on a floor plan to show one light point controlled by three switches.

Refer

The screenshot shows a PDF document titled 'UEENEEE107A - Drawing and Diagrams.pdf' in Adobe Acrobat Pro DC. The document contains a floor plan diagram of a house with various rooms labeled: BED 1, BED 2, KITCHEN, BATH, and LIVING. The diagram shows a light point in the living room controlled by three switches. Above the floor plan, there are three wall construction symbols: 'Cavity brick wall', 'Brick veneer wall', and 'Timber stud wall'. Below the floor plan, there is a section titled '4. ARCHITECTURAL SCALES' which explains the importance of scales in drawing and provides an example of a scale: SCALE 1:100 = 1 millimetre on the plan = 100 millimetres on the job. It also includes a table with drawing dimensions and actual lengths.

Length measure from the drawing	Scale	Length on the job
63 mm	1:100	6300 mm
32 mm	1:50	1600 mm

4. Indicate the actual lengths of the following drawing dimensions at the scales specified. Include the correct unit of measurement in your answer (m, mm etc)

- a. Line length 75mm – scale 1:100 _____
- b. Line length 68mm – scale 1:200 _____
- c. Line length 32mm – scale 1:50 _____
- d. Line length 4.5mm – scale 1:10 _____
- e. Line length 115mm – scale 1:100 _____
- Do yourself

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5. Identify the AS/NZS 1102 architectural electrical location symbols shown below.

a.		
b.		
c.		
d.		
e.		

6. Draw the AS/NZS 1102 architectural electrical location symbols for the following items of electrical equipment:

Refer P69

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used are specified in AS 1102, and are listed below.

LIGHTING			
Incandescent	1	Luminaire – general symbols or luminaire outlet	
	2	Luminaire fixed to a wall	
	3	Number & power of lamps in a group may be specified	3 x 15w
	4	Spot light	
Fluorescent	5	Flood light	
	6	Signal Light	
	7	Tubular Fluorescent Luminaire – one Lamp	
	8	Tubular Fluorescent Luminaire – two Lamp	
SWITCHBOARD	9	Discharge Lamp – general symbol	
	10	General symbol: within the symbol the type of switchboard should be nominated. MSB = Main Switch Board MB = Meter Board	
APPLIANCE	11	General symbol: within the symbol is placed the accepted abbreviation for the appliance. HSW = Hot water system EF = Exhaust fan	
	12	Air Conditioner	

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		one Lamp	
	8	Tubular Fluorescent Luminaire	
	9	Discharge Lamp - general symbol	
SWITCHBOARD	10	General symbol: within the symbol the type of switchboard should be nominated. MSB = Main Switch Board MB = Meter Board	
APPLIANCE	11	General symbol: within the symbol is placed the accepted abbreviation for the appliance. HSW = Hot water system EF = Exhaust fan	
	12	Air Conditioner (an example of Number 11)	AC
	13	Electric Heater	
SWITCH	14	Single pole (one-way) switch	
	15	Single pole pull switch	
	16	Two way switch	

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	17	Intermediate switch	
	18	Dimmer Control switch	
	19	Time Switch	
	20	Push Button	
POWER	21	10A Socket Outlet	
	22	Multiple Outlet (in this case - double)	15A
	23	15A Plug Socket	12V
	24	Special Outlet (in this case - 32V)	
	25	Multi-phase outlet (in this case - 3 Phase)	
COMMUNICATION	26	Telecommunication Outlet (use abbreviation adjacent to symbol) TV = Television	TV
	27	Wall Telephone	
	28	Floor Telephone	
	29	Electric Bell	
	30	Electric Clock	

Note:
The symbols above are drawn to AS1102 convention

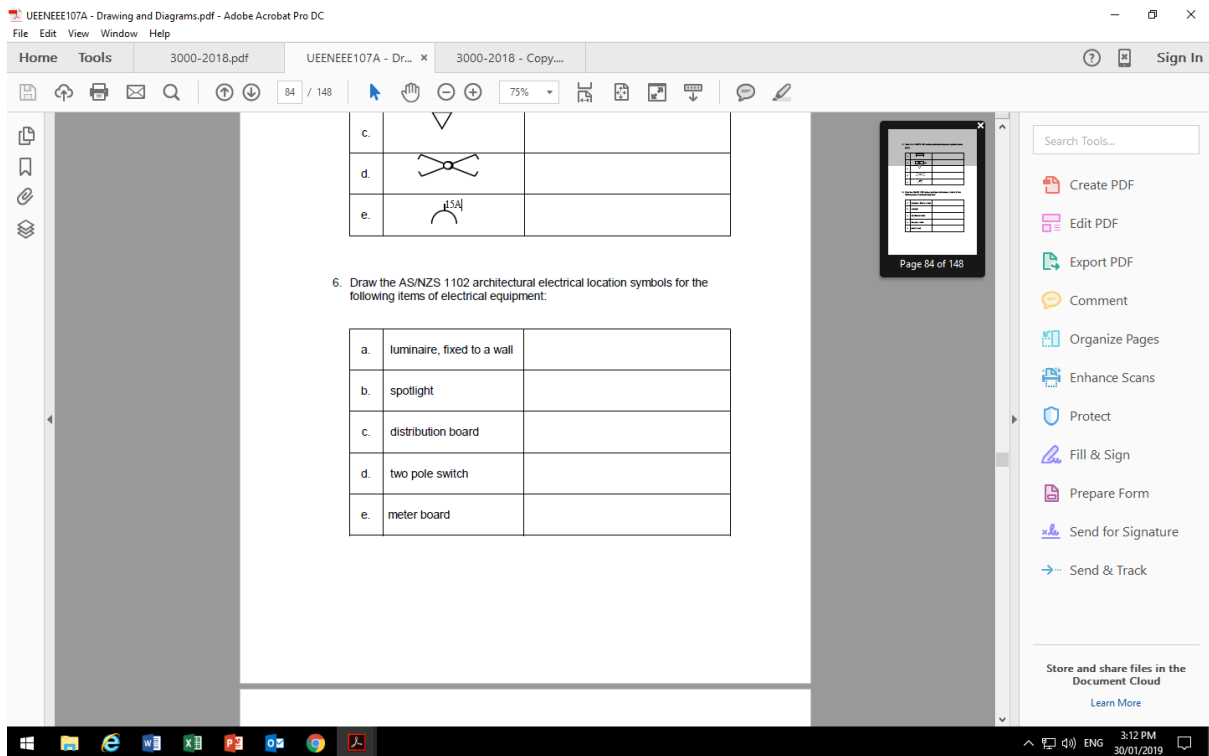
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Also refer P69+70 as above

7.Explain why the “point of entry” is not shown on the floor plan of a domestic installation.

Because floor plan is to show the electrical layout of each floor rather than supply entry from main power line

8.Briefly explain the meaning of the term “standard drawing”.

a drawing or illustration that is **accurate** and **comprehensive** enough to be used in different projects with little or no **change**

9.Name five parts of an electrical installation that may have their location(or route) determined from the site

- plan.1. _____
2. _____
3. _____
4. _____
5. _____

Equipments+light points, outlets , switch, relevant actuation, layout of conduit,

10.Who has the responsibility of determining the cable routes for the various

various circuits of a domestic installation?

Installing Electrician

P92

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There is a need for a standard to be adopted when representing components in a circuit, wiring or block diagram. The use of standard symbols allows communication of ideas between individuals or organisations without the need for lengthy documentation accompanying every diagram.

The standard adopted in Australia for drawing symbols is the ISO (International Standards Organisation) standard. These symbols are laid out in Australian Standard AS 1102.

Some of these symbols will be required to complete the work in this section.

Student Exercise 1:
Using a pencil, draw what you think may be the Australian Standard symbols for each description given in Table 1 below:

Description	Your drawing	Correct drawing
Manually operated switch – Normally Open		
Manually operated switch – Normally Closed		
Fuse		
Circuit Breaker – single pole		
Lamp – illuminating		

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hydraulic fused circuit outlet dimmer limit switch valve spdt pneumatic cad selector actuation autocad normally closed

Normally open contact, manually operated

Normally closed contact, manually operated by pressing

Normally closed contact, manually operated by pulling

Normally open contact, manually operated by turning

Design elements - Switches

Electrical Maintenance - Industrial ...

Electrical Switch Symbols

Electrical Switches AutoCAD ...

Motor Control Fundamentals ...

Introduction

Chapter 6 Control Relays - ppt video ...

Electrical Symbols — Switches and ...

Sequential Process Control - ppt video ...

Electrical Switch Symbols

Mechanically Operated Switches

Limit Switch Operation

Limit switches take

NO Contact

Fuse

Google Search results for "Fuse symbol". The search bar shows "Fuse symbol" and the results are filtered by "Images". The top results include:

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- File Fuses.svg - Wikipedia en.wikipedia.org
- Electronic fuse, fuse, fuse icon, fuse ... iconfinder.com
- Fuse Schematic Symbol - Simple Wiring ... 5.2 sandra-jos.de
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Circuit breaker Single pole symbol

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- Circuit Breakers symbols ... symbols.radicasoftware.com
- residual current circuit breaker ... forums.autodesk.com
- Industrial electrical symbols slideshare.net
- Terminal AutoCAD: Where are the 2 Pole ... myacade.blogspot.com
- Circuit breaker - Wikipedia en.wikipedia.org

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Lamps-Illuminating

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The location of all appliances and accessories, which form part of the electrical installation, are shown with the use of symbols on the floor plan. The symbols used are specified in AS 1102, and are listed below.

LIGHTING			
Incandescent	1	Luminaire – general symbols or luminaire outlet	○
	2	Luminaire fixed to a wall	⌋
	3	Number & power of lamps in a group may be specified	3 x 15w ○
	4	Spot light	⊙
	5	Flood light	⊙
	6	Signal Light	⊙
Fluorescent	7	Tubular Fluorescent Luminaire – one Lamp	⌈
	8	Tubular Fluorescent Luminaire – two Lamp	⌈
	9	Discharge Lamp – general symbol	⌈
SWITCHBOARD	10	General symbol: within the symbol the type of switchboard should be nominated. MSB = Main Switch Board MB = Meter Board	□
	11	General symbol: within the symbol is placed the accepted abbreviation for the appliance. HSW = Hot water system EF = Exhaust fan	□
APPLIANCE	12	Air Conditioner (an example of Number 11)	AC □
	13	Electric Heater	□

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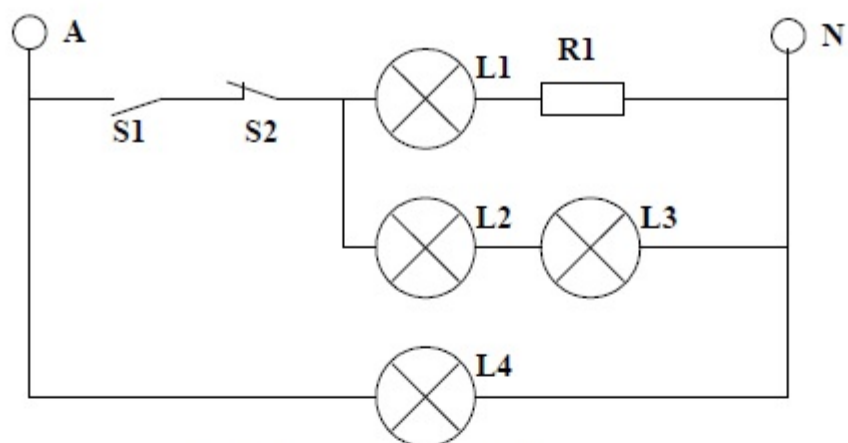


