SECTION 3.0 TECHNICAL SPECIFICATION

3.8 SMOKE SPILL SYSTEM

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SECTION 3.8 SMOKE SPILL SYSTEM

1.0 SMOKE SPILL SYSTEM (Where specified)

System should be able to maintain smoke free escape conditions at all occupied levels to allow the building to be evacuated with minimum risk of smoke inhalation, injury or death.

The smoke spill system receives alarm signals from the Fire Alarm Control Panel(FACP) and manual command signals from the Fire fighter Smoke Control Station(FSCS) or Building Monitoring System(BMS). On receiving alarm signals and/or manual commands, the smoke control system controls the mechanical smoke control equipment. Manual command signals from the FSCS take priority over alarm signals.

The smoke control system controls fans and positions dedicated and Non-dedicated dampers, both in the smoke control zones and at the air handling(AHU) systems. It may also position dampers or air modulation devices such as variable-air-volume (VAV) boxes serving the smoke control zones

The smoke spill system shall comply with Australia Standard 1668 Part 1-1974 and the requirements of Jabatan Bomba dan Penyelamat Malaysia.

The Contractor shall supply, install, test and commission the Smoke Spill System where indicated on drawings or as specified herein..

1.1 Smoke Spill Components :

Exhaust Ventilation

System device shall be to move smoke and hot gases out under conditions of fire. Fan shall be aero foil bifurcated fans conforming to BS EN170 : 2002 and BS 2613 / BS EN 60068-2-2:2007 with motor insulation in accordance with Class 'H' Specification of BS EN 2757 : 2011. Fan shall have approval from CIFS for use in smoke spill system.

Fans shall be capable in handling air of temperature up to 450^0F. Fan capacity shall not be less than as specified and shall not be less than 12 air change.

Impeller hub shall be precision machined spheroidal graphite cast iron and keyed for direct fitting to motor shaft. Impeller blades shall be of cast aluminum silicon alloy, anti-static to suit application and supported in long life, axial type, high quality thrust ball bearings.

All motors suitable for use in hazardous areas are manufactured/modified in strict accordance with the conditions required by the relevant standards and the issued Certificate of Compliance, and are fully tested prior to despatch by the manufacture. It's necessary to ensure that the maximum surface temperature of equipment introduced into a hazardous area does not exceed the ignition temperature for the gas, vapors or dust in the hazardous area.

Standard finish is enamel paint top coat on suitable primer to give good appearance and protection for general usage. Alternative finishes such as epoxy coating or upon S.O approval.

Fans shall comply with the maximum in-duct sound power levels as indicated in the Fan equipment schedules enclosed and/or shown in the drawings. Nonetheless, they shall be quiet in operation and shall produce no objectionable pure tones within the occupied areas.

Sound power level data submitted shall be measured in accordance with BS 848 part 2 1985 or equivalent approved National standard. All fans shall be mounted on vibration isolators as specified and/or shown in the drawings.

1.2 TYPE OF FANS

1.2.1 CENTRIFUGAL FANS

Centrifugal fans shall be backward curved, aerofoil blade, limit load type complete with V-belt drives, drive guards, motors, steel bases and anti-vibration mountings.

Fan discharge velocity at design air flow shall not exceed 9 m/s.

Fan casings shall be hot dipped galvanized steel plate braced with hot dipped galvanized steel angles. Scrolls shall be not less than 3mm thick and side plates not less than 5mm thick. Casings shall be provided with angle flanged outlets, curved inlet rings, sealed access panels and 40mm diameter screwed and plugged drain connections. Access panels shall provide full access to the fan interior and shall be fitted with wedge type clamps to provide air tight sealing. Curved inlet rings shall be removable to allow removal of fan impeller. Casings on fans over 500mm diameter shall be fitted with lifting lugs.

Blades shall be hot dipped galvanized steel all welded construction with die formed aero foil blades and front plates. The impeller hub shall be securely keyed to the drive shaft.

Drive shafts shall be machined high tensile steel and shall be stepped to facilitate easy impeller removal. All fan and motor shaft ends shall be countersunk at the shaft centers to take the tachometer.

The fan shall be driven by not less than, two metric vee-belts via taper lock pulleys. Drive guards shall be braced open mesh construction to completely enclose the drive and be readily removable. Guards shall be drilled at the fan shaft and motor shaft positions to allow measurement of shaft speeds with a tachometer.

