Commerical Kitchen Ventilation System

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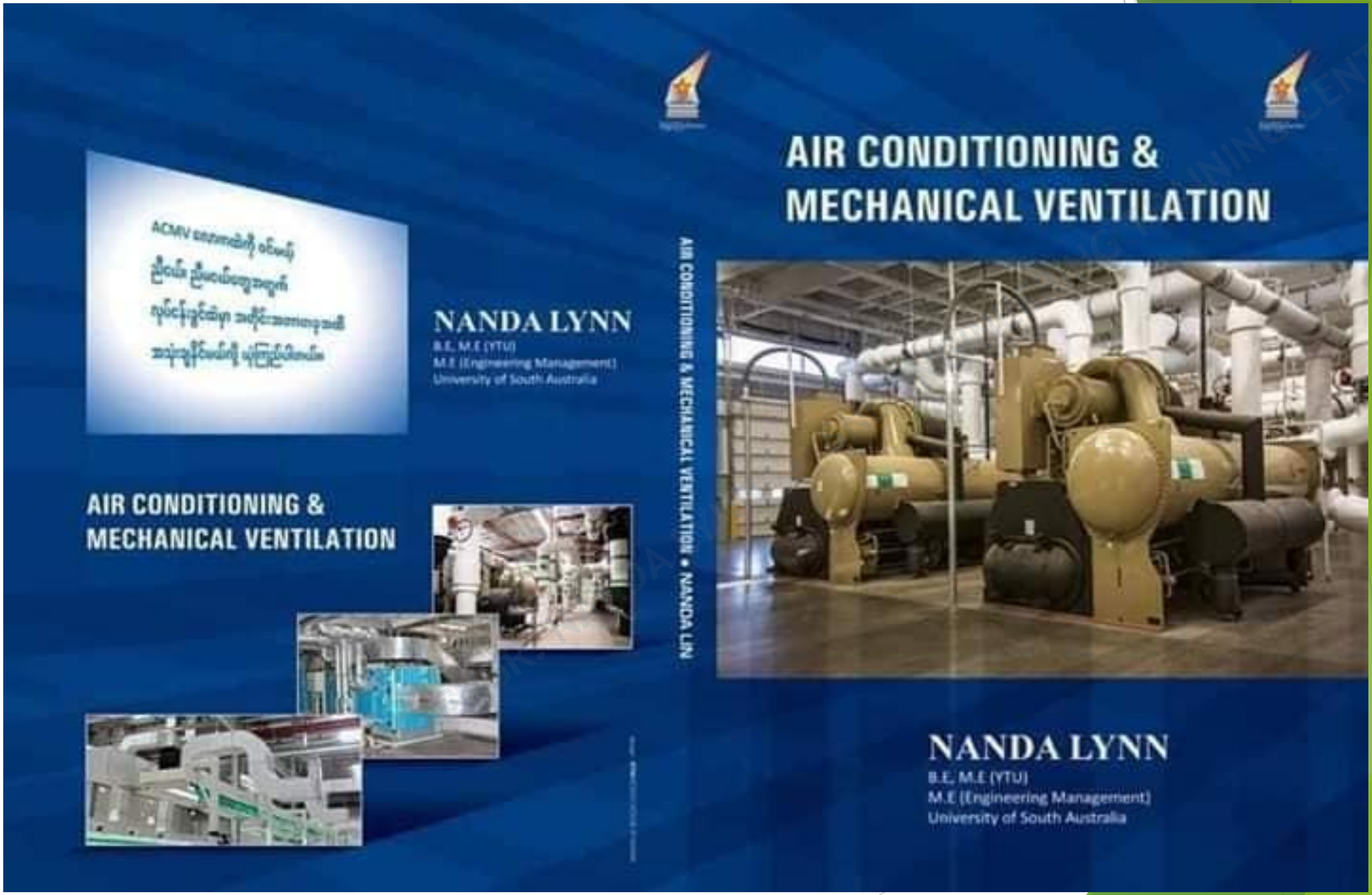
Commerical Kitchen Ventilation System