Fig. 7 Circuit diagram - Light Circuit

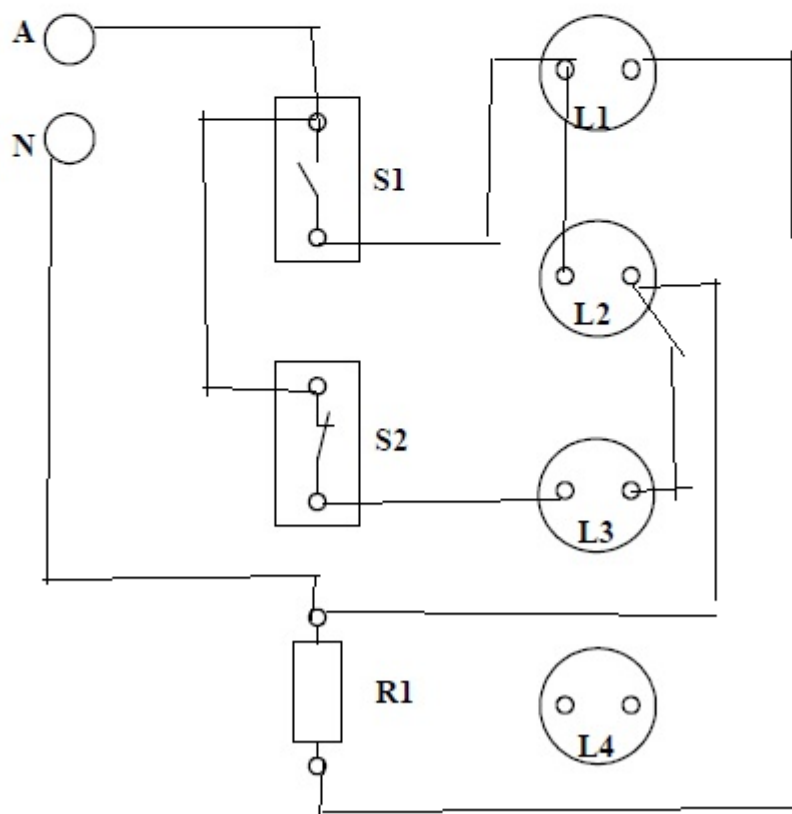


Fig. 8: Wiring diagram - Light Circuit

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Student exercise 3:

Using the cable schedule shown in the table draw, on the cabinet diagram, the cables with the following wire numbers:

a. A1
b. A3
c. B4
d. D1
e. E23
f. K12

Control cabinet

Wire No.	Colour	From	To	Wire No.	Colour	From	To
A1	R	Y11:1	X1:1	D1	BK	Y14:5	A43:5
A2	W	Y11:2	K2:1	D2	BL	Y14:6	A43:6
A3	B	Y11:3	K3:1	D3	BR	Y14:7	A43:7
A4	BK	Y12:1	Z1:C1	D4	R	Y14:8	A43:8
A5	BK	Y12:2	Z1:C2	E23	Y	A23:1	L1:1
A6	Y	Y12:3	Z1:C7	E24	Y	A23:2	L2:1
B1	GY	Y13:1	A23:1	E25	Y	A23:3	L3:1
B2	GY	Y13:2	A23:2	K12	GY	A43:5	L1:2
B3	GY	Y13:4	A23:3	K13	R	A43:6	L2:2
B4	B	Y14:4	A23:4	K14	B	A43:7	L3:2
B5	R	Y14:4	L3:2				

Cable schedule

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PROCEDURE 1 – Single lamp controlled by a single switch

1. For circuit diagram 1 shown, neatly sketch the layout of wiring diagram 1 for the circuit.

Circuit diagram 1

AC supply

Fuse

Lamp panel

Switch panel

Wiring diagram 1

2. Connect the circuit according to the wiring diagram.

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PROCEDURE 1 – Single lamp controlled by a single switch

1. For circuit diagram 1 shown, neatly sketch the layout of wiring diagram 1 for the circuit.

Circuit diagram 1

Wiring diagram 1

2. Connect the circuit according to the wiring diagram.

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PROCEDURE 2 – Single lamp controlled by parallel connected switches

1. For circuit diagram 2 shown, neatly sketch the layout of wiring diagram 2 for the circuit.

Circuit diagram 2

Wiring diagram 2

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1. For circuit diagram 3 shown, neatly sketch the layout of wiring diagram 3 for the circuit.

Circuit diagram 3

AC supply

Fuse

Lamp panel

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1. For circuit diagram 4 shown, neatly sketch the layout of wiring diagram 4 for the circuit.

Circuit diagram 4

AC supply

Fuse

Lamp panel

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PROCEDURE 5 – Multiple lamp circuit

1. For circuit diagram 5 shown, neatly sketch the layout of wiring diagram 5 for the circuit.

Circuit diagram 5

AC supply

Fuse

Lamp panel

Switch panel

Wiring diagram 5

2. Connect the circuit according to the wiring diagram.

Have your teacher check your circuit connections.

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1. AS/NZS 3000:2007 provides a table of electrical symbols as used in the standard. Find and neatly sketch the electrical symbols for the following devices and write down their reference number to AS 1102.

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Electrical Drawings.

These questions will help you revise what you have learnt in Section.

1. AS/NZS 3000:2007 provides a table of electrical symbols as used in the standard. Find and neatly sketch the electrical symbols for the following devices and write down their reference number to AS 1102.

Description	Symbol	Reference No.
A Switch (general Symbol)		
A fuse		
A circuit breaker		
An RCD		
A socket outlet		
The earth connection		

2. The best type of electrical diagram to use when fault finding electrical equipment is a...

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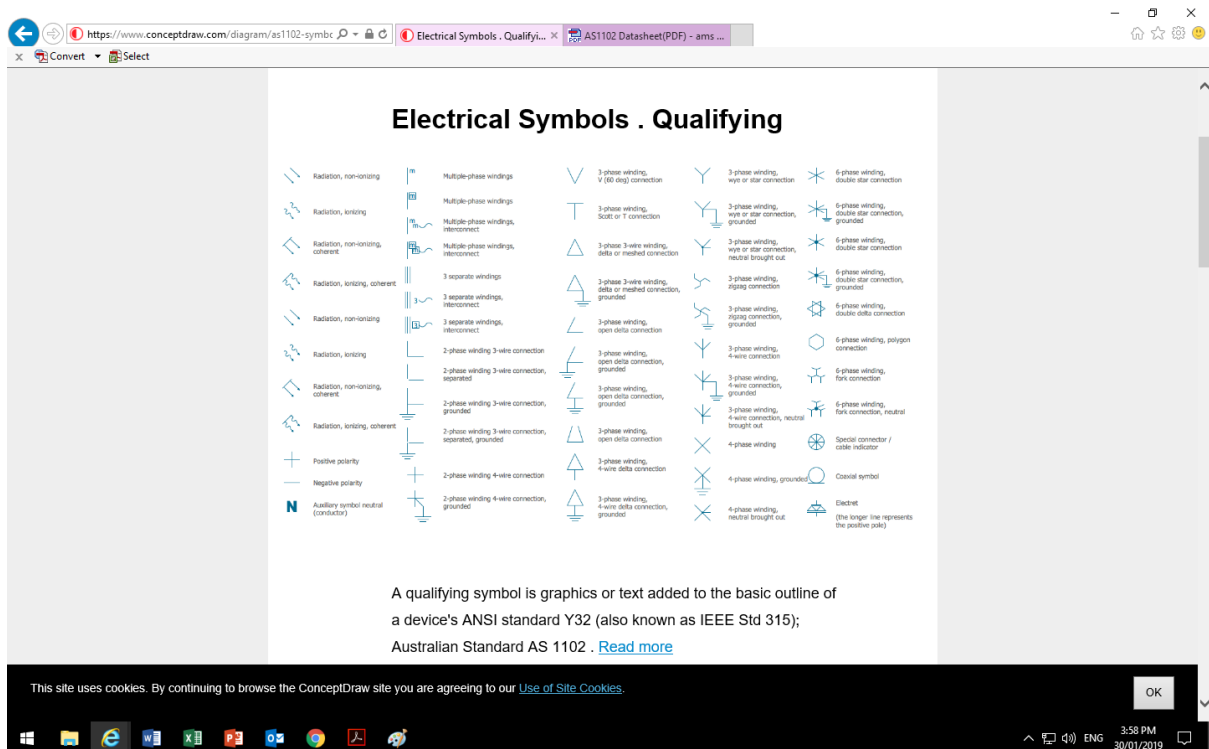
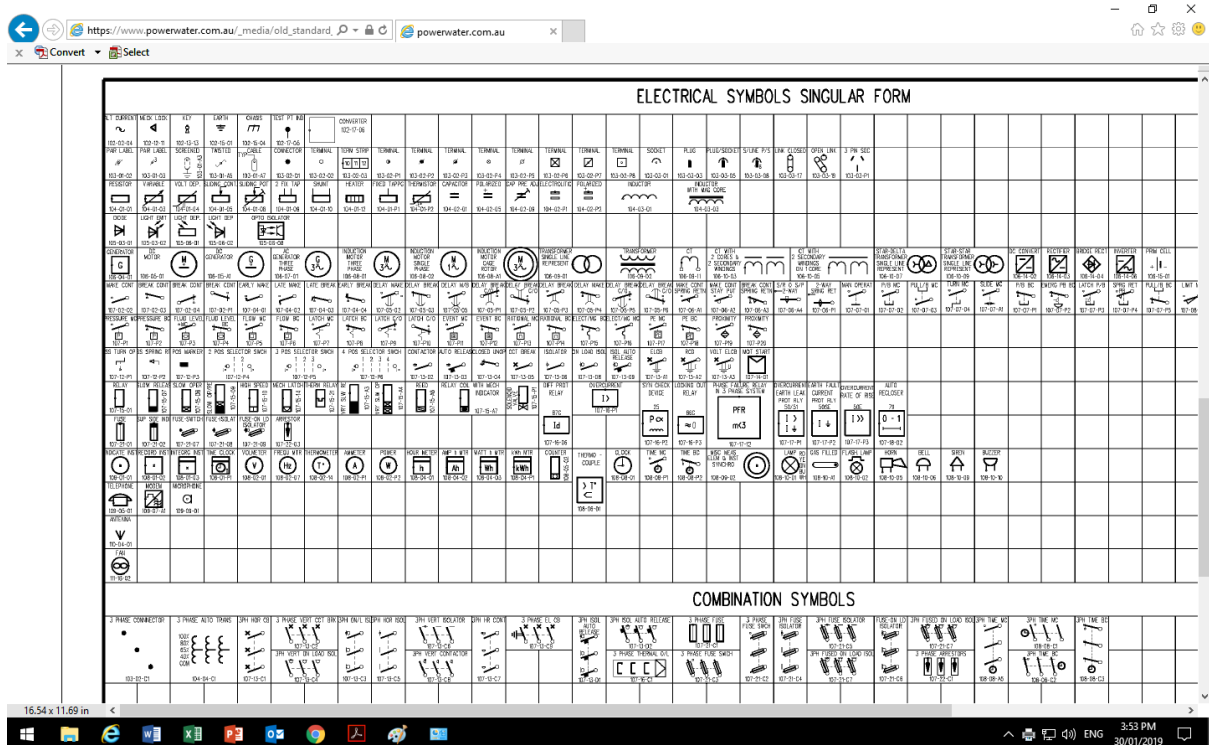
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Refer the given sheet



2. The best type of electrical diagram to use when fault finding electrical equipment is a/an:-

- circuit diagram;
- wiring diagram;
- block diagram;
- architectural diagram.