Fan and motor bases shall be fully welded hot dipped galvanized heavy steel construction complete with anti-vibration mountings.

1.2.2 AXIAL FLOW FANS

Axial fans shall have flanged hot dipped galvanized tubular casings extending over the length of the fan and motor (unless specified otherwise) complete with an airtight access door suitably placed for easy fan inspection. Fans 300 diameter or less may have casings without access doors. Open fan intakes and discharges which are accessible to personnel shall incorporate heavy gauge galvanized or bronze wire mesh guards.

Non-overloading aero foil fans shall have adjustable pitch cast aluminum alloy impellers or may have adjustable pitch polypropylene impellers on fans up to 300 diameter and glass reinforced polyester resin impellers on fans up to 765 diameter.

1.2.3 ROOF MOUNTED FANS

Roof mounted units shall be totally weatherproof and shall comprise centrifugal, mixed flow or axial flow fans housed in a compact base fitted with a weathering skirt and surmounted by a bird proof cowl with a curved contour.

The units shall be of all welded construction and shall be hot dipped galvanized after fabrication. All rotating parts of the units shall be isolated from the unit casings by approved resilient mounting.

Access to motor and fan shall be via a hinged cowl or a service door in the cowl. Fan motors shall be positioned above impellers to allow servicing from above the roof.

1.2.4 PROPELLER FANS

Propeller fans shall be of approved manufacture of the in-duct diaphragm, wall mounting or roof cowl mounting type.

Fans shall have die cast aluminium, hot dipped galvanised steel or pressed aluminium blades mounted in hot dipped galvanised steel, cast iron or die cast aluminium hubs and complete with hot dipped galvanised steel or aluminium brackets.

Wall mounted fans shall be of the ring mounted type complete with hot dip galvanised ring mountings, wire mesh guards and aluminiurn louvre shutters. In addition, hot dip galvanised external wall cowls shall be provided on externally located fans.

1.2.5 BIFURCATED FANS

Bifurcated fans shall be able to handle air at temperatures of up to 232'C and shall withstand moisture laden atmosphere, smoke or airborne dust.

The motor shall be isolated from the main air stream in a tunnel which extends to one side of the casing. It shall be cooled by ambient air drawn into the tunnel and passed over the motor carcass by an impeller mounted on a shaft extension at the tail end of the motor. The casing and external terminal box shall be hot dipped galvanised

1.3 SMOKE SPILL DUCTWORK

1.3.1 Fire Rated Ductwork

All sheet metal ducts and plenums denoted on the drawings as being fire rated or in the lobbies and protected corridors shall have a construction that shall give a minimum of 2 hours fire retardance product

The construction method shall be similar and equal to that approved in principle by the Commonwealth Experimental Building Station (or CSIRO division of Building Research).

The ducts and plenums to be fire rated shall be encased with a framework of formed metal support channels and furring channels of sizes and at spacings recommended by the supplier of the fire rated construction.

A 50 mm layer of ceramic type spray shall be applied over the walls of the duct or plenum, and then an expanded metal lath shall be attached to the furring channels. A second coat of ceramic type spray shall be applied to give a minimum overall thickness of 75 mm spray.

The exposed sides of the duct or plenum shall then be sheathed with 0.8 mm (22 swg) galvanised steel fixed as specified for externally insulated duct sheathing.

Where the width of ducts or plenum is such that they exceed the recommended support spacing, intermediate fire rated supports shall be placed in the centre of the duct plenum with a sheet metal sleeve around the support being sealed to the duct or plenum.

All ductwork shall be constructed and installed in accordance with Sheet Metal and Air Conditioning Contractors National Association Inc. - HVAC Duct Construction Standards Metal and Flexible, or HVCA DW 142 standards and guidelines, and the following clauses.

1.3.2 Schedule of Ductwork Classification

Pressure Classification is specified in SMACNA HVAC Duct Construction Standards Metal and Flexible Tables 1. 1 to 1.9 inclusive for rectangular duct, Tables 3.1 to 3.3 inclusive for circular duct, or the relevant clauses in DW 142.

