

Construction Measurement III

SBQ3314

Air Conditioning Installations : Central System

Dr. Sarajul Fikri Mohamed

Table of Contents

1. Air conditioning installations: main components of package & central system
2. SMM2 measurement rules for air conditioning installations
3. Taking off list for air conditioning installations
4. Heading and description.

Main components

Main Components

PREAMBLES

EQUIPMENT: CONDENSING UNIT & FAN COIL UNIT ETC

DUCTING: SUPPLY DUCT & RETURN DUCT

DUCTING FITTING

DUCT WORK SUPPORT

PIPEWORK

INSULATION TO DUCTWORK/PIPE

EQUIPMENT/DIFFUSER/GRILLE/DAMPER

BUILDER'S WORK

ELECTRICAL SYSTEM

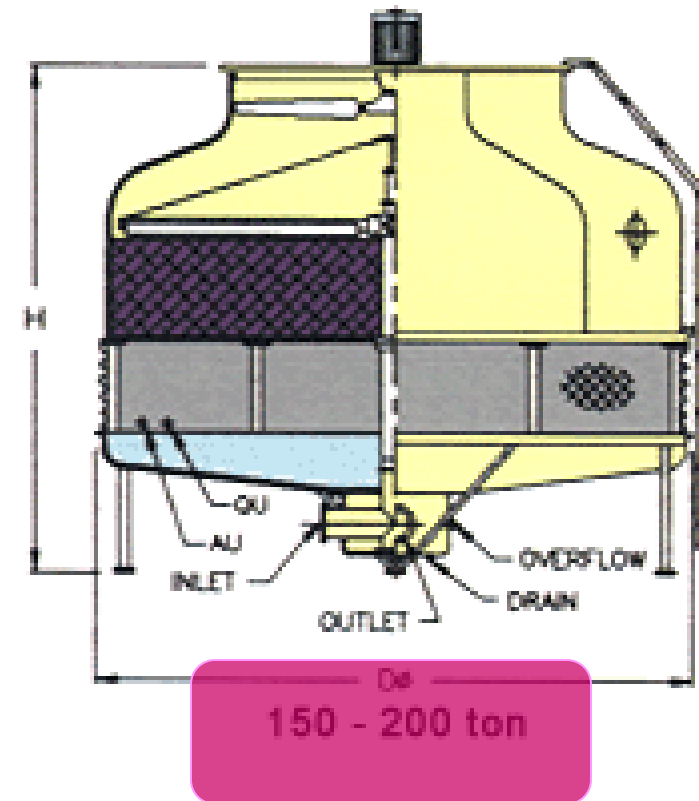
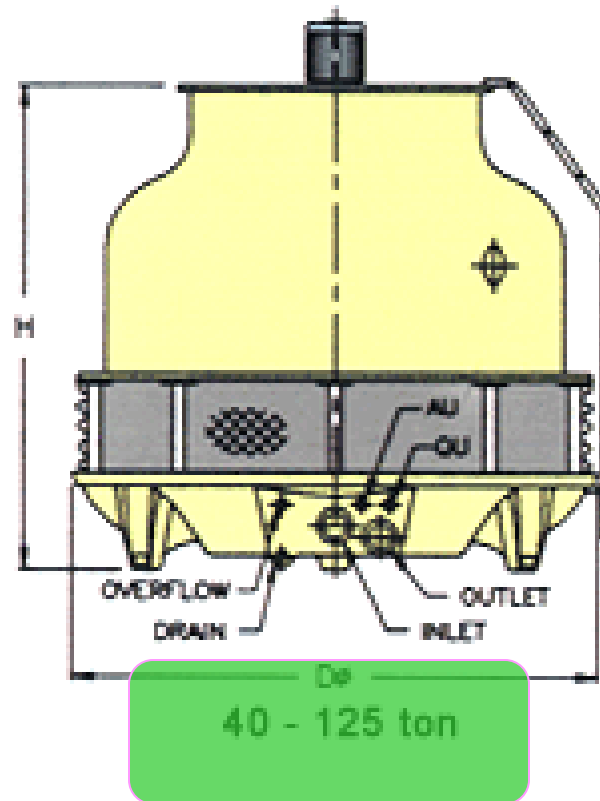
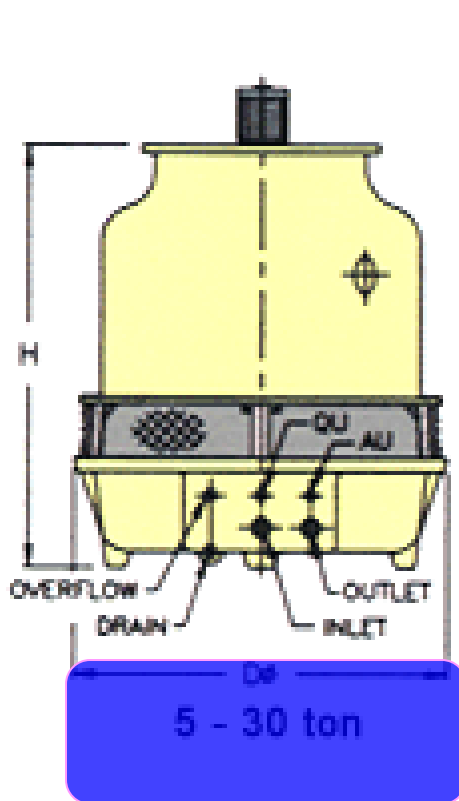
TESTING