3. What are the five different type of diagrams used in the electrical industry?

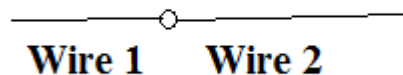
- a) _____
- b) _____
- c) _____
- d) _____
- e) _____

- a) circuit diagram;
- b) wiring diagram;
- c) block diagram;
- d) skeleton diagram
- e/schematic diagram

4. What is another name for a circuit diagram?

Connection diagram

5. Draw the symbol for a connection of 2 wires to a terminal as used in a wiring diagram.



6. Convert the circuit diagram in below into a wiring diagram

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Convert the circuit diagram in below into a wiring diagram

Circuit Diagram

Wiring Diagram

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1. INTRODUCTION
The circuit diagram is a detailed diagram intended to describe the _____ of every component in the circuit and can also be used to assist with _____. Circuit diagrams are sometimes referred to as 'schematic diagrams'. Circuit diagrams can be very complex and for a piece of equipment may in fact contain several circuits. All circuit diagrams contain symbols representing components, or items of equipment, interconnected by lines representing conductors.

2. CIRCUIT DIAGRAM CONVENTIONS
Power/Energy Flow and Operational Sequence
The figures below show the two accepted methods of aligning or arranging diagrams to show energy flow throughout a circuit. Although both are acceptable, the most common arrangement for circuit diagrams is the vertical representation.

Vertical Orientation Horizontal Orientation

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Connection/ Fault finding

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Vertical Orientation
□ Power flow top to bottom
□ Sequence of operation left to right

Horizontal Orientation
□ Power flow left to right
□ Sequence of operation top to bottom

Symbol Relationships
Circuit diagrams are most commonly drawn as detached representation where component parts of an item are drawn _____ from each other. This method of presentation of symbols produces a _____ understood diagram compared to using the correct physical layout because the parts are drawn to show how they affect circuit operation (detached) rather than where they actually appear in the circuit (attached). The example shown is the control part of the motor start circuit from the previous section. It can be seen that there are five contacts being used on contactor 'L' and three on contactor 'A'. Contacts L4 and L5 are being used to latch the start operation and control the timing of the energising of contactor A respectively.

Detached (remote) representation

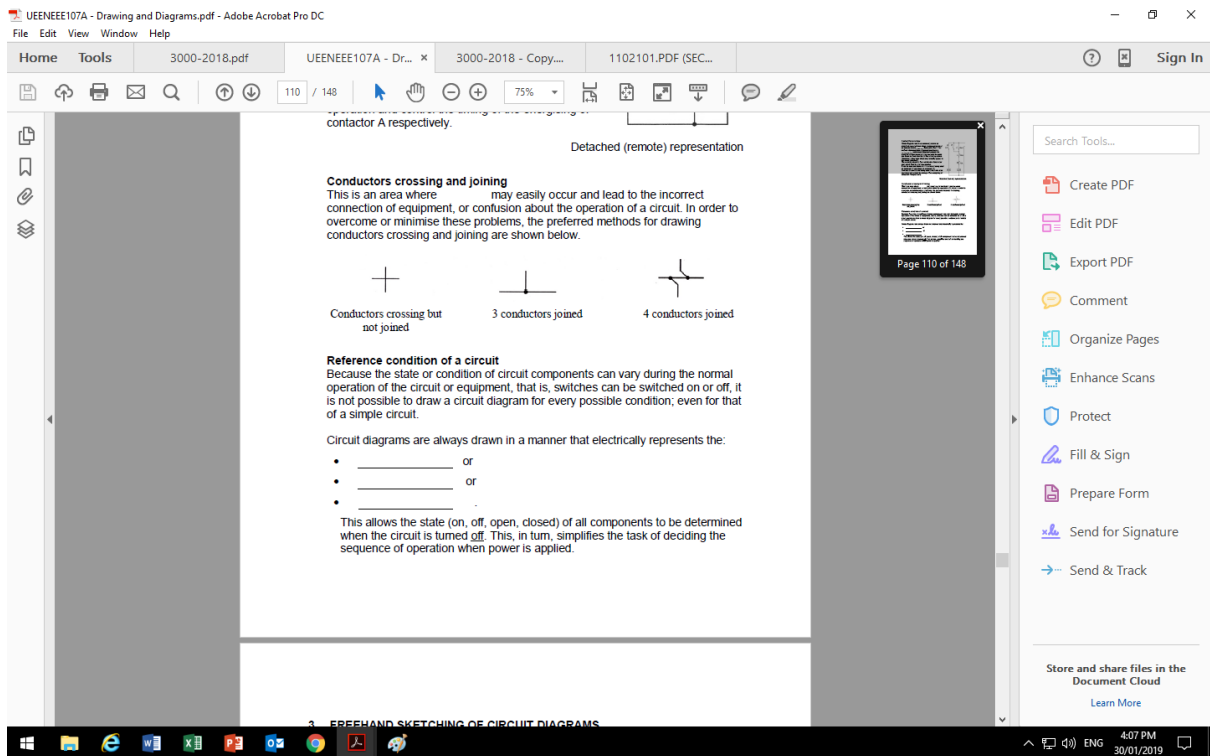
Conductors crossing and joining
This is an area where _____ may easily occur and lead to the incorrect connection of equipment, or confusion about the operation of a circuit. In order to overcome or minimise these problems, the preferred methods for drawing conductors crossing and joining are shown below.

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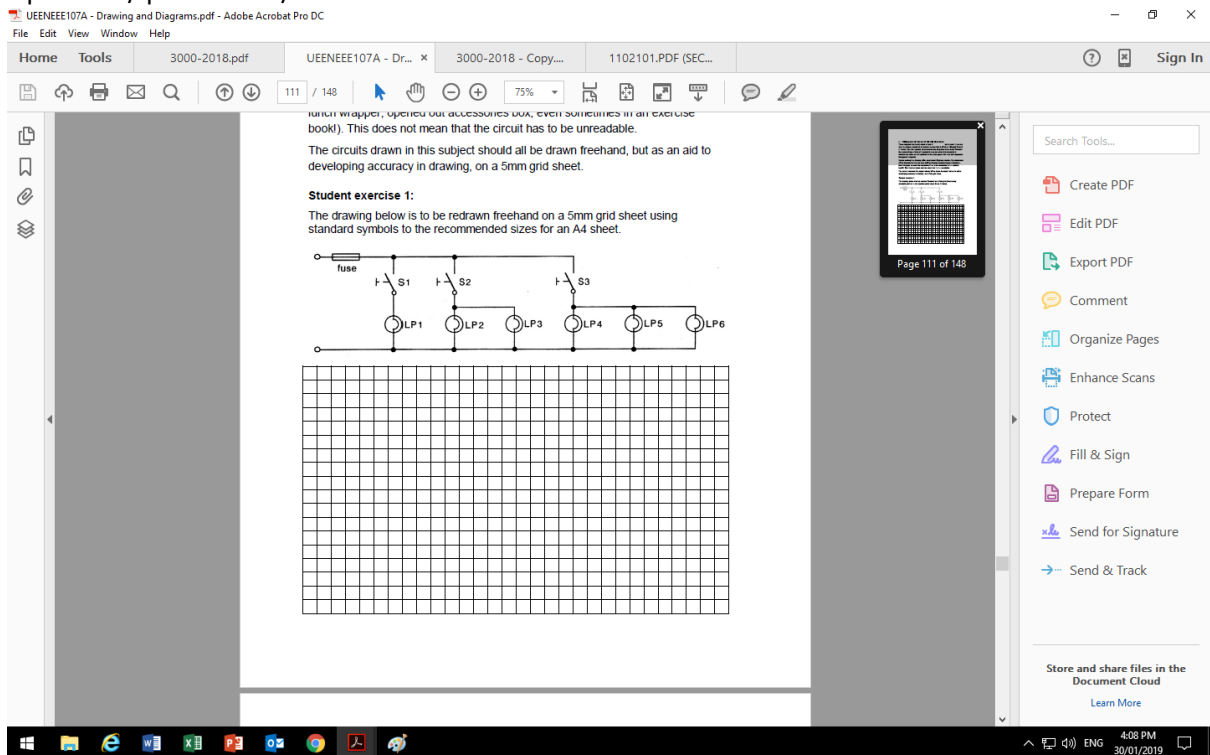
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Right/ Sequence



Operation/ power flow/ control



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4. CIRCUIT SYMBOLS

Student Exercise 2: Using a pencil, draw what you think may be the Australian Standard symbols for each description given in Table 1 below (you may refer to your textbook):

Description	Your drawing	Correct drawing
Manually operated switch – Normally Open		
Manually operated switch – N/C		
Fuse		
Lamp – illuminating		
Lamp – signal or illuminating		
Single Pole, Double Throw (SPDT) – changeover switch		
Time Delay Contacts (switch – instant on/time delay off)		
Circuit Breaker – single pole		
Double Pole Switch – switch both active and neutral. (used on construction sites for safety)		
Triple Pole Switch – 3 phase switch		
Single Pole, Multi Position – selector switch		
Push Button Switch – single pole, non latching (N/O)		
Push Button Switch – single pole, non		

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It is not always necessary to enter an actual resistance value in the table, usually it is sufficient to indicate with an 'X' only those positions where a circuit is present.

Student Exercise 3:

The following diagram of figure 2 is that of a circuit containing a single-pole double-throw switch (such as a HPM type 770) controlling a lamp. Using the diagram and your electrical reasoning, fill in the switching table.

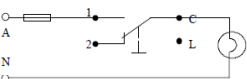


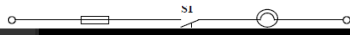
Fig. 2

Terminals	Toggle Up	Toggle Down
C - 1		
C - 2		
C - L		
1 - 2		
1 - L		
2 - L		

This procedure can be used for all unfamiliar accessories and devices. Only experience with a given accessory eliminates the need to determine terminal connections. This procedure may also be used for accessories other than switches, as it provides a useful means of identifying terminal allocation.

Single-way switching - single lighting point

Single-way switching provides simple ON/OFF control of one or more lighting points from a single switch.



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Student Exercise 3:

The following diagram of figure 2 is that of a circuit containing a single-pole double-throw switch (such as a HPM type 770) controlling a lamp. Using the diagram and your electrically reasoning, fill in the switching table.