1.3.3 Low Pressure Ductwork Specification

Construct and install all sheet metal in accordance with latest ASHRAE, or SMACNA or DW 142 recommendations. Provide variations in duct size and additional duct fittings as required to clear obstructions and maintain clearances, as approved by the Engineer at no extra cost.

Ductwork, including fittings, shall be made of commercial grade galvanized sheet of the following minimum thickness:

Size of Duct (mm)	**Galvanized Sheet**
Up to 400	0.6 mm
401 to 1000	0.8 mm
1001 to 2500	1.0 mm
Above 2500	1.2 mm

Smoke spills ducts are commonly used in smoke and heat control systems. Ductwork shall be 2 hours fire rated duct. Provide perforated grille at the inlet.

Smoke spills duct sections are intended for use in smoke control ducts to limit leakage in a fire and smoke control situation. Ductwork shall be maintain stability, integrity and insulation of fire rating to EN1366-8 for the same period of the compartment. Ductwork shall suitable for clearing smoke.

Where a horizontal duct exhausts into a common protected vertical shaft that requires installation of a fire damper, a sub-duct may be installed. Such sub-duct shall be constructed of sheet metal ductwork of minimum 2 mm thickness.

1.4 TYPE OF SMOKE SPILL DUCTWORK

1.4.1 RECTANGULAR SHEET METAL DUCTWORK

All rectangular sheet metal ductwork shall be fabricated from full size galvanised steel sheet specifically manufactured for roll forming. Galvanising shall remain unbroken after fabrication and installation and, in all cases, long runs of ducts up to 2400mm in length shall be fabricated from continuous sheets unless broken by transitions, bends and fittings. Patched ductwork fabricated from small pieces shall not be used. All ducts shall be adequately stiffened to prevent "drumming/panelling".

Wherever possible full radius bends shall be used unless available space and structural limitations preclude their use, in which case, bends with splitters may be used. Details and dimensions of splitters shall be shown on all construction drawings.

Where shown on the drawings, acoustic type air turns shall be of the double thickness type in accordance with the following:

(a) Vanes shall be fabricated from 0.8mm thick perforated galvanised or zinc anneal sheets, having 5mm diameter holes and approximately 10% free area and shall be filled with semi-rigid fibreglass or mineral wool having a density of not less than 48 kg/m3. Insulation shall be treated with a fire retardant plastic spray to prevent exfoliation and leading edges of vanes shall be felt tipped.

(b) Where special acoustic splitters are shown on drawings or separately specified they shall be fabricated from not less than 1.6mm thick G.I. covered both sides with 25mm thick acoustic material and perforated metal as for air turns. The leading edge of each splitter shall be formed into an aerofoil shape. Splitters shall be rigidly fixed to side ducts and shall be completely free from vibration. Complete details of all splitters and air turns shall be shown on construction drawings.

1.4.2 EXPOSED RECTANGULAR SHEET METAL DUCTWORK

All exposed rectangular air conditioning and mechanical ventilation ductwork shall be specially constructed to provide a neat aesthetic appearance.

In general the ductwork shall be constructed with heavy gauge drive cleat Joints, false drive cleat cover strips mid way between joints and internal stiffeners.

All corners of drive cleat Joints shall be fitted with a sheet metal closing piece and shall then are filled with an approved body sealing compound and be ground smooth after setting.

Under no circumstances will exposed fittings such as rivets, pop rivets, bolts or welds be accepted and any damage to ductwork such as dents or buckles will be rejected.

All support hangers shall be located on the top of the ducts and shall be concealed wherever possible.

Longitude joints in pieces of duct other than corner Joints will not be acceptable. Corner Joints shall 'u-c of the Pittsburg lock type with each piece of duct installed such that the joints match in a continuous run. On the smaller size ducts the joint shall be located on a concealed side wherever possible.

All exposed air conditioning ductwork shall be internally insulated to the specified requirements.

1.4.3 CIRCULAR SHEET METAL DUCTWORK

All circular sheet metal ductwork for low pressure application shall be fabricated from full size galvanised sheet steel specifically manufactured for roll forming. Galvanising shall remain unbroken after fabrication and, in all cases, long runs of duct up to 2400mm in length shall be fabricated from continuous sheets unless broken by transitions, bends and fittings. Patched ductwork fabricated from small pieces shall not be used. In particular, preference will be given to the use of pressed metal bends in lieu of lobster back bends.