Air Conditioning System : CENTRALISED SYSTEM

COOLING TOWER



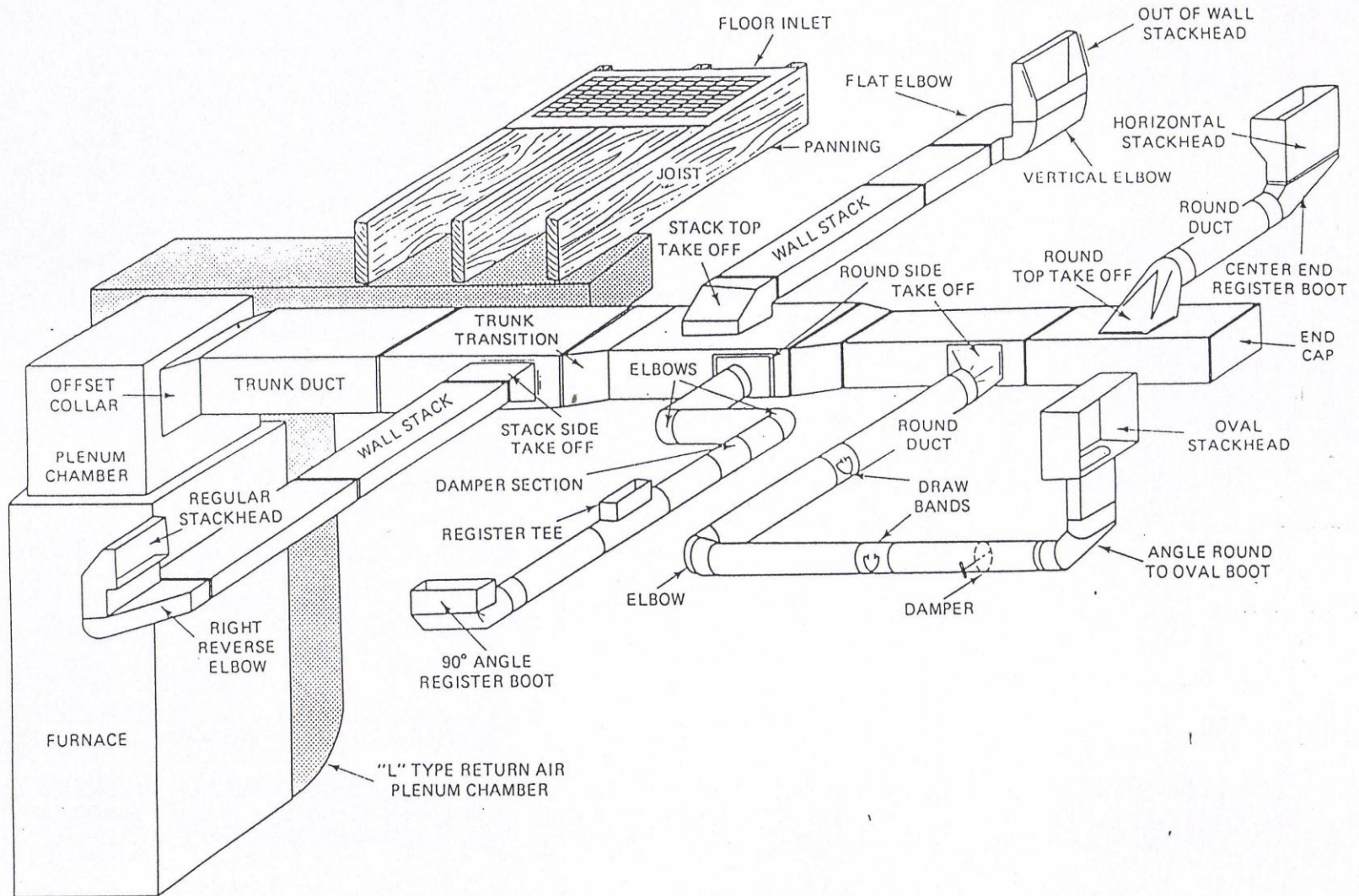
Cooling Tower Capacity



Ductwork, Duck Fitting & Components

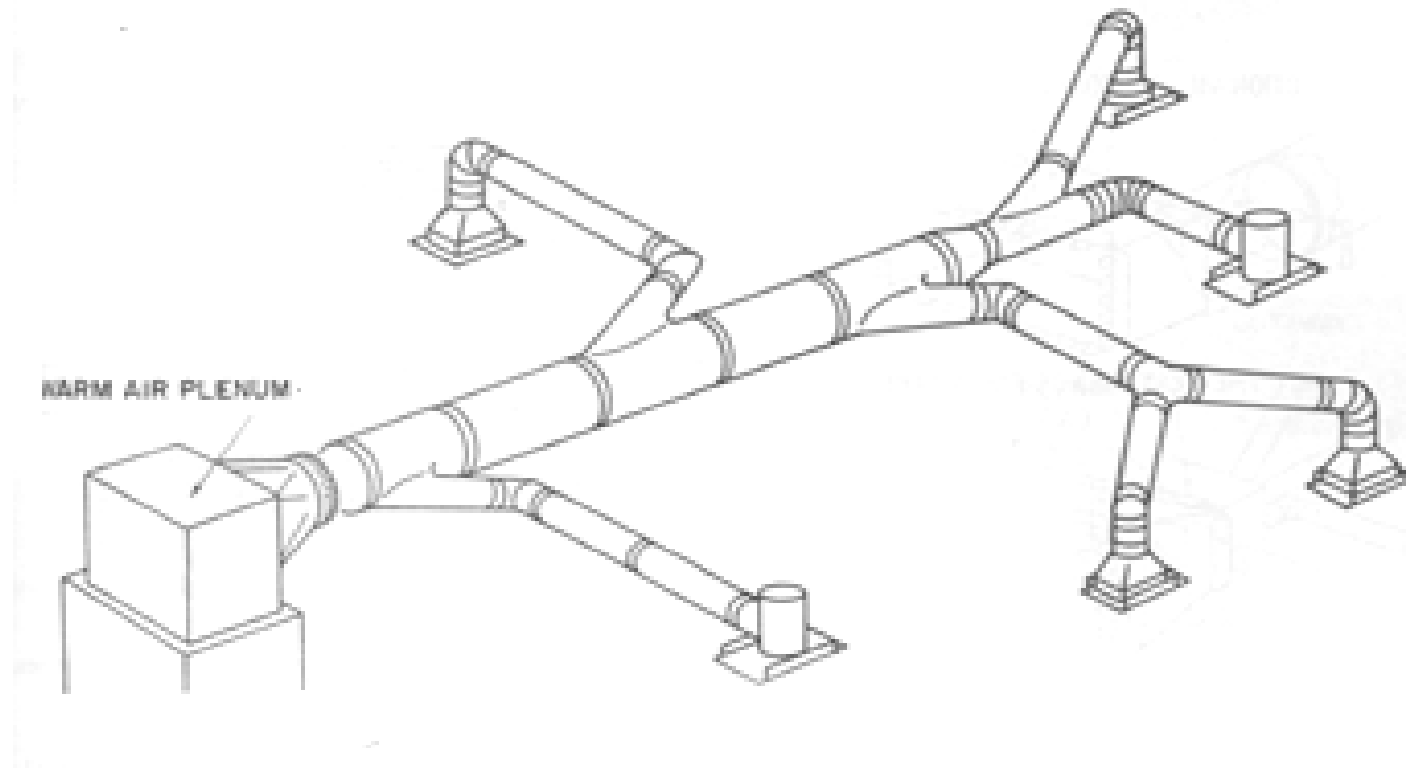
Ductwork Components

635



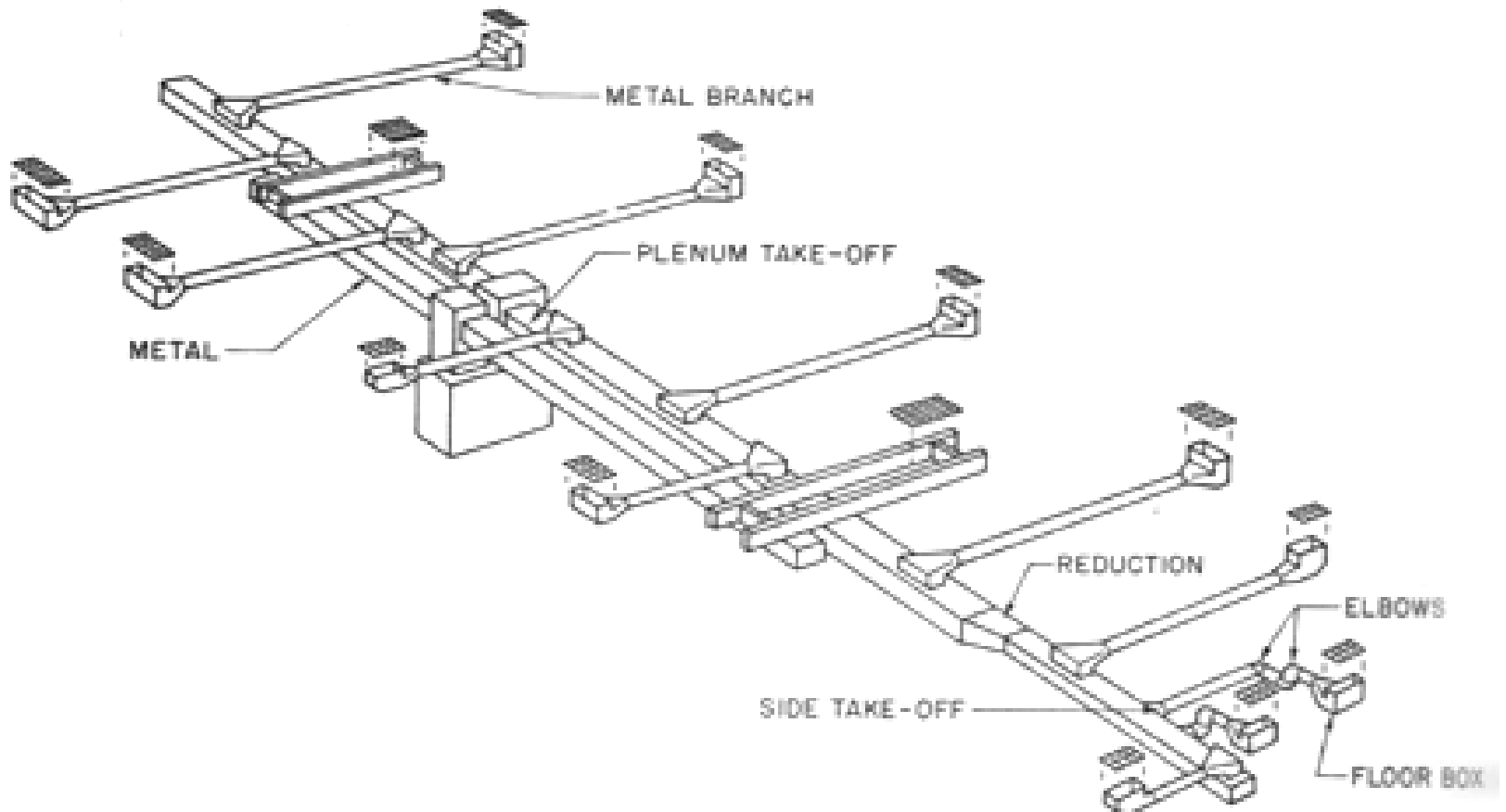