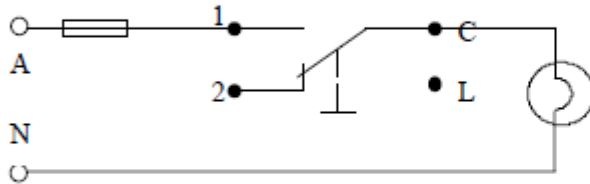


Fig. 2

Table 2

Terminals	Toggle Up	Toggle Down
C - 1	X	
C - 2		X
C - L	X	X
1 - 2		
1 - L	X	
2 - L		X

This procedure can be used for all unfamiliar accessories and devices. Only experience with a given accessory eliminates the need to determine terminal connections. This procedure may also be used for accessories other than switches, as it provides a useful means of identifying terminal allocation.

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Two-way switching - single lighting point

It is often necessary to control a lighting point from either of two positions e.g. for lighting in a or . In these situations the lighting point must be capable of being switched ON or OFF from either of the two control positions. Switches S1 and S2 in figure 5 are SPDT type switches. The switching chart for a SPDT switch is shown on the previous page (table 2).

Fig. 5: Two-way switching single lighting point

NOTE: with a two-way switching circuit, it is possible that the light can be turned on by moving the toggle up, depending on the position of the other switch. That is, neither switch has a true OFF position. A typical light switch such as a Clipsal 39 series or a HPM 770 series may be used as either a single or two-way switch.

Student Exercise 4:

Refer to figure 5 and complete table 3.

Switch configuration	LP1 condition On	LP1 condition Off
Switches S1 and S2 both toggled down (as drawn)		
Switch S1 toggled up only		
Switch S2 toggled up only		
Switches S1 and S2 both toggled up		

Intermediate Switching

Intermediate switching is an extension of the principle of two-way switching. The block diagram of Fig. 6 explains.

Fig. 6: Block diagram - two-way and intermediate switching

Two-way switching - single lighting point

It is often necessary to control a lighting point from either of two positions e.g. for lighting in a or . In these situations the lighting point must be capable of being switched ON or OFF from either of the two control positions. Switches S1 and S2 in figure 5 are SPDT type switches. The switching chart for a SPDT switch is shown on the previous page (table 2).

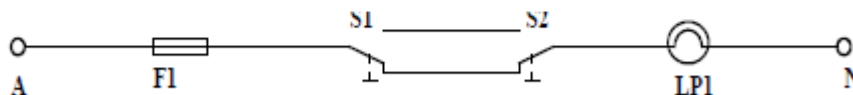


Fig.5: Two-way switching single lighting point

NOTE: with a two-way switching circuit, it is possible that the light can be turned on by moving the toggle up, depending on the position of the other switch. That is, neither switch has a true OFF position. A typical light switch such as a Clipsal 39 series or a HPM 770 series may be used as either a single or two-way switch.

Student Exercise 4:

Refer to figure 5 and complete table 3.

Switch configuration	LP1 condition	
	On	Off
Switches S1 and S2 both toggled down (as drawn)	X	
Switch S1 toggled up only		X
Switch S2 toggled up only		X
Switches S1 and S2 both toggled up	X	

Upstair / Downstair
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Switch 1 – Panel 1

1. Using a suitable testing device, check for continuity between each terminal combination for each position of the switch toggle.
2. Number the switch terminals on the diagram according to your results.
3. Draw, in the table below, the switching chart for the switch on the panel stated. Remember to take into account the:
 - a. Number of terminals
 - b. Number of switch positions
4. Indicate the closed terminal connections with a cross in the appropriate box.
5. Draw the Australian standard symbol for the switch next to the table.

Terminals	Toggle Up	Toggle Down

Switch 1 – Panel 2

1. Using a suitable testing device, check for continuity between each terminal combination for each position of the switch toggle.
2. Number the switch terminals on the diagram according to your results.
3. Draw, in the table below, the switching chart for the switch on the panel stated. Remember to take into account the:
 - a. Number of terminals
 - b. Number of switch positions
4. Indicate the closed terminal connections with a cross in the appropriate box.
5. Draw the Australian standard symbol for the switch next to the table.

Terminals	P/B In	P/B Out

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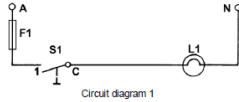
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2. CIRCUIT DIAGRAMS

The task is to connect equipment according to a circuit diagram and confirm the operation of the circuit.

Single lamp controlled by a single switch

1. Connect the circuit according to the circuit diagram.



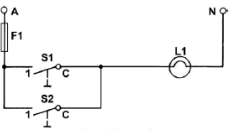
Circuit diagram 1

Have your teacher check your circuit connections

2. Apply power to the circuit and check that it operates correctly.

3. With the power turned off disconnect the circuit.

Single lamp controlled by parallel connected switches



Circuit diagram 2

1. Connect the circuit according to the circuit diagram

Have your teacher check your circuit connections

2. Apply power to the circuit and check that it operates correctly.

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These questions will help you revise what you have learnt in Section. In the following statements, circle the letter that best answers the question.

1. Circuit diagrams are intended to describe:

- (a) The operation of some components in a circuit
- (b) The operation of switch contacts in a circuit
- (c) **The operation of all components in a circuit**
- (d) The physical layout of components in a circuit

2. Circuit diagrams are sometimes referred to as:

- (a) **schematic diagrams**
- (b) block diagrams
- (c) wiring diagrams
- (d) component diagrams

3. Circuit diagrams are always drawn in the electrically:

- (a) cold condition
- (b) shutdown condition.
- (c) reset condition
- (d) **all of the above**

4. SPST is an abbreviation for:

- (a) single plate/single throw
- (b) switch plate/single throw
- (c) single pole/switch toggle
- (d) **single pole/single throw**

5. An instrument suitable for testing circuit continuity would be a:

- (a) voltmeter
- (b) ohmmeter
- (c) wattmeter
- (d) none of the above

6. What is the minimum number of switches to be wired for an intermediate switch setup:

- (a) 1
- (b) 2
- (c) 3
- (d) 4

7. A triple pole switch is a switch which:

- (a) opens or closes three contacts simultaneously with one toggle action
- (b) opens or closes one single contact with three toggle actions
- (c) has three switch mechanisms mounted on one plate
- (d) opens or closes three contacts with a triple action

Section B - Blank spaces in the following statements represent omissions. Write the appropriate information.

1. All circuit diagrams contain ____symbol____ that represent components or items of equipment.

2. The most common arrangement for circuit diagrams is ____equipment____ representation.

3. Circuit diagrams are commonly drawn as ____left to right____ where component parts of an item are drawn remote from each other.

4. When freehand sketching, it is important to maintain the same ____sketch____ for all symbols for the same type of device.

5. Switching charts provide a useful means of identifying ____switch____ allocation.

6. Intermediate switching allows on/off control from any of ____3____ or more switching positions.

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6. Intermediate switching allows on/off control from any of ____ or more switching positions.

Section C - In the space provided, draw the Australian Standard symbols for the following:

a) Lamp - illuminating	
b) SPST switch (open)	
c) SPST switch (closed)	
d) Circuit breaker - single pole	
e) Circuit breaker - double pole	

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Building Construction Drawings & Diagrams.

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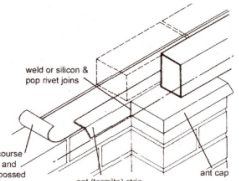
ii. Brick piers
iii. Concrete stumps (some states allow timber stumps)

To help prevent dampness and white ants entering the floor structure, a _____ course and _____ caps are placed between the base and the floor timbers.

Ant capping to piers and ant stripping to the base wall is an essential measure required in all areas, particularly where there is termite activity. The capping must be thoroughly bonded and must be kept intact.

The damp course prevents moisture rising up the wall. ("rising damp")

NOTE: Ant caps or strips and damp course should never be cut, damaged or removed to gain cable access.



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Damp proof course/ Ant cap **Student exercise 1:** - Complete the following:

What is the purpose of a 'drip loop'?

When terminating, an excess of cable should be pushed back into the cavity so that a loop of cable is formed which is lower than the point of termination.

List 2 possible consequences of not properly forming a 'drip loop'

It will provide a moisture path from the external wall to the internal/ Cable will be wet by touching with wall.

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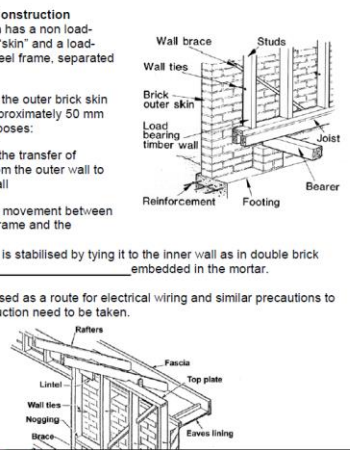
Brick Veneer Wall Construction
Veneer construction has a non load-bearing outer brick "skin" and a load-bearing timber or steel frame, separated by a cavity.

The cavity between the outer brick skin and the frame is approximately 50 mm and serves two purposes:

- To prevent the transfer of moisture from the outer wall to the inner wall
- To allow for movement between the timber frame and the brickwork.

The outer brick wall is stabilised by tying it to the inner wall as in double brick construction, with _____ embedded in the mortar.

The cavity can be used as a route for electrical wiring and similar precautions to double brick construction need to be taken.



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Damp course

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Hardboard
PVC (sheeting or planks)

Electrical cabling is run through the timber frame by means of drilled holes.

The holes should be drilled to the _____ possible dimension to avoid weakening the timber structure.

The cable hole must be drilled in the centre of the studs to avoid cable damage from fixing devices, nails and screws etc.

Metal frame walls have integral holes in them which allow the passage of cable. The holes must be fitted with a flexible grommet to protect the cable from damage.

Student exercise 2:
Refer to AS/NZS 3000:2007 *Clause 3.9.4*, and answer the following:

(a) TPS cable requires further mechanical protection if installed within _____ mm of an external or internal surface.

(b) List 1 protection method (including the clause number) that could be used if a cable were to be installed in a location deemed to 'require additional protection'.

_____ Clause: _____

Minimum

Student exercise 2:

Refer to AS/NZS 3000:2007 *Clause 3.9.4*, and answer the following:

(a) TPS cable requires further mechanical protection if installed within _____ mm of an external or internal surface.

(b) List 1 protection method (including the clause number) that could be used if a cable were to be installed in a location deemed to 'require additional protection'.

_____ Clause: _____

3.3.2.6 Mechanical damage

Wiring systems shall be selected and installed so as to minimize the risk of mechanical damage.

Protection against mechanical damage shall be provided by one or any combination of the following:

- (a) Mechanical characteristics of the wiring system.
- (b) Location selected.
- (c) Provision of additional local or general mechanical protection.

NOTE: Guide to adequacy and WS classification is provided in Appendix H.

3.9.3.3 Wiring systems likely to be disturbed

3.9.3.3.1 Location

Wiring systems installed in the following locations are deemed likely to be disturbed:

- (a) On the surface of a wall or on the underside of a ceiling or roof.
- (b) In a space between a floor and the ground to which a person may gain entry.
- (c) In parts of a ceiling space where access is greater than 0.6 m in height.
- (d) Within 2.0 m of any access to any space to which a person may gain

entry.

(e) Below raised floors.