All straight ducts shall be fabricated in lengths as long as possible consistent with transport, access and site requirements, to minimise site joints. Spiral duct of the outside locked seam formed from galvanised sheet metal is acceptable and shall be 0.5mm thick for duct up to 200 mm dia. and 0.6 mm for duct 230 mm. and above.

All longitudinal seams in shop fabricated rolled ductwork shall be of the grooved lock or snaplock seam type. All site joints shall be of either the beaded sleeve or flanged type.

1.4.4 EXPOSED CIRCULAR AND OVAL SHEET METAL DUCTWORK

All exposed circular and oval supply air ductwork shall be fabricated from I mm thick heavy ribbed spiral joint.

Duct lengths shall be as long as possible with a minimum of site joints.

Site joints shall be reinforced with galvanised mild steel reinforced spigot and shall be arranged so that the spiral Joint matches in a continuous method. The joint shall be sealed with an approved mastic or sealer which shall be wiped clean after assembly to give a smooth Joint. Badly made and open joints will be rejected.

Any dents, blemishes or exposed fixings will be rejected if judged to be unsightly on completion of painting.

Bends shall be constructed using a minimum of eleven (11) pieces for each bend

Exposed pop rivets will not be accepted and shall be ground smooth and filled with body filler to approval.

Double ribbed ductwork will not be accepted.

The internal section of the ducts shall be reinforced to prevent sagging or distortion of the duct between hangers.

1.4.5 FLEXIBLE DUCTWORK

All flexible ductwork shall be aluminium duct of corrugated construction with triple locking seam. Flexible ducts for air conditioning supply air shall be patent factory pre-insulated and wrapped with reinforced aluminium foil laminate and vapour sealed. Insulation and foil details shall be as specified herein.

Flexible metal ductwork shall be installed in all location indicated on the drawings and wherever else necessary to eliminate vibration transmission.

All bends made in flexible ducting shall be formed to manufacturer's recommendations and shall have a centre-line radius of not less than 1.5 times the diameter of the ducts. Bends shall remain at full diameter throughout the length of the bend and all bends deformed or damaged in any way during installation shall be replaced with new bends.

All fittings such as tee-pieces, Y-pieces and reducers shall be of galvanized sheet metal exactly as specified for circular sheet metal ductwork.

All joints between lengths of flexible ductwork shall be made with short spigots of galvanized sheet metal circular duct to form a slip joint.

Similarly all connections to fittings and terminal boxes etc. shall be of the spigotted slip joint type. Spigot outlets from ducts or spigot connections to grille and diffuser boxes shall be fitted with a galvanised steel butterfly type damper complete with coated mild steel shaft and a quadrant arm.

All Joints shall be made by sealing the flexible duct to the spigot with expandite duct sealant or duct sealing tape, following by the application of a metal band with worm drive hose clip. Self tapping metal screws and rivets shall not be used.

1.5 ACCESS PANELS

Access panels shall be provided adjacent to each fire damper, modulating damper and all similar locations where access is required for maintenance purposes.

Access panels shall be of adequate size to suit ductwork and for the maintenance purposes envisaged and shall be fabricated or pressed from galvanised sheet metal and be complete with adequate sealing gaskets and quick release catches. Drill screws, self tapping screws or pop rivets shall not be used.

Access panels shall be suitable for the type of duct system specified and shall be constructed to withstand the pressures required in the system.

The location and construction of all access panels shall be clearly shown on construction drawings and subject to on-site approval.

1.6 PITOT TUBE OPENINGS

Pitot tube openings shall be provided in all large branch mains and main ducts for reading static, velocity and total pressures for accurate balancing and control purposes.

Where required to be provided within low pressure ductwork systems each pitot opening shall comprise a 25mm diameter minimum opening and rubber sealing grommet. Opening sizes shall be increased as necessary for internally insulated ductwork to allow the pitot instrument to be inserted without difficulty.
All pitot tube openings shall be located in the sides of straight lengths of ducts and not less than two duct diagonal dimensions (for rectangular ducts) or two duct diameters (for circular ducts) downstream and not less than one duct diagonal dimension or one duct diameter upstream of all bends, tees, transitions, etc.

The number and positions of the pitot tube openings to be provided at each location shall be as follows:

1.6.1 Circular Ducts

(a) For ducts up to 1200mm diameter provide two openings on perpendicular centre lines.