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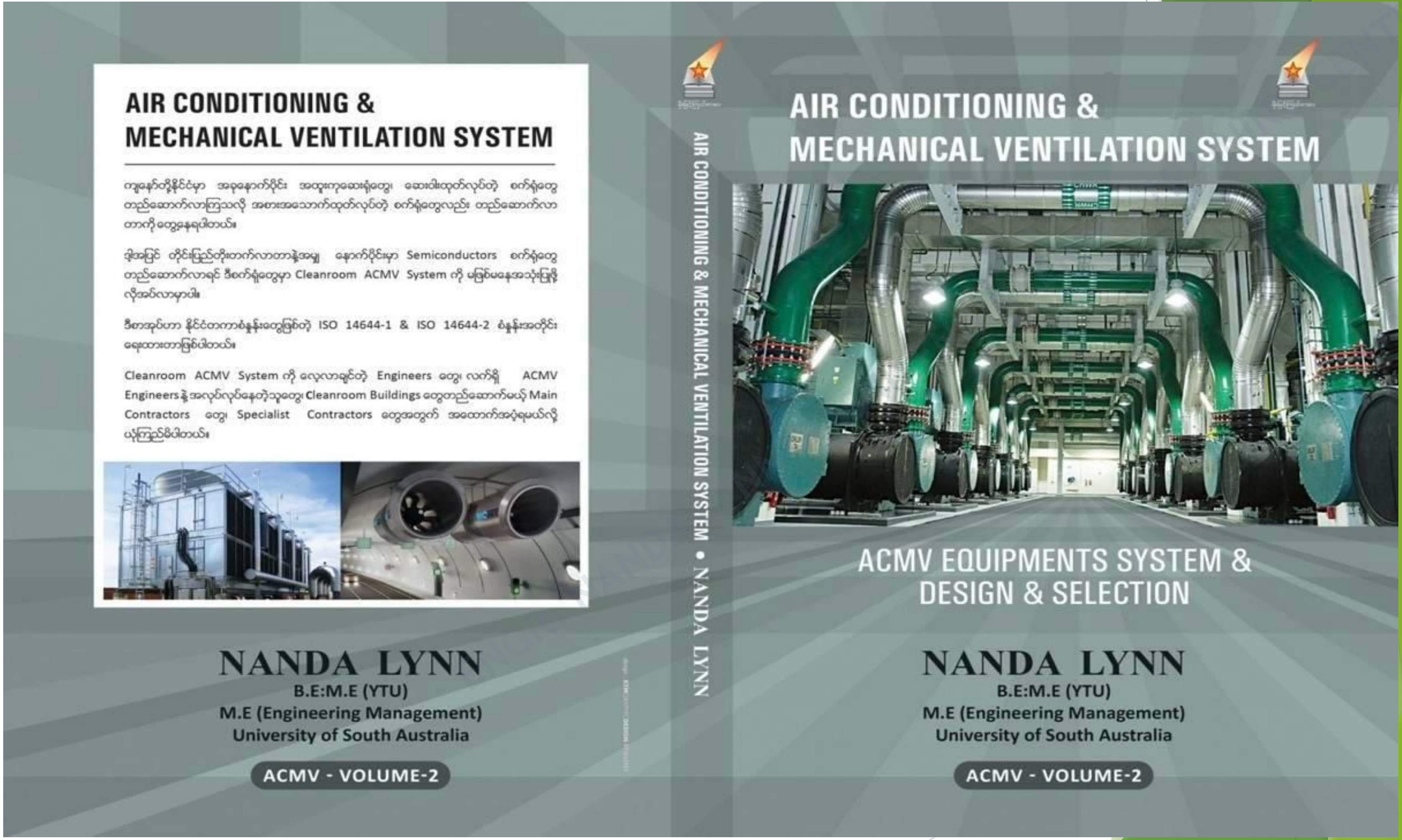

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