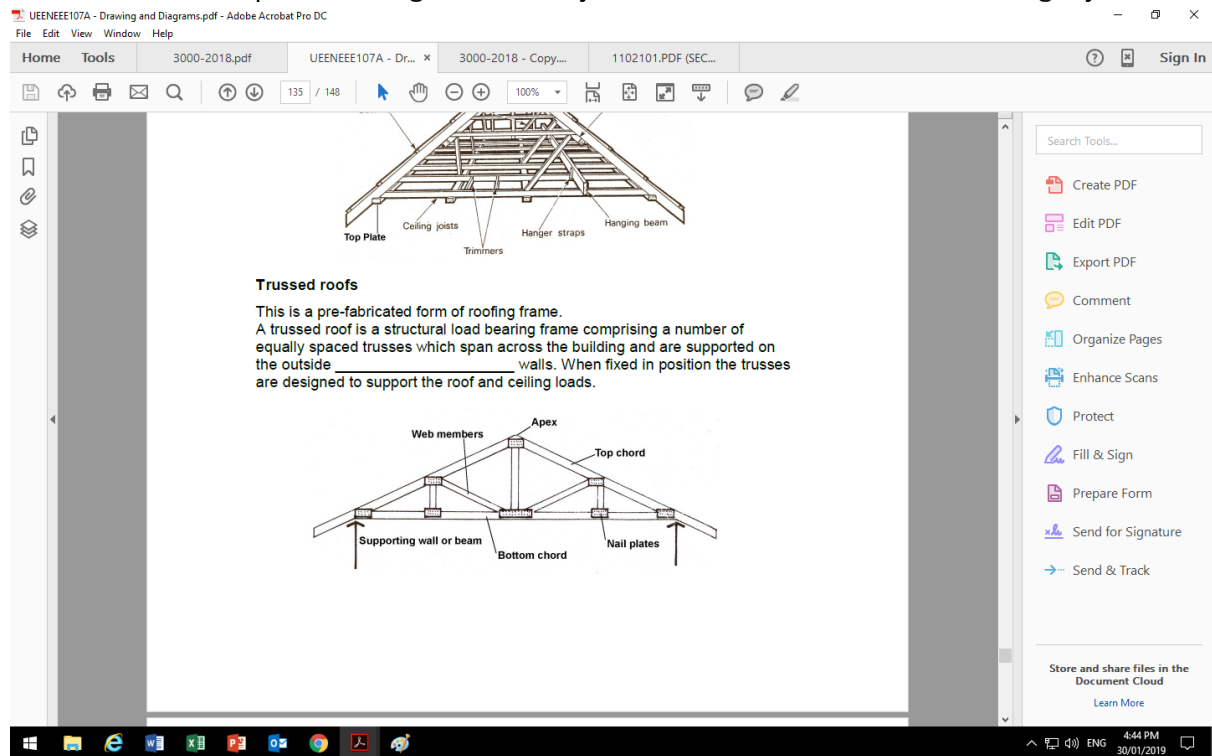
3.9.4.2 Wiring systems near building surfaces

* Wiring systems that are fixed in position by fasteners, or held in position by

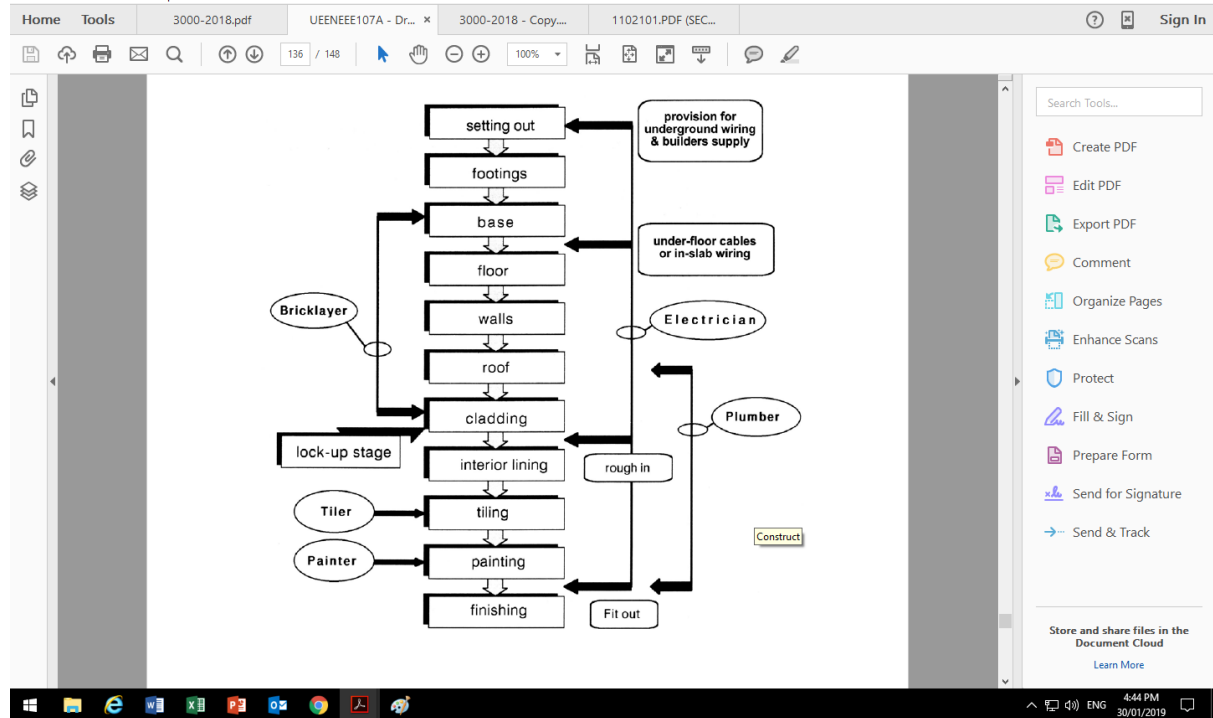
thermal insulation, or by passing through an opening in a structural member, shall be protected by one of the methods outlined in

Clause 3.9.4.4 if they are concealed within 50 mm from the surface of a wall, floor, ceiling or roof.

Exception: This requirement need not apply to wiring systems that can move freely to a point not less than 50 mm from the surface in the event of a nail or screw penetrating the cavity at the location of the wiring system.



Cavity



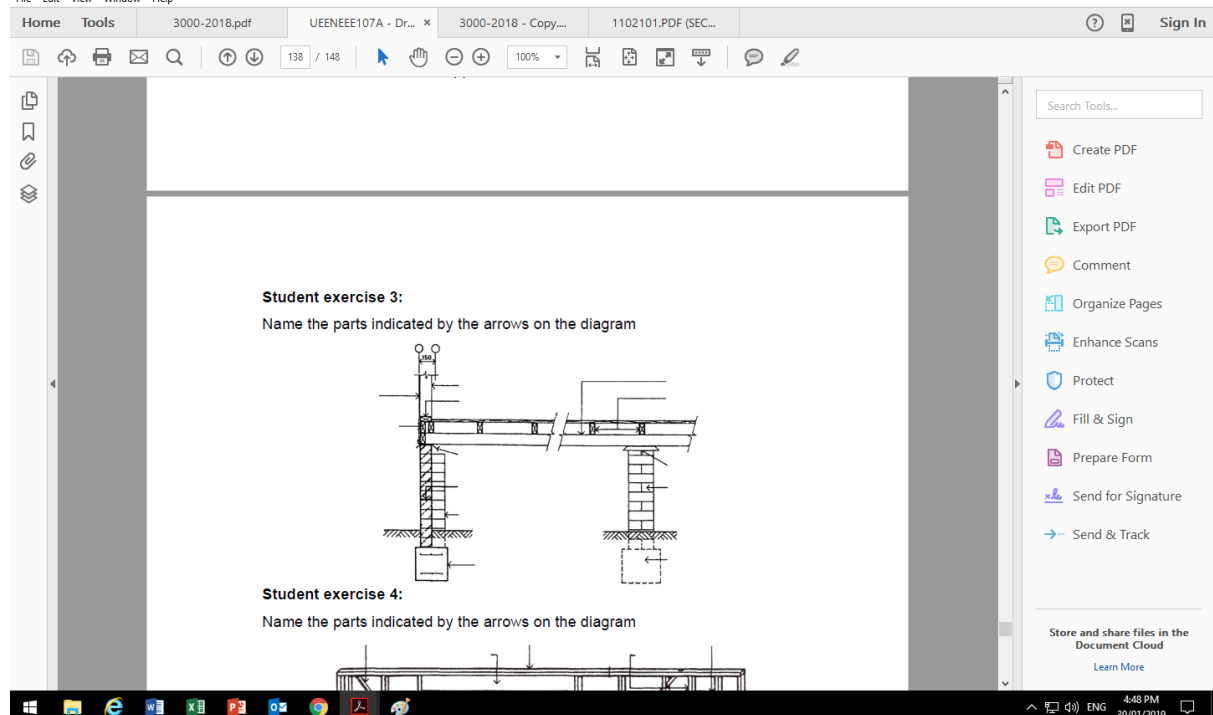
Inter-trade Relationships in the Building Sequence

The electrician must be familiar with the construction sequence and the structural details so that the wiring can be hidden as much as possible.

Also, an appreciation of the role and timing of other tradespersons on the job can improve communication and co-operation. This is important to be able to determine when it is appropriate to install _____, fit _____ and _____.

Under floor cable/ slab wiring , fit out, rough in

EXERCISE 3



Refer

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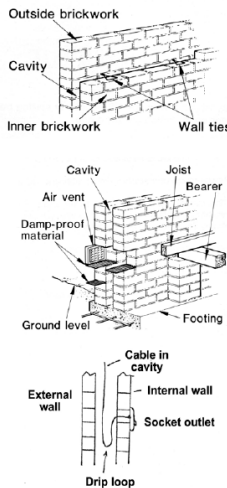
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Cavity Brick Wall Construction
Cavity or double brick construction has two brick walls separated by a cavity of approximately 50 mm and the two walls are held together with wall ties of either steel strip or wire embedded in the joints.

The inner skin of the brickwork is structural i.e. the load-bearing part, while the outer skin provides protection from the weather as well as being designed for visual effect.

The function of the wall cavity is to:

- Provide a moisture barrier from the outside wall to the inside wall (most masonry is porous)
- Provide air circulation to assist in drying out any moisture that has penetrated the external wall
- Provide thermal and acoustic insulation



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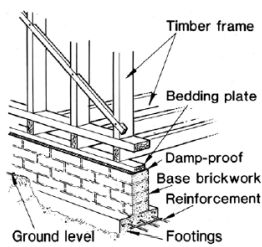
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Timber or Metal Frame Construction
Timber frame construction employs a single timber frame, which forms the internal and external walls.
That is there is no cavity.
The internal wall is clad with normal internal cladding (Gyprock etc)
The outside of the frame must be covered with one of various types of waterproof cladding.
Some types of cladding include:

- Weatherboards (timber)
- Brick tile sheets
- Treated metal (aluminium or steel)
- Fibre cement (sheets or planks)
- Plywood
- Hardboard
- PVC (sheeting or planks)



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EXERCISE 4+5

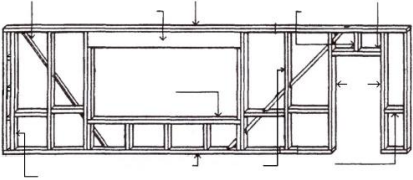
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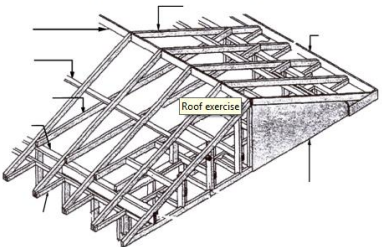
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Student exercise 4:
Name the parts indicated by the arrows on the diagram



Student exercise 5:
Name the parts indicated by the arrows on the diagram



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masonry.