(b) For ducts above 1200mm diameter provide four openings on two sets of perpendicular centrelines. The two sets of perpendicular centerlines shall be at 45 degrees to each other.

1.6.2 Rectangular Ducts

(a) For ducts having diagonal dimensions up to 450mm provide six openings, located on two perpendicular sides, three per side. Openings to be located at 1/6, 1/2 and 5/6 locations on both sides.

(b) For ducts having diagonal dimensions up to 900mm provide eight openings located on two perpendicular sides, four per side. Openings to be located at 1/8, 3/8, 5/8 and 7/8 locations on both duct faces.

(c) For ducts having diagonal dimensions up to 2300mm provide ten openings, located on two perpendicular sides, five per side. Openings to be located at 1/10, 3/10, 5/10, 7/10 and 9/10 locations on both duct faces.

(d) For ducts having diagonal dimensions exceeding 2300mm provide twelve openings, located on two perpendicular sides, six per side. Openings to be located 1 /12, 1 /4, 5/12, 7/12, 3/4 and 11 /12 locations on both duct faces.

Notwithstanding the above, pitot tube openings shall also be provided at locations and spacings as stipulated and recommended in the BSRIA commissioning guidelines for air systems

1. 7 SMOKE SPILLS NON RETURN DAMPER

Non return damper shall provide smoke isolation. It shall be constructed of galvanized steel of minimum 16 BSWG and shall have counter balanced weight to reduce pressure drop across the damper.

Damper frames shall be constructed from not less than 1.6mm thick galvanised sheet steel folded into channel sections, the damper blades shall be 150mm deep, maximum 1000 mm/long of the parallel action type construction from 0. 8mm aluminium folded for rigidity. Spindles shall be 12mm diameter stainless steel grade 316 with oil retaining sintered porous "oilite" bearings or rotating in 7mm drilled holes on frame.

The blades shall be individually hinged and counterweighted for minimal resistance to air passage and for closure by gravity with minimal backflow leakage.

1.7.1 Controls

Provide controller for automatic starting of the smoke spill fan when a fire alarm signal is detected. The fire alarm signal shall be provided by others.

Remote manual start stop shall be provided on the Fire Panel in the control room. Where motorized damper is indicated on the Tender Drawing, control shall be provided to open or close the damper in accordance with the design and the requirements of the Jabatan Bomba dan Penyelamat Malaysia.

1.7.2 Electrical Requirements

An electrical installation shall comply with the requirement of Tenaga Nasional Berhad and Jabatan Bomba dan Penyelamat Malaysia. Electrical power shall be provided from the emergency supply. All cables used shall be MICC

1.8 SMOKE SPILL FIRE DAMPERS

Fire dampers shall be provided and installed at all positions where ducts pass through fire-rated partition walls, floors and where they enter vertical masonry shafts and where indicated on the drawings or required by the Chief Inspector of Fire Services.

All fire dampers required to be supplied and installed under this contract shall be in compliance with AS 1682:1974 and to the approval of all authorities having jurisdiction.

Approved fire dampers of either the drop curtain or multiple blade type may be used. The fire damper shall be held in the open position by means of a fusible link rated at 68C. An access door shall be provided at each fire damper to permit inspection and replacement of the fusible link. The fusible link shall be accessible from the room side where fire damper is installed in duct take-offs from masonry shafts.

Provide 3.5mm mild steel sleeves where ducts pass through masonry walls. The gap between the sleeve and fire damper shall be packed with rock wool to the latest requirements of the Chief Inspector of fire Services.

Submit catalogues and samples for examination.

1.9 SMOKE SPILLS BALANCING DAMPERS

Volume control dampers shall be provided as necessary for the correction and proper balancing of all systems.

Unless a system is self balancing e.g. on the primary side of a variable air volume system, balancing dampers shall be fitted to all branches and where a branch duct serves more than one air outlet. Opposed blade dampers or other approved devices shall be fitted behind air outlets to balance and straighten the air flow across the face of the grille.

1.9.1 Directional Volume Controls

Directional volume controls shall be of zinc coated steel construction painted matt black and comprising multiple, linked, 30 degree turning vanes. Construction shall be of 1.2mm minimum thickness for mounting frames and 0.8mm minimum thickness for each blade. Leading edges of all blades shall be return folded for strength and quietness of operation.