Ductwork Types

ALL ROUND METAL DUCT WITH ROUND METAL BRANCH DUCTS

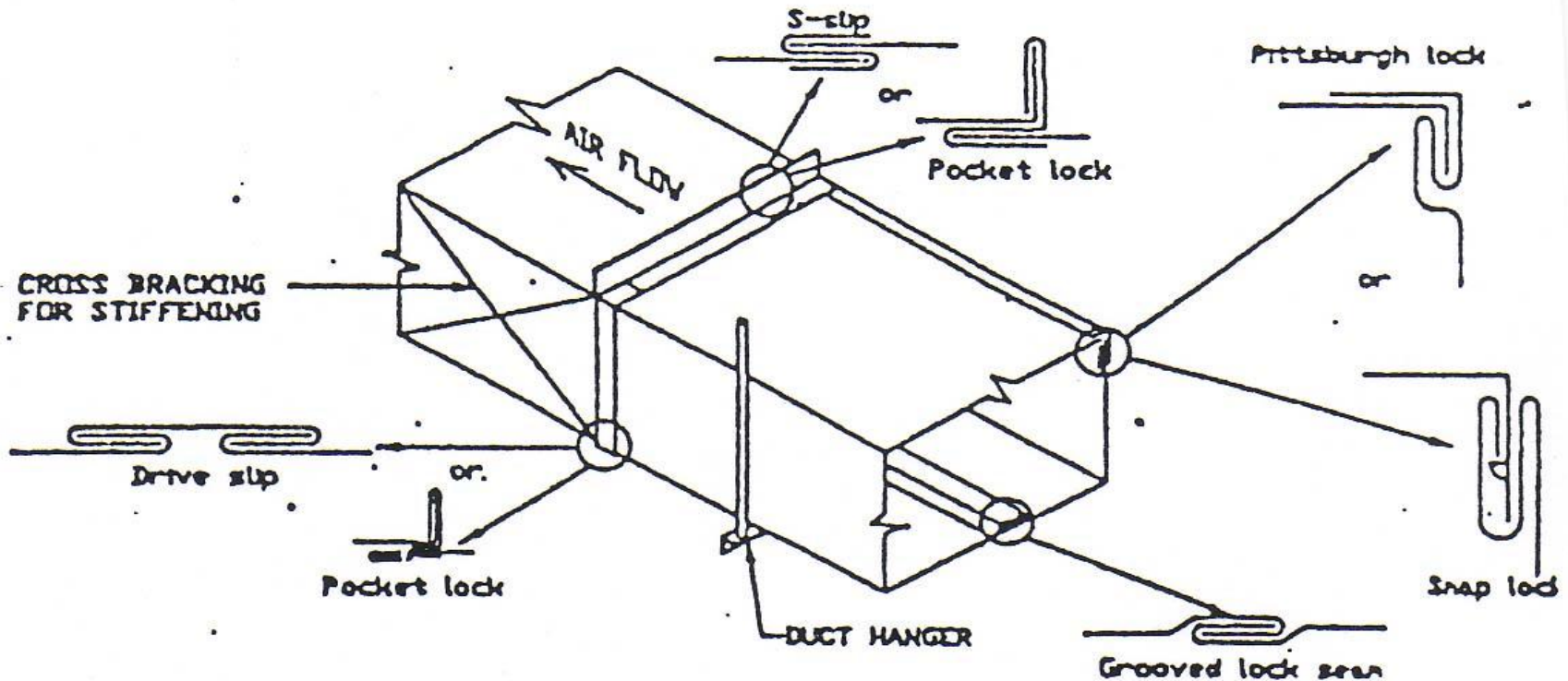


Ductwork Types

METAL TRUNK LINES WITH ROUND FIBERGLASS BRANCH DUCT

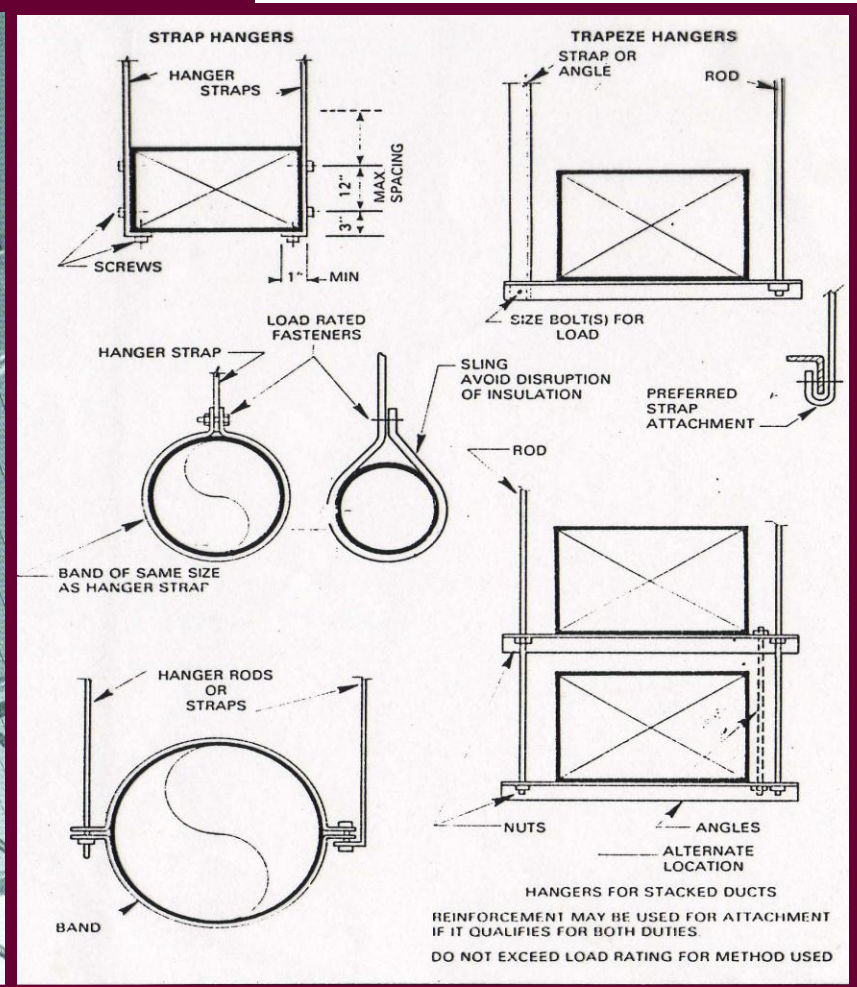
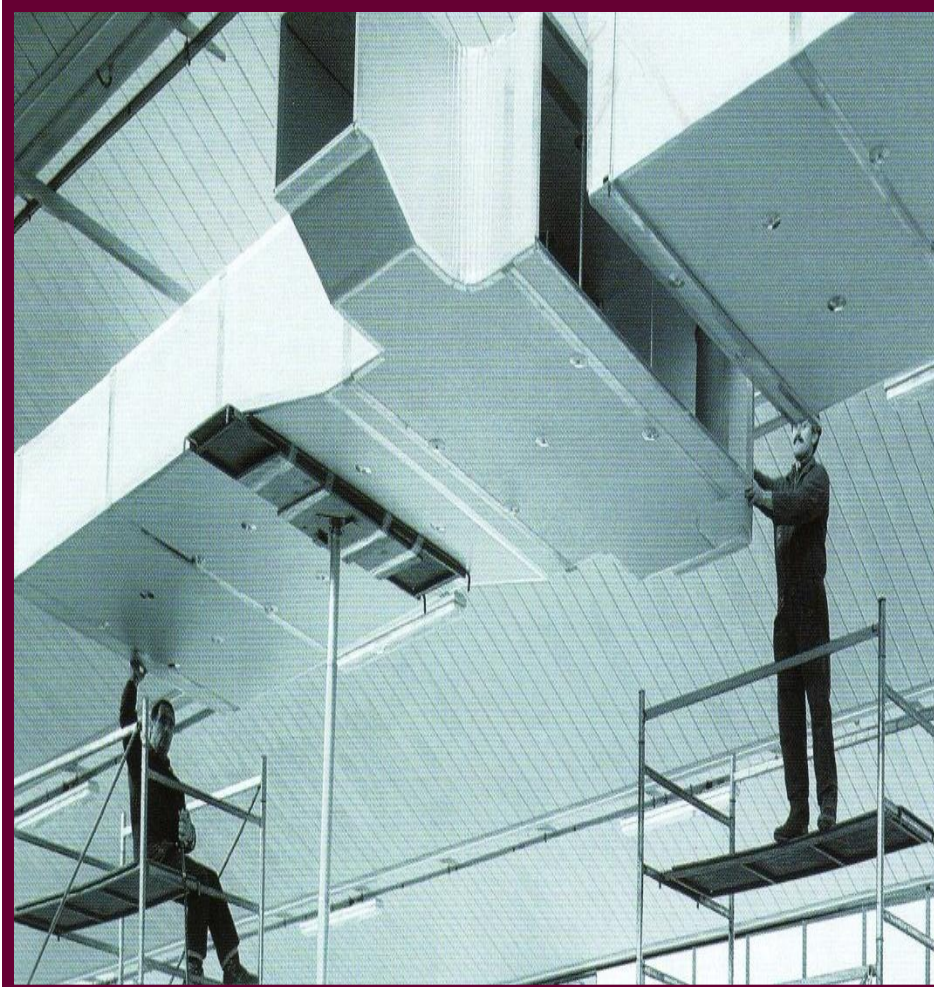


Fabrication Method



METHOD OF FABRICATION AND ASSEMBLING
GALVANISED-IRON DUCTWORK

Ductwork Support



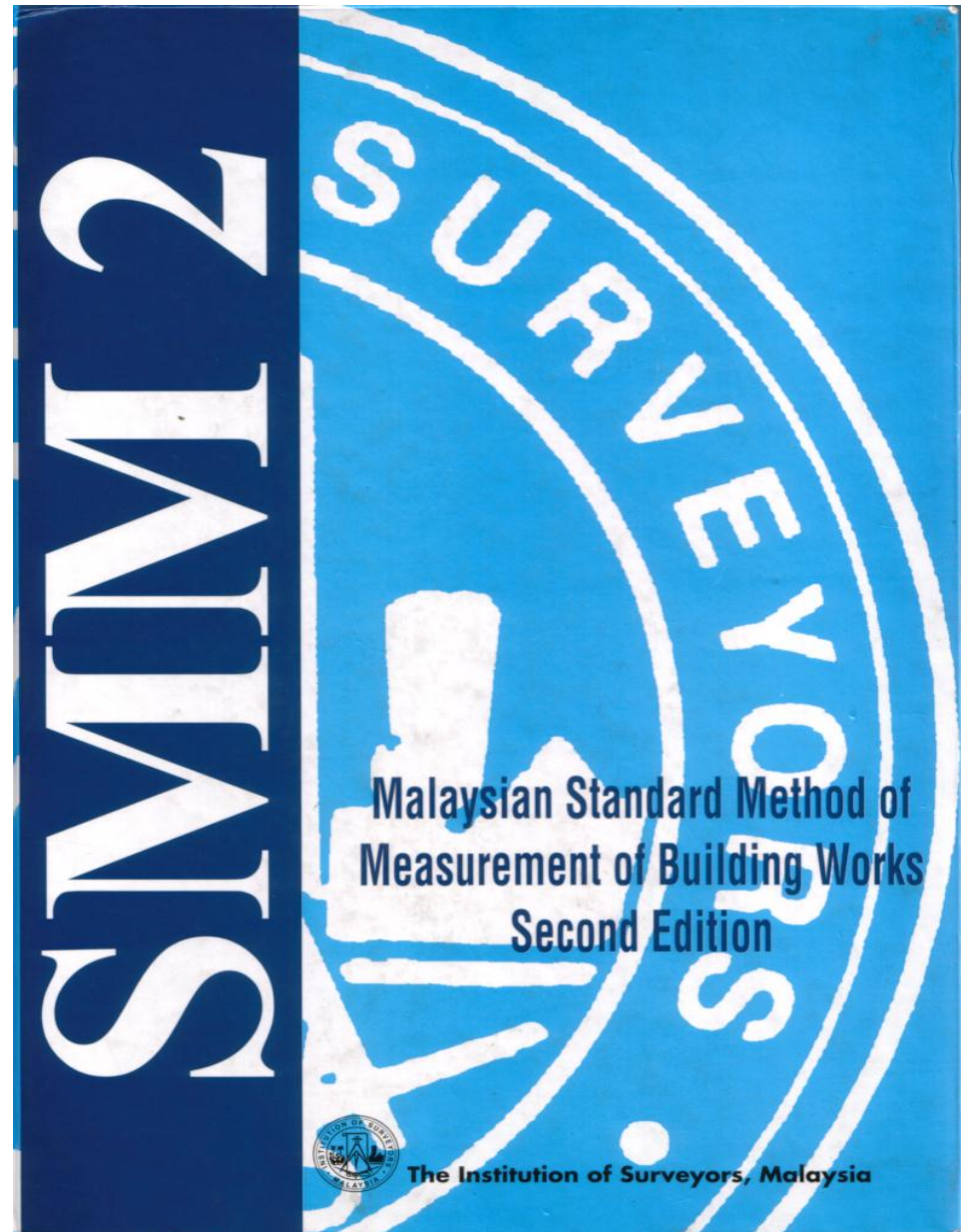
Ductwork, Duck Fitting & Components

AIR CONDITIONING AND VENTILATION SYSTEM

MEASUREMENT RULES

**PLUMBING AND MECHANICAL
ENGINEERING INSTALLATIONS**

SECTION Q



MEASUREMENT RULES

DUCTWORK

Q.14 DUCTING AND FITTING

1. Ducting (measured over all pipe fittings, short running lengths and branches) shall be given in metres stating the type and the normal size. Joints in the running length shall be given in the description stating the method of jointing.
2. *Lining ducting internally – meter – separately* – stating the type and the thickness of the lining material and internal size of ducting.
3. *Flexible ducting and extensible ducting* (measured as fully extended)- described and enumerated.

Measurement Rules

DUCTWORK

Q.14 DUCTING AND FITTING

4. Curved ducting - described and enumerated-stating mean radius. Curved rectangular ducting stated whether shaped to curved on the wider or narrow side.
5. Duct fitting – in numbers – extra over the duct in which they occur. Cutting and forming openings and jointing ducting to fitting – shall be deemed to be included. Fitting involving a change of direction of ducting- shall be described.

Measurement Rules

Elbow, Reducer And Branch

- Shall be described and **enumerated** as **extra over** in which they occur. (Q.14.5)
6. Providing materials, heat, bolts, nuts, washers and everything else necessary for making joints in ducting **shall be deemed** to be included with the items. (Q.14.6)

Measurement Rules

DUCTWORK

Q.15 SPECIAL CONNECTION, ETC

1. Special connection and special joints in ducting shall be **enumerated** separately (except where given in the description of other enumerated item) stating size and kind of ducting concerned and method of jointing.

2. **Classification :**
 - a. Connection between ducting of differing materials.
 - b. Connection between ducting and equipment stating the nature of the equipment.
 - c. Isolated joints which differ from those given in the description of the ducting.
 - d. Flexible connection between ducting and plant.

Measurement Rules

DUCTWORK

Q.15 SPECIAL CONNECTION, ETC

3. Ducting turn and splitter shall be **enumerated** separately stating the type and internal size of ducting.
4. Nozzle outlets, test holes and covers and access door shall be **enumerated** separately stating the size and method of jointing and material and thickness or gauge of the ducting and lining.
5. Cowls, terminals, intake louvres and like shall be **enumerated** separately stating the size and type, the size of ducting.

Measurement Rules

Q.16 DUCTWORK SUPPORTS

1. Components for supporting ductworks shall be **enumerated**- size and type of the components and size of ducting.
 - Stating the:-
 - Size,type of the components
 - Size of the ducting
 - **Classification** shall be as follows:-
 - Components for supporting single runs of ducting
 - Ditto multiple runs of ducting
 - Combined components for supporting ducting and pipework.

Measurement Rules

Q.17 ALTERNATIVE METHOD OF MEASUREMENT

1. Clause **Q. 18** provide alternative method of measurement.

Measurement Rules

Q.18 DUCTING AND DUCTING FITTING

1. Measured in **metres** (over all ducting fittings, short lengths and branches) stating the type and size.(Q.18.1)
2. Joints and method of the jointing shall be **given in the description.**
3. Flexible / extensible ducting shall be described and **enumerated.**(Q.18.3)
4. Curved ducting shall be so described and **enumerated** stating the mean radius.(Q.18.4)

Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.19 GENERALLY

1. Unless otherwise stated, equipment such as boiler, generators, cylinder, pumps, cooling, air handling unit, fans, refrigerator equipment etc – in numbers – (Q.19.1)

Condenser Unit And Fan Coil, etc.

- Measured in nos (Q.19.1)

2. *Packaged item* – shall be described in conjunction with a manufacturer's detailed specification (Q.19.2)

Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.19 GENERALLY

3. Any limiting dimensions on the size shall be given.
(Q.19.3)
4. Electrical connection shall be given in accordance with section R . (Q.19.4) *Section R*.
5. *Platwork, fuel hoppers and supporting steelwork - accordance Section P.*

Measurement Rules

EQUIPMENT

FIRE DAMPER

- Measured in nos. (Q.19.1)
- The related specification shall be described

Measurement Rules

EQUIPMENT

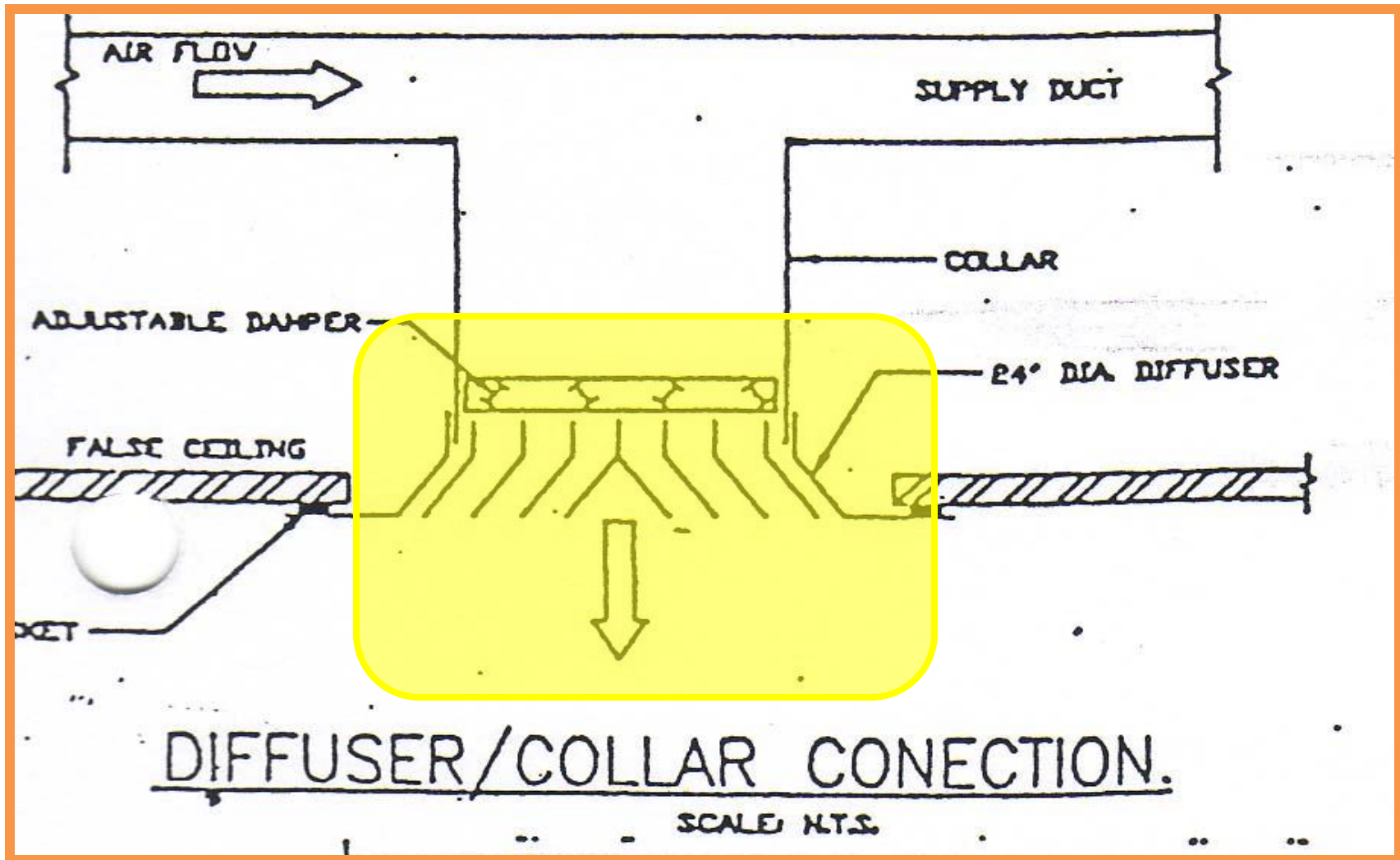
AIR DIFFUSER & AIR GRILLE

- Measured in nos.
- Stating the type, size and method of fixing.
- Described accordance with the details drawing and specification given.

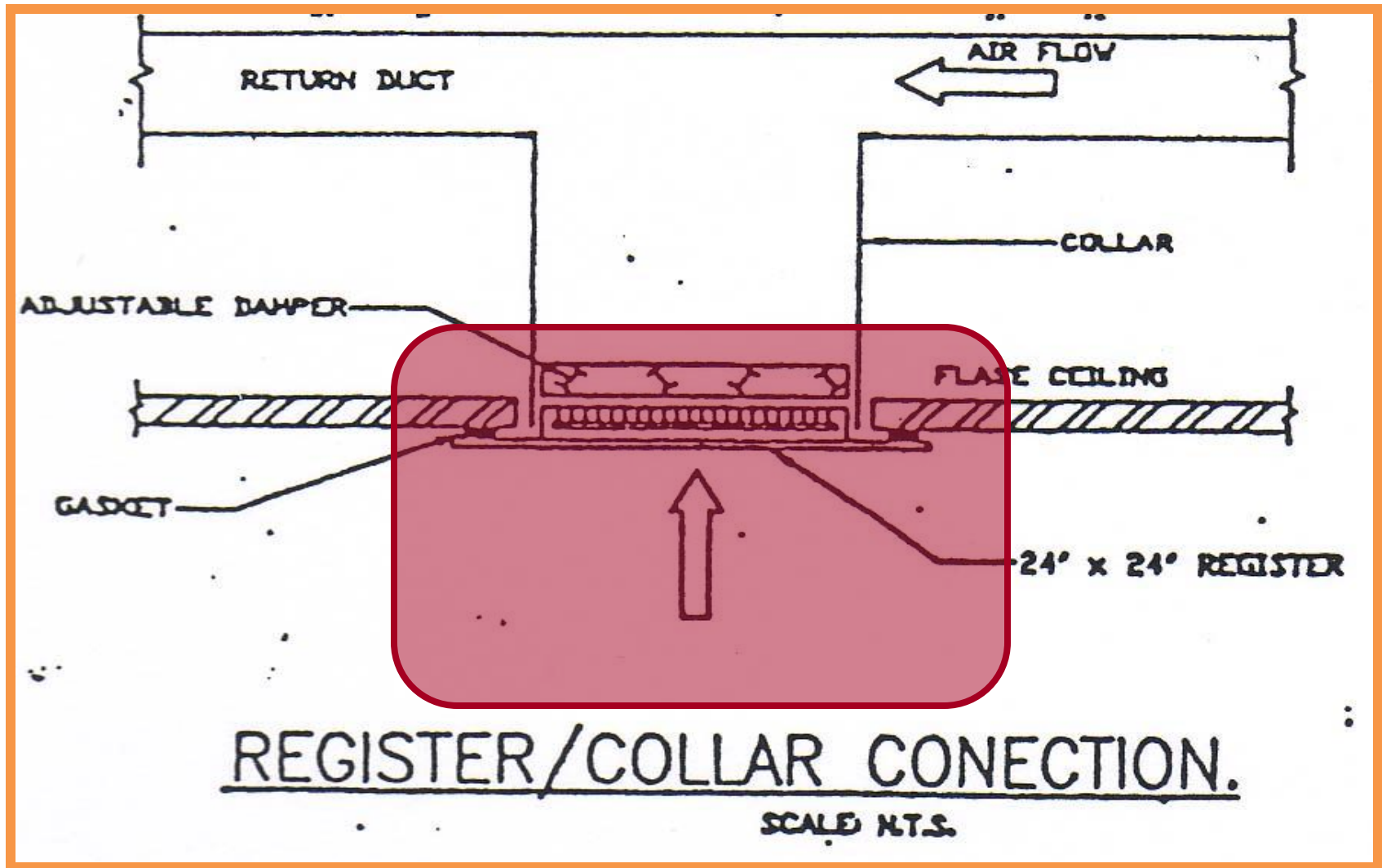
Air Diffuser



Diffuser / Collar Connection



Register / Collar Connection



Equipment

Measurement Rules

GENERALLY

Q.1 INFORMATION

AIR CONDITIONING SYSTEM AND INSTALLATION

Generally

Q.1. Information

- 1 Particulars of the following shall be given :
 - a) Regulation, etc.
 - b) Kind and quality of material.
 - c) Gauge, thickness or substance of material.
 - d) Any tests, etc.

Measurement Rules

- Q.1.2 Assembling and jointing together the component parts of composite units and providing any necessary connecting flanges and jointing materials shall be deemed to be included with the items concerned. Where composite units are supplied by the Employer, particulars shall be given of the assembly work involved.
- Q.1.3 Patterns, moulds, templets and the like **shall be deemed to be included** with the items.

Bills of Quantities : EQUIPMENT

WATER COOLED CHILLER UNIT

Install and complete the water cooled chiller unit (minimum capacity 186 tonne) c/w microprocessor system, concrete plinth (if necessary), vibration isolators and other accessories. (No)

CHILLED WATER PUMPSET

Horizontal split casing chilled water pumpset (minimum requirement 608 igpm, 120 ft) c/w motor, concrete plinth (if necessary), vibration isolators and other accessories. (No)

Bills of Quantities : EQUIPMENT

WATER EXPANSION TANK

200 gallons chilled water expansion tank c/w concrete plinth (if necessary) and other accessories. (No)

AIR HANDLING UNIT

Install and complete the 366 000 min btu/hr air handling unit c/w thermostat, evaporator blower unit, fan, motor, filters, concrete plinth (if necessary), vibration isolators and other accessories. (No)

Measurement Rules

- Q.1.4 Priming and painting off-site and proprietary finishes or surface treatment applied as part of the production process **shall be described** stating whether applied before or after fabrication or assembly.
- Q.1.5 Except where otherwise stated the method of fixing and the provision of nails, bolts, nuts, holes, screws, plugs, shot-fired pins and the like **shall be given in the description of the work.**

Measurement Rules

- Q.1.6 The **nature of the background** to which work is to be fixed shall be given in the description. Any necessary drilling of the backgrounds shall be deemed to be included. Backgrounds shall be **classified as follows** :
- a) Building-board which shall be deemed to include hardboard, compressed cement sheet, plasterboard, fibreboard and similar materials which do not grip woodscrews.
 - b) Etc

Measurement Rules

Q.1.6 The **nature of the background**

- b) Timber which shall be deemed to include softwood, hardwood, blockboard, plywood and similar materials which will grip wood-screws when a lead-hole has been drilled.
- c) Brickwork, concrete or stone work
- d) Plain metal
- e) Glass

Measurement Rules

- Q.1.7. Temporary work shall be so described. Removing temporary work and making good after shall be deemed to be included with the item.
- 1.8. Connecting to existing services – shall be described

Measurement Rules

GENERALLY

Q.2. CLASSIFICATION OF WORK

Q.2.1 Work together with its metalwork, supports and the like (unless associated with more than one installation) shall be classified as follows and given under an appropriate heading :

t) Air handling installation, identifying whether ventilation supply, ventilation extract, ventilation with heating (air heated centrally), ventilation with heating (air heated locally), air conditioning (air heated centrally), air conditioning (air heated locally), or foul air extract.

Measurement Rules

Q.3. LOCATION OF WORK

Location of works :

- a. Internally
- b. Externally
- c. In plant rooms

Measurement Rules

- PIPE WORKS
- Q.7 GENERALLY
- 1. Purpose-made pipes and purpose-made pipe fittings **shall be described**.
- 2. Pipes and pipe fittings which are wrapped, coated or lined by the manufacturer **shall be so described** stating the type of treatment.
- 3. Pipework required to be temporarily fixed in position, dismantled for chromium-plating or other special finishing and subsequently refixed **shall be so described**.

Measurement Rules

PIPEWORKS

a) Shall be supplied and installed:

- all necessary interconnecting pipeworks between item of equipment
- all vents and exhausts
- all necessary pipe, valves, fittings, anchors, supports, brackets, insulation etc

Q.8 PIPE AND FITTING

1. Pipes (measured over all pipe fittings, short running lengths and branches) shall be given in **metres** stating the type and the normal size. (Q.8.1)

Purpose-made pipe **shall be so described** and given separately. **Curved pipes** shall be so described stating the mean radius.

Joints in the running length shall be given in the description stating the method of jointing.

Measurement Rules

Q.8 PIPE AND FITTING

2. Flexible pipes and extensible pipes (measured as fully extended) shall each **be so described.** (Q.8.3)

3. Pipes laid or fixed in ducts, trenches and chases or embedded in in-situ concrete or screeds shall each **be so described.** (Q.8.4)

Measurement Rules

- Q.9. SPECIAL CONNECTIONS, ETC.
 1. Special connections and special joints in pipes shall each be **enumerated** separately (except where given in the description of another **enumerated item**) stating the nominal **size** and **kind of pipe concerned** and the **method of jointing**. **Classification shall be as follows :**
 - a) Connections between pipes of differing materials and differing grades of the same material.
 - b) Connections between pipes and appliances or equipment.
 - c) Connections to existing pipes.

Measurement Rules

Q.10. LABOURS

- Labours on pipes (e.g. made bends, made springs, made offsets, beaded ends, ornamental ends, etc.) shall be deemed to be included with the pipes on which they occur.

Measurement Rules

Q.11 SUNDRIES

- Pipe-sleeves through walls, floors ceilings shall be **enumerated** stating the type, lengths, the nominal size and kind of pipe passing through and the type of packing required, and if to be supplied for fixing by other trades, this **shall be so described**.
- Wall, floor or ceiling plates shall be grouped together as plates and **enumerated** stating the type and size.

Measurement Rules

Q.12 PIPEWORK SUPPORTS

- Components or assemblies of components (e.g. clips, saddles, pipe-hooks, holderbats, brackets, rollers, chairs and hangers or black-plates and girder-lugs) used to fix supports for more than one pipe shall be **enumerated** separately stating the type and size of components.
- Spring compensated components shall be so described stating the loading and movement to be accommodated.

Ductworks

Measurement Rules

DUCTWORK

Q.14 DUCTING AND FITTING

1. **Ducting** (measured over all pipe fittings, short running lengths and branches) shall be given in **metres** stating the type and the normal size. Joints in the running length shall be given in the description stating the method of jointing.
2. *Lining ducting internally* – **meter** – **separately** – stating the type and the thickness of the lining material and internal size of ducting.
3. **Flexible ducting and extensible ducting** (measured as fully extended)-described and enumerated.

Measurement Rules

DUCTWORK

Q.14 DUCTING AND FITTING

4. Curved ducting - described and **enumerated**-stating mean radius. Curved rectangular ducting stated whether shaped to curved on the wider or narrow side.
5. Duct fitting – in **numbers – extra over** the duct in which they occur. Cutting and forming openings and jointing ducting to fitting – shall be deemed to be included. Fitting involving a change of direction of ducting- shall be described.

Measurement Rules

ELBOW, REDUCER AND BRANCH

- Shall be described and **enumerated** as **extra over** in which they occur. (Q.14.5)
- Providing materials, heat, bolts, nuts, washers and everything else necessary for making joints in ducting **shall be deemed** to be included with the items. (Q.14.6)

Measurement Rules

DUCTWORK

Q.15 SPECIAL CONNECTION, ETC

1. Special connection and special joints in ducting shall be **enumerated** separately (except where given in the description of other enumerated item) stating size and kind of ducting concerned and method of jointing.
2. **Classification :**
 - a. Connection between ducting of differing materials.
 - b. Connection between ducting and equipment stating the nature of the equipment.
 - c. Isolated joints which differ from those given in the description of the ducting.
 - d. Flexible connection between ducting and plant.

Measurement Rules

DUCTWORK

Q.15 SPECIAL CONNECTION, ETC

3. Ducting turn and splitter shall be **enumerated** separately stating the type and internal size of ducting.
4. Nozzle outlets, test holes and covers and access door shall be **enumerated** separately stating the size and method of jointing and material and thickness or gauge of the ducting and lining.
5. Cowls, terminals, intake louvres and like shall be **enumerated** separately stating the size and type, the size of ducting.

Measurement Rules : DUCTWORKS

Heading:

Galvanised iron duct as described with snaplock beam, pocket lock, grooved lock seam, pittsburgh lock and cross bracking for stiffening and including jointing and fixing for supply air

Description:

150mm x 150mm supply duct (M)

350mm x 300mm return duct (M)

Measurement Rules : DUCTWORKS FITTING

ELBOW

EXTRA over for 900mm x 350mm to 900mm x 350mm galvanised iron round elbow duct including cutting and forming opening and jointing ducting to fitting (NO)

REDUCER

EXTRA over for 450mm x 350mm to 350mm x 350mm galvanised iron round reducer including cutting and forming opening and jointing ducting to fitting (NO)

BRANCH

EXTRA over for 200mm x 250mm to 400mm x 450mm to 300mm x 500mm galvanised iron branch including cutting and forming opening and jointing ducting to fitting (NO)

Measurement Rules

Q.16 DUCTWORK SUPPORTS

1. Components for supporting ductworks shall be enumerated- size and type of the components and size of ducting.
 - Stating the:-
 - Size,type of the components
 - Size of the ducting
 - **Classification** shall be as follows:-
 - Components for supporting single runs of ducting
 - Ditto multiple runs of ducting
 - Combined components for supporting ducting and pipework.

Measurement Rules

Q.17 ALTERNATIVE METHOD OF MEASUREMENT

1. Clause Q. 18 provide alternative method of measurement.

Measurement Rules

Q.18 DUCTING AND DUCTING FITTING

1. Measured in **metres** (over all ducting fittings, short lengths and branches) stating the type and size.(Q.18.1)
2. Joints and method of the jointing shall be **given in the description.**
3. Flexible / extensible ducting shall be described and **enumerated.**(Q.18.3)
4. Curved ducting shall be so described and **enumerated** stating the mean radius.(Q.18.4)

Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.19 GENERALLY

1. Unless otherwise stated, equipment such as boiler, generators, cylinder, pumps, cooling, air handling unit, fans, refrigerator equipment etc – in numbers – (Q.19.1)

Condenser Unit And Fan Coil, etc.

- Measured in nos (Q.19.1)

2. *Packaged item* – shall be described in conjunction with a manufacturer's detailed specification (Q.19.2)

Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.19 GENERALLY

3. Any limiting dimensions on the size shall be given.
(Q.19.3)
4. Electrical connection shall be given in accordance with section R . (Q.19.4) *Section R*.
5. Platework, fuel hoppers and supporting steelwork -
accordance **Section P**.

Measurement Rules : ELECTRICAL WIRING

ELECTRICAL WORKS

Power cabling using 4 x 50mm sq. XLPE/PVC/CU c/w 150A TPN metalclad isolator and 150A TPN MCCB for 2 nos Air Cooled Chiller from ACP switchboard (at chiller plant room) (ITEM)

ELECTRICAL WORKS

Power cabling using 4 x 35mm sq. XLPE/PVC/CU c/w 100A TPN metalclad isolator and 100A TPN MCCB for 3 nos chiller water pump from ACP switchboard (at chiller plant room) (ITEM)

Measurement Rules

EQUIPMENT

FIRE DAMPER

- Measured in nos. (Q.19.1)
- The related specification shall be described

Measurement Rules

EQUIPMENT

AIR DIFFUSER & AIR GRILLE

- Measured in nos.
- Stating the type, size and method of fixing.
- Described accordance with the details drawing and specification given.



DIFFUSER

Measurement Rules : EQUIPMENTS

DIFFUSER

600mm x 600mm anodized extruded aluminium supply air diffuser complete with blade damper.

200mm x 400mm 4 way square type air diffuser , fixed to suspended ceiling complete with all approved gasket

Measurement Rules : EQUIPMENTS

RETURN AIR GRILLES

600mm x600mm extruded aluminium return air grilles

DAMPER

Volume control damper complete with access opening.

Fusible link type fire damper (2 hour fire rated and approved by Jabatan Bomba) complete with access opening.

HANGER

Hanger, constructed of 2 nos 12mm mild steel rod, 60mm long centres, 25mm x 25mm x 5mm mild steel angels 80" long for 300 mm x 250 mm (m/s) supply duct / return duct (no)

Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.20 Anti-vibration and sound insulation

- Anti-vibration mountings for plant shall be **enumerated** stating the type and the size. Anti-vibration material and sound-insulating material in plant bases shall be given in **square metres** stating the nature of the material and the thickness.

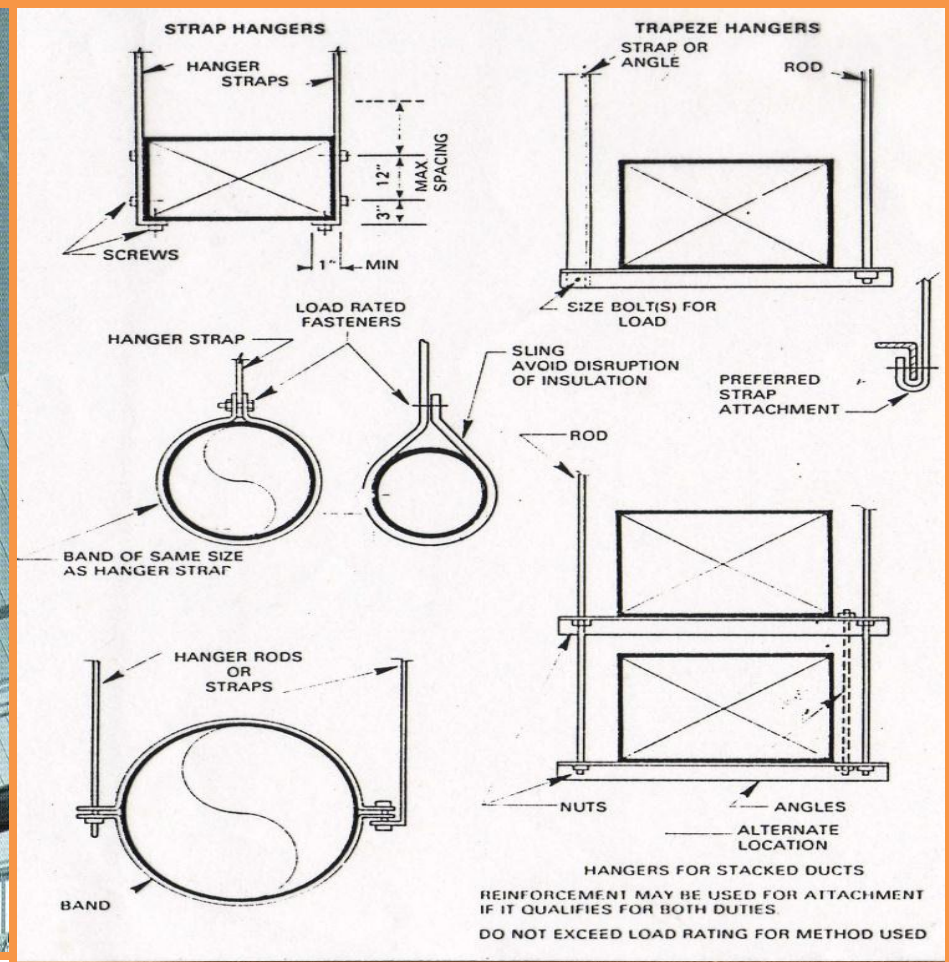
Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.21 Equipment supports

- Equipment supports shall be **enumerated** and described.
- Particulars of the method of fixing shall be given in the description in accordance with clauses Q.1.5-6.

Measurement Rules : EQUIPMENT SUPPORTS



Measurement Rules

Q.22 JOINTING (PENYAMBUNGAN)

- Particulars of the method of jointing – shall be given in the description of the equipment.

Measurement Rules

EQUIPMENT AND ANCILLARIES

Q.24 IDENTIFICATION PLATES

- Plates, discs and labels for identification plants **shall be deemed to be included** with the item concerned. (Q.24)
- Charts giving the keys – shall be **enumerated**

Insulation

Measurement Rules

INSULATION

Q.25 GENERALLY

1. Particulars of the following shall be given: (Q.25.1)
 - Kind and quality of material
 - Thickness of material
 - Finish of material
 - Method of fixing

2. Includes smoothing the material and working around supports.(Q.25.2)

Measurement Rules

Q.26 INSULATION TO PIPEWORK

1. Insulation to pipework – meter – stating types and size of the pipe.
2. Working insulation around ancillaries shall be enumerated separately – in numbers – extra over
3. Working insulation over flanges and pipe fitting shall be deemed.
4. Insulation boxes shall be enumerated separately – in numbers – stating types of material and infill.

Measurement Rules

Q.27 INSULATION TO DUCTWORK

1. Insulation to ductwork – meter – stating types and size of the ducting.
2. Working insulation around ducting fittings, special fittings and ancillaries – in numbers – extra over

Measurement Rules : INSULATION TO EQUIPMENT

Q.28 INSULATION TO EQUIPMENT

1. Insulation to equipment – enumerated – stating overall size of the unit. Particular shall be given of any protection to the insulation.
2. Providing *detachable mattresses* and working insulation around *special fittings* and *ancillaries* – *shall be deemed*.

Measurement Rules : SUNDRY INSULATION

Q.29 SUNDRY INSULATION

1. Loose insulation in trench, ducts, tank casings and like - shall be given separately in cubic metres stating nature of materials.
2. Cellular concrete insulation in trench and ducts (grouped together) - shall be given in cubic metres stating mix of the concrete.
3. 3. Special protection or finish at opening through wall, valve chambers and the like – *shall each be described* enumerated.

Measurement Rules : INSULATION TO DUCTWORKS

Insulation to duct works

50 mm Thick fibreglass insulation to 200 mm X 100 mm galvanised iron ducting, with clips at 450 mm centres and covered with single side aluminium foil for supply air duct.

Insulation to pipe works

50mm Thick “Aeroflax” or other approved flexible expanded rubber compound insulation to 40mm diameter copper tubing.

Testing

Measurement Rules : SUNDRIES

Q.30 SUNDRIES

1. Testing each installation shall be given as an ITEM.
stating any required qualifications, no of stage tests in addition to the final, purpose, instruments and appliances required, special insurances etc.

Measurement Rules : TESTING

TESTING

Upon completion allowed for testing the foregoing Air Cooled Chiller System air conditioning, make good any defects and leave the whole of the installation in perfect working order to the satisfaction of engineer.

Builder's work

Measurement Rules : BWIC

BUILDER'S WORK

Q.31 GENERALLY

1. Unless otherwise stated, all items of builder's shall be given in accordance with the **appropriate section**.
2. Builder's works in connection with plumbing and mechanical engineering installations **shall be grouped together under an appropriate heading**.

Measurement Rules : BWIC

BUILDER'S WORK

Q.32 PARTICULARLY

1. Excavation works.
2. Inspection chamber-V.6.
3. Bedding and pointing equipments or unit of equipment.
4. Cutting away for and making goods after the plumbing and mechanical installations.
5. Etc

Bills of Quantities : BWIC

BUILDER'S WORK

50 mm thick concrete grade 15 as base of 300 mm wide (m³)

Taking off list

Bills of Quantities : Taking Off List

AIR CONDITIONING SYSTEM

1. Preamble
2. Equipment – Chiller unit, water pump, water tank, AHU.
3. Ducting - supply duct, return duct
4. Ducting Fitting
5. Ductwork Support
6. Pipe work
7. Insulation to ductwork/pipe
8. Equipment - Diffuser, Grille, Damper
9. Builder's Work
10. Electrical system
11. Testing

Bills of Quantities : Taking Off List

1) Air cond Equipment (NO)

- Air cooled chiller
- Chilled water tank
- Chilled water pump
- Air handling unit

2) Ducting (M)

3) Ducting Fitting (NO)

- Elbow
- Tee
- Branch

4) Ducting Support (NO)

- Hanger

5) Pipe Work (M)

- Refrigerant pipe
- Suction pipe
- Drain Pipe

6) Insulation (M)

- To ductwork
- To pipe work

7) Equipment (NO)

- Diffuser
- Grill
- Damper

8) Sundries

9) Builders work