Eaves – The lower part of the roof that overhangs the wall.

Footing – The construction whereby the weight of the structure is transferred from the base structure to the foundation.

Gable – The triangular end of a house formed at the end of a pitched roof, from the eaves line to the apex.

Hip roof – A roof which is roughly pyramidal in shape with surfaces sloping upwards from all the eaves.

Joists, ceiling – Timber members spanning between walls or other supports, to which the ceiling is attached.

Joists, floor – Timber members to which the flooring is fixed.

Lintel – A horizontal load-bearing member spanning an opening.

Nogging – A horizontal piece of timber providing a stiffener between studs in wall frames.

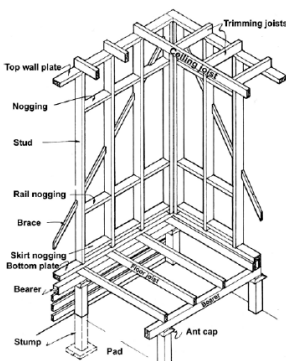
Pier caps (Ant caps) – A membrane (usually galvanised steel) to prevent dampness and deter insect attack of sub-floor timber.

Purlins – Longitudinal roof timber giving intermediate support for rafters.

Rafter – In roof construction, a timber framing member providing the principle support for the roofing material.

Sarking – A covering of waterproof building paper or boarding fixed on the top of the rafters beneath the external roof covering.

Skillion or lean-to roof – A roof sloping in one direction only with the rafters pitching or leaning against a wall.



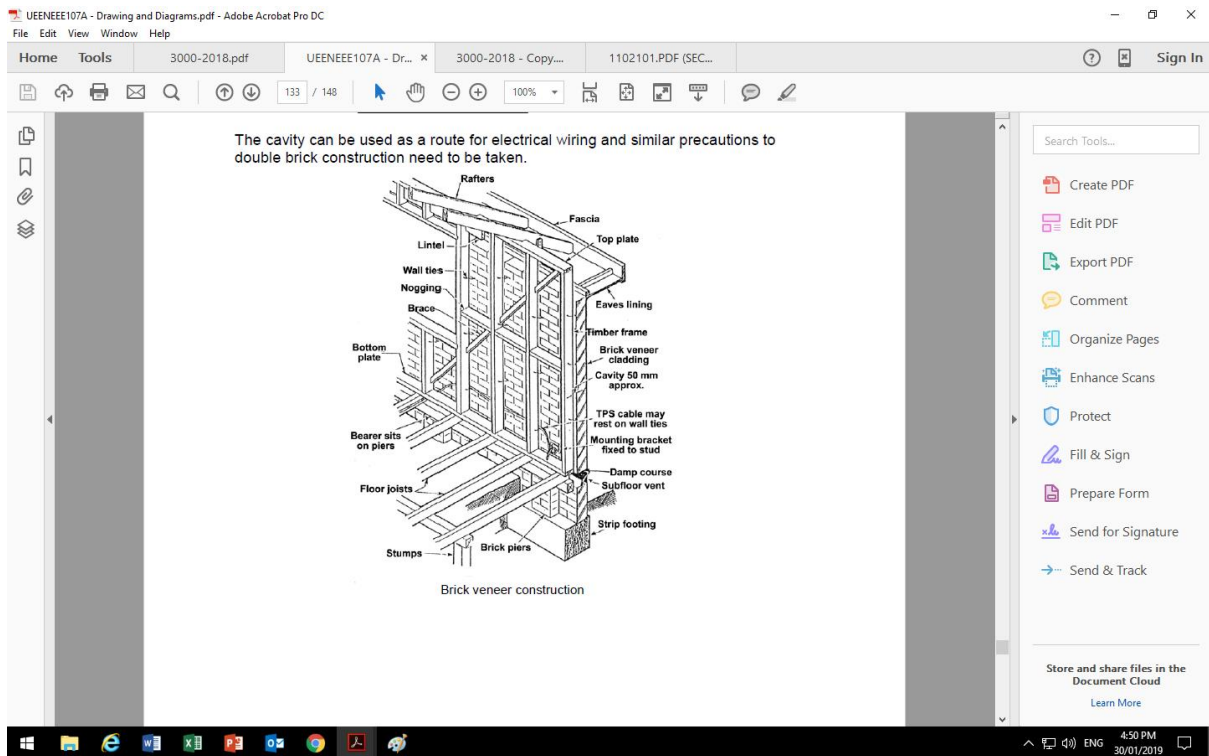
Labels in diagram: Top wall plate, Stud, Nogging, Rail nogging, Brace, Skirt nogging, Bottom plate, Bearer, Stump, Pad, Ant cap, Trimming joists, Ceiling joist.

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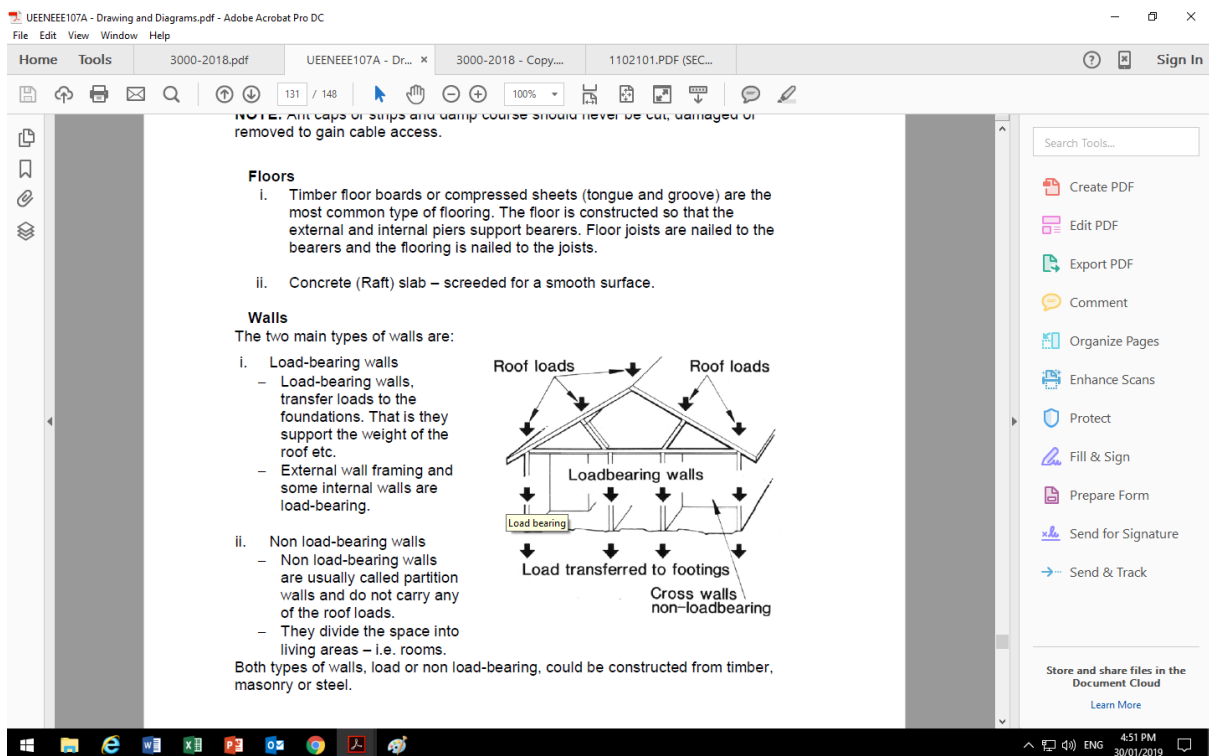
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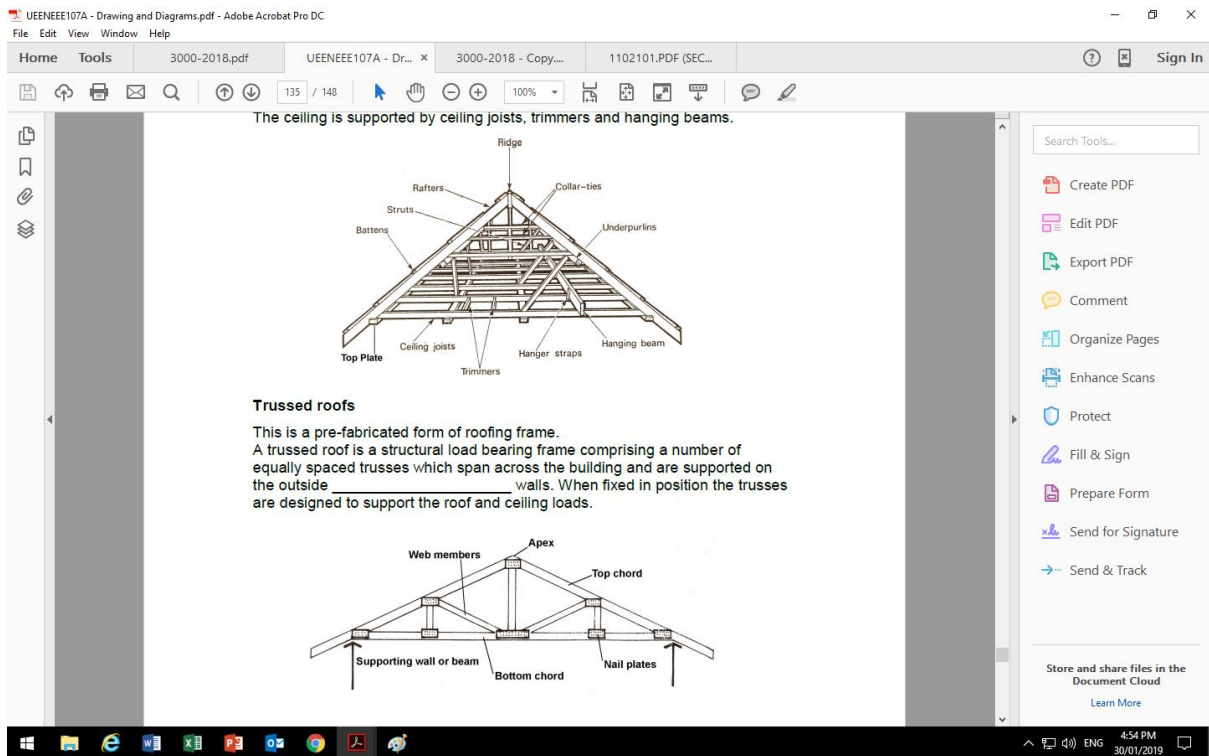
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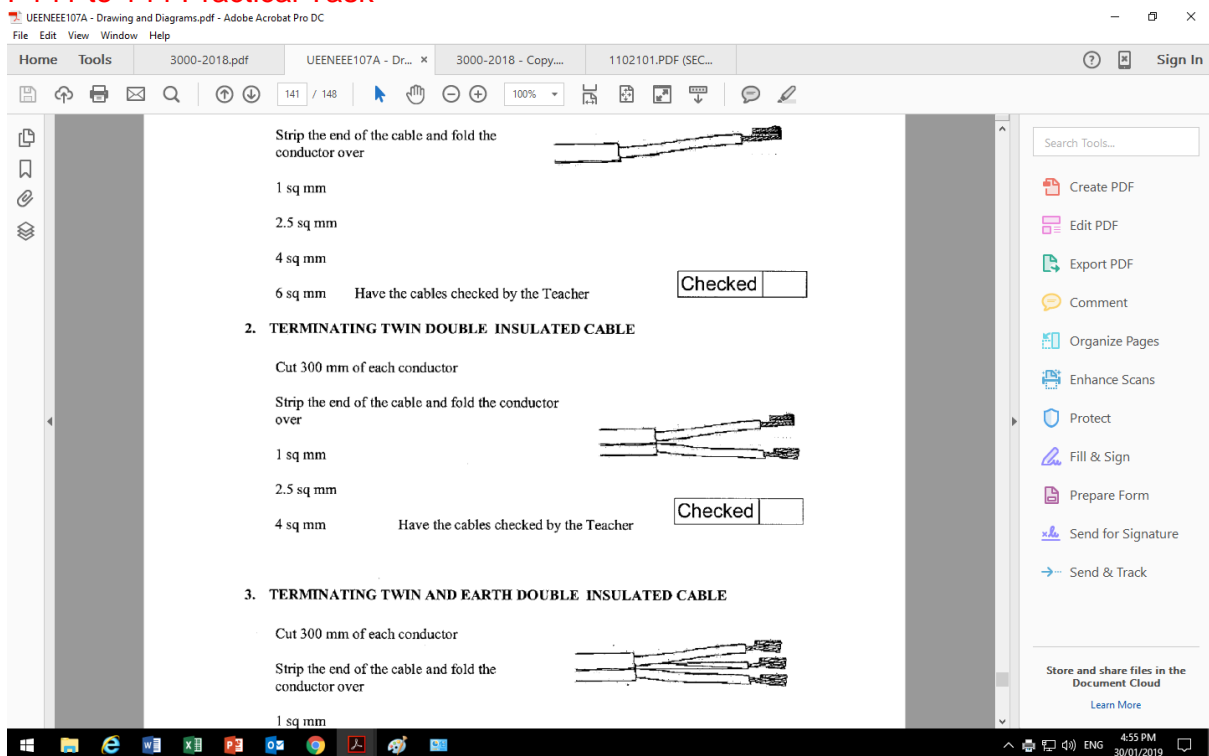


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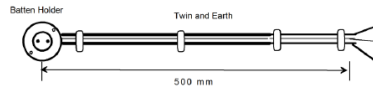


P141 to 144 Practical Task



1. 1.5 SQ MM TWIN AND EARTH CABLE

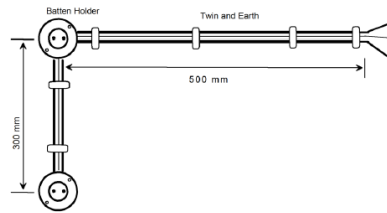
1. Cut cable to size and pin clip or cable clip the cables to the board
2. Fix junction box to the board and connect the junction box
3. Connect the lighting point
4. Strip the end of the supply cable – 75mm single insulated, 15mm exposed, twisted copper.



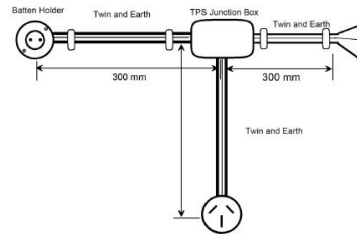
Have your teacher check your work

Checked

5. Add another light point to the existing point.



6. Re-arrange the circuit and add a junction box and 3 pin socket base.



Have your teacher check your work

Checked

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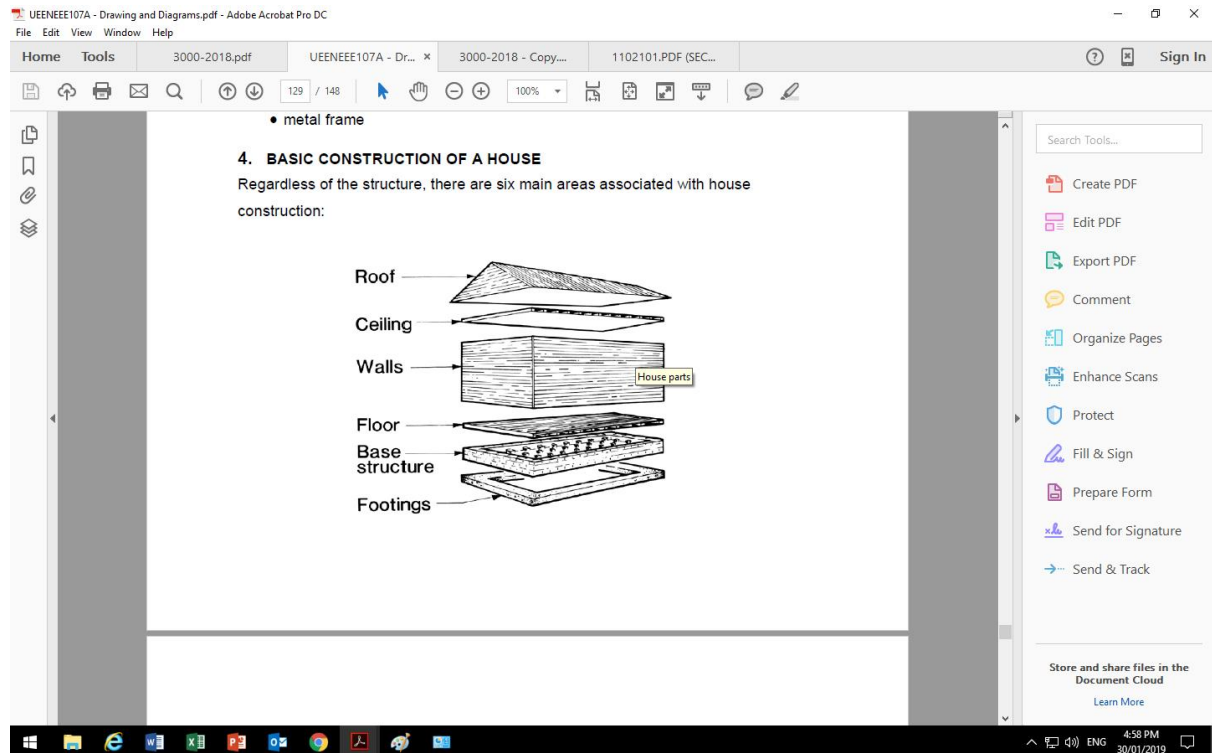
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Building Construction.

These questions will help you revise what you have learnt in Section. In the following statements, circle the letter that best answers the question.

1) Name the six main parts of a structure.

a) _____ b) _____ c) _____
b) _____ e) _____ f) _____



2) State two reasons why a concrete slab footing is sometimes used in preference to piers.

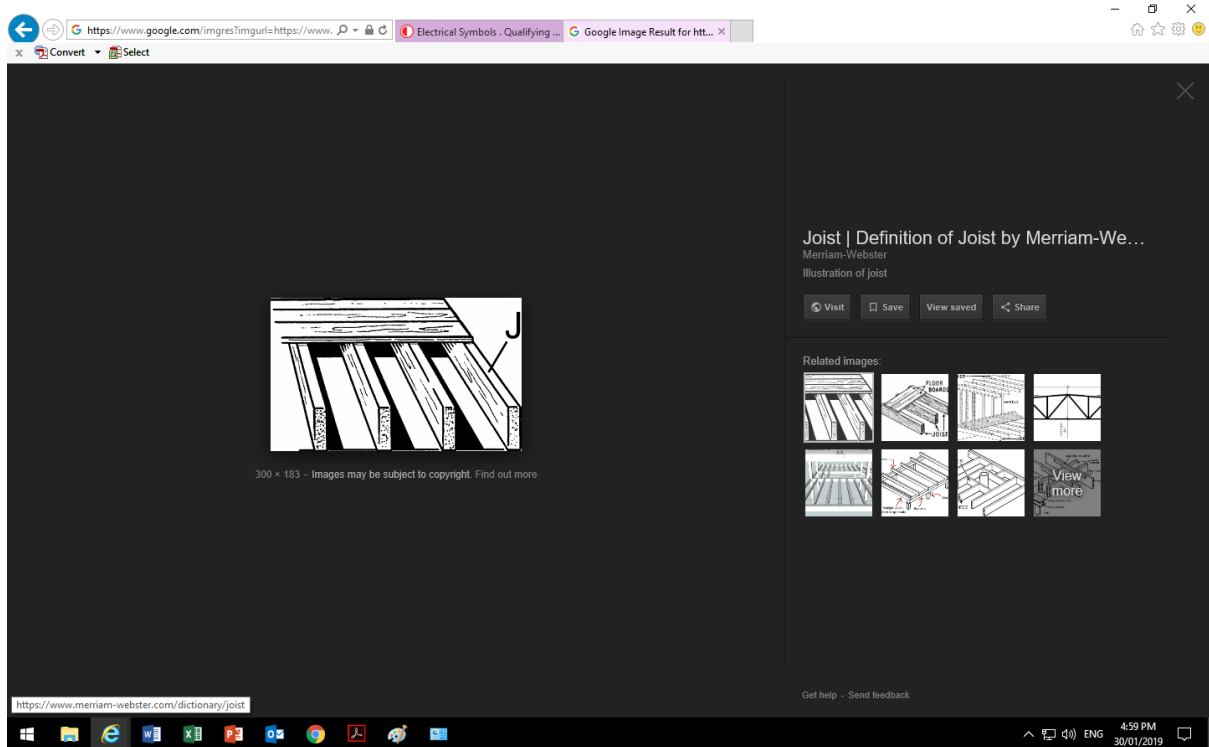
a) _____
b) _____

Concrete slab footings – act as the support for the structure as well as being the floor

3) Define the following terms used in timber floor construction:

a) Floor joists: _____

_____ **Definition of joist.** : any of the small timbers or metal beams ranged parallel from wall to wall in a structure to support a **floor** or ceiling.



b) Bearers: _____

___ **Bearers** are the timber or steel that attaches directly to the stumps in the ground, that supports the deck of flooring structure. **Joists** are the timbers that then attach across the top of the **bearers**, after which the timber or particle board floor is then attached _____

c) Pier: _____
1. a platform on pillars

d) Floorboard: _____
long plank making up part of a wooden floor in a building.

4) Define the following terms used in framed wall construction:

a) Studs: _____

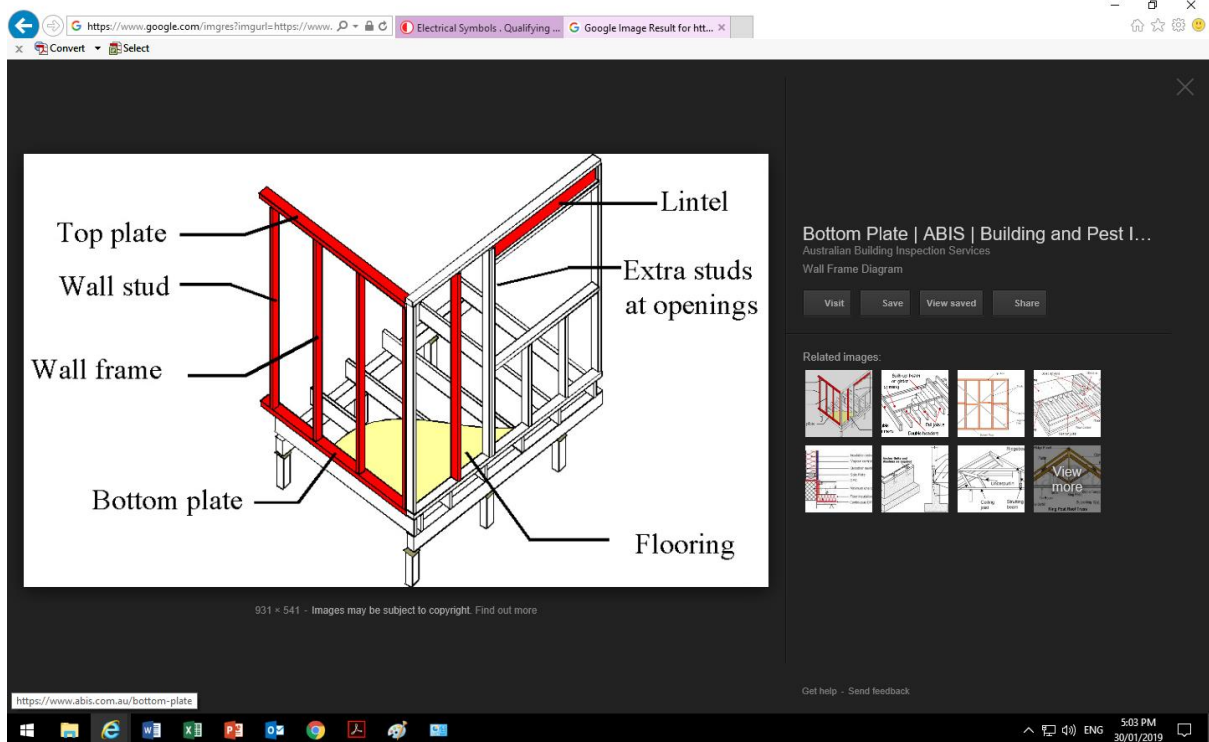
_____ large-headed piece of metal that pierces and projects from a surface, especially for decoration

b) Top plate: _____

_____ A **Top Plate** is the continuous timber beam on **top** of the walls that supports the roof structure by carrying the vertical forces from the rafters to the wall studs

c) Bottom plate: _____

A **Bottom Plate** is the piece of timber which sits on the floor and forms the **bottom** of the wall, carrying the stud loads to the floor joists



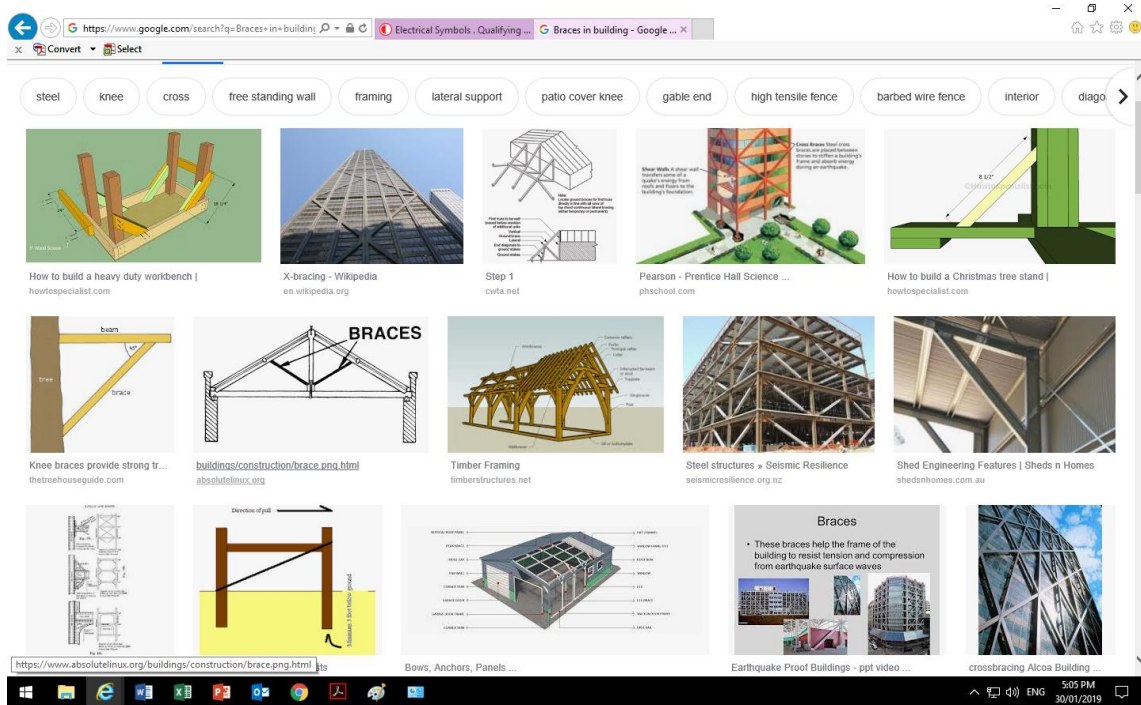
d) Noggings: _____

- _____ a horizontal piece of wood fixed to a framework to strengthen it.

e) Braces: _____

What is a brace in construction?

In **construction**, cross **bracing** is a system utilized to reinforce building structures in which diagonal supports intersect. Cross **bracing** can increase a building's capability to withstand seismic activity. **Bracing** is important in earthquake resistant buildings because it helps keep a structure standing



5) Define the following terms used in brick wall construction: a) Single brick wall:

What is a single brick wall?

A leaf is as thick as the width of one **brick**, but a **wall** is said to be one **brick** thick if it is as wide as the length of a **brick**. Accordingly, a **single-leaf wall** is a half **brick** thickness; a **wall** with the simplest possible masonry transverse bond is said to be one **brick** thick, and so on

b) Course: _____

What is a course in masonry?

A **course** is a layer of the same unit running horizontally in a wall. It can also be defined as a continuous row of any **masonry** unit such as bricks, concrete **masonry** units (CMU), stone, shingles, tiles, etc. ... If a **course** is the horizontal arrangement then a wythe is the vertical section of a wall

c) Feature wall:

What is feature wall?

Feature walls are most often used when the rest of the room is decorated with a fairly neutral colour. You pick a **wall** in the room and paint it a different colour, or **wallpaper** it with a bold pattern, creating a **feature**. A **feature wall** can also be used to create a more defined space in an open-plan area

d) Rendered wall:

_____ What does render a wall mean?

Cement **rendering** is the application of a premixed layer of sand and cement to brick, cement, stone, or mud brick. It **is** often textured, colored, or painted after application. It **is** generally used on exterior **walls** but can be used to feature an interior **wall**.

6) What is the average width of the cavity between the brick wall and the framed wall in brick veneer construction?

___ **Cavity width**

General: Provide minimum cavity widths in conformance with the following:

- Masonry walls: 50 mm.
 - Masonry veneer walls: 40 mm between the masonry leaf and the loadbearing frame and 25 mm minimum between the masonry leaf and sheet bracing.
-

7) What purpose does the cavity serve in a double brick wall?

_____ **Cavity** walls consist of two "skins" separated by a hollow space (**cavity**). The skins are commonly masonry, such as brick or concrete block. Masonry is an absorbent material, and therefore will slowly draw rainwater or even humidity into the wall, as well as from the inside of the house as from outside Advantages of Cavity Walls. Following are the advantages of cavity wall when compared to solid walls. Cavity walls give better thermal **insulation** than solid walls. It is because of the **space** provided between two leaves of cavity walls is full of air and reduces heat transmission into the building from outside.

8) Name three common types of roof covering.

- a) _____ b) _____ c) _____
- Asphalt Roofing. Asphalt roofing is the most common form of roof covering in the United States. ...
 - Clay Tile Roofing. Clay tile roofing is one of the oldest forms of roofing. ...
 - Flat Roof Covering Options. ...
 - Metal Roofing. ...
 - PVC Flat Roofing. ...
 - Rubber Roofing. ...
 - Shingle Roofing. ...
 - Slate Roofing.

9) In what circumstances are trussed roofs used?

Planar truss. ... Planar **trusses** are typically **used in** parallel to form roofs and bridges. The depth of a truss, or the height between the upper and lower chords, is what makes it an efficient structural form. A solid girder or beam of equal strength would have substantial weight and material cost as compared to a truss

10) List four materials used to clad the external walls of a house built using timber frame construction.

a) _____ b) _____
c) _____ d) _____

Materials. Cladding can be made of any of a wide range of **materials** including wood, metal, brick, vinyl, and composite **materials** that can include aluminium, wood, blends of cement and recycled polystyrene, wheat/rice straw fibres. **Materials used for cladding** affect vulnerability to fire.

11) In relation to the installation of wiring, describe the meaning of the following terms:

c) First fixing or rough in: _____

_____ **First fix** comprises all the work needed to take a building from foundation to putting plaster on the internal walls. This includes constructing walls, floors and ceilings, and inserting cables for electrical supply and pipes for water supply.

d) Second fixing or fit out: _____

_____ **Second fix** comprises all the work after the plastering of a finished house. Electrical fixtures are connected to the cables, sinks and baths connected to the pipes, and doors fitted into doorframes. ... Some construction companies specialise in first **fix** work or **second fix** work, but most do both.

12) When installing wiring in the cavity of a cavity wall, explain why it is important that the cables don't touch both the internal and external walls.

To prevent the external dampness to be transferred to cable

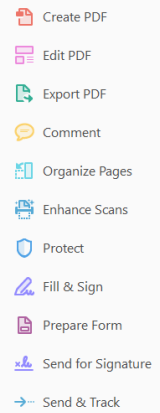
13) The following is a list of constructional stages of a timber framed cottage. Write these in the correct sequence.

Base cladding finishing floor roof walls footings interior lining painting setting out tiling

a) _____ b) _____ c) _____
d) _____ e) _____ f) _____
g) _____ h) _____ i) _____

j) _____ k) _____

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**Switch 1 – Panel 1**

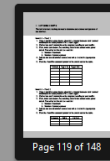
1. Using a suitable testing device, check for continuity between each terminal combination for each position of the switch toggle.
2. Number the switch terminals on the diagram according to your results.
3. Draw, in the table below, the switching chart for the switch on the panel stated. Remember to take into account the:
 - a. Number of terminals
 - b. Number of switch positions
4. Indicate the closed terminal connections with a cross in the appropriate box.
5. Draw the Australian standard symbol for the switch next to the table.

Terminals	Toggle Up	Toggle Down

Switch 1 – Panel 2

1. Using a suitable testing device, check for continuity between each terminal combination for each position of the switch toggle.
2. Number the switch terminals on the diagram according to your results.
3. Draw, in the table below, the switching chart for the switch on the panel stated. Remember to take into account the:
 - a. Number of terminals
 - b. Number of switch positions
4. Indicate the closed terminal connections with a cross in the appropriate box.
5. Draw the Australian standard symbol for the switch next to the table.

Terminals	P/B In	P/B Out



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