Where such units are installed directly behind supply air grilles then the volume adjustment shall be facilitated through the face of the grille. Where such units are installed at branch duct take-offs then the volume adjustment shall be facilitated externally to the duct.

1.9.2 Splitter Dampers

Splitter dampers shall be of zinc coated steel construction comprising single blade, adjusting quadrant or adjusting rod spindle and bearings. The blade shall be of the same thickness as the duct but not less than 0.8mm thick and be double folded.

Adjusting rods shall be constructed from galvanized steel with damper position indicator and external locking mechanism. Spindles shall be 12mm diameter bright mild steel, utilizing brass, nylon or "iolite" bearings.

1.9.3 Opposed Blade Dampers

Construction shall be of zinc coated steel, painted matt black and of a minimum of 0.8mm material thickness for the mounting frame and a minimum of 0.6mm material thickness for the blades. Blades shall be linked using nylon gear trains or spring wire and shall be fully adjustable through the face of the grille. Maximum unsupported blade length shall not exceed 600mm.

Where opposed blade dampers are located in ducts, plenums or walls, they shall be constructed as follows:

(a) Blades shall be fabricated from not less than 1.6mm thick galvanized sheet steel with 12mm wide edge breaks and fastened securely to 12mm diameter stainless steel grade 316 spindles. Unsupported blade length shall not exceed 1200mm. Spindles shall rotate freely in brass, Teflon or iolite bearings mounted on a damper frame.

(b) Frames shall be constructed of not less than 2.5mm thick galvanized sheet steel folded into channel sections not less than 150mm wide. Corners of frames shall be welded, cleaned and coated with one coat of cold galvanizing paint.

(c) 1.10.3.3 Dampers in ducts up to 350mm deep shall be of the single blade butterfly type.

(d) Dampers in ducts over 350mm deep shall be of opposed blade type with blades not more than 225mm wide. All leading edges of blades shall be felt tipped.

(e) Dampers shall be controlled by the use of quadrants, control levers and locking device. Linkages between blades shall be of zinc coated steel construction. Plastic type gears shall not be used.

(f) Blade position, where blades are not visible shall be clearly marked.

1.10 SMOKE SPILL DUCT SEALANT

Sealants are often used to reduce the air/gas leakage from smoke and heat exhaust ventilation systems. Failure of these sealants whilst the smoke and heat exhaust ventilation system is operating in its emergency mode may result in the failure of the duct's leakage criteria.
The following general requirements for duct sealants shall apply.

(a) Sealants shall be suitable for the environment to which the smoke control duct is to be subjected to.
(b) The sealants shall be durable for the proposed life of the smoke control duct section.
(c) The sealants shall be resistant to mechanical damage during the installation of the smoke control duct section.
(d) Any deterioration of the sealant shall not cause the smoke control duct section to fail the leakage criteria for the duct classification.

1.11 Electrical Cables

Fire performance cables shall be maintain circuit integrity in a fire and so are suitable for fire detection, alarm and emergency lighting system

The fire resisting property of cable is measured in BS6387. This takes to a flame of 950°C for 3 hours while carrying 3 amps of current. The specification also emulates fire conditions by subjecting the burning sample to water spray and mechanical shock (categories C, W and Z respectively).

Standard IEC 60331 for concentrate on fire performance and BS7629 combines this fire survivability with low smoke and toxicity emission.

Fire-resisting cables such as MICC (mineral insulated, copper clad) shall be used to provide robust links in fire protection systems.

UK standards such as BS6387 and BS7629 seek to ensure that cables used in fire detection and alarm circuits (BS5839) and emergency lighting (BS5266) for meet fire resistance, smoke and toxicity emission's and propagation criteria.

EN50200 standards stresses on cable and its supporting infrastructure during fires the assumption that these cables can maintain circuit integrity for extended periods in fire conditions is a dangerous fallacy.

Optional standard for fire cables shall be IEC60331: 750 deg C for 3 hours ,
Flame Propagation BS EN 50266 parts 1 and 3, IEC 60332-3, BS EN 60332:2004
Smoke Emission IEC 61034, BS EN 61034:2005 and Corrosive Acid Gas BS EN 50267-2-1:1999, IEC 60754-1.

---------- END OF SECTION 3.8 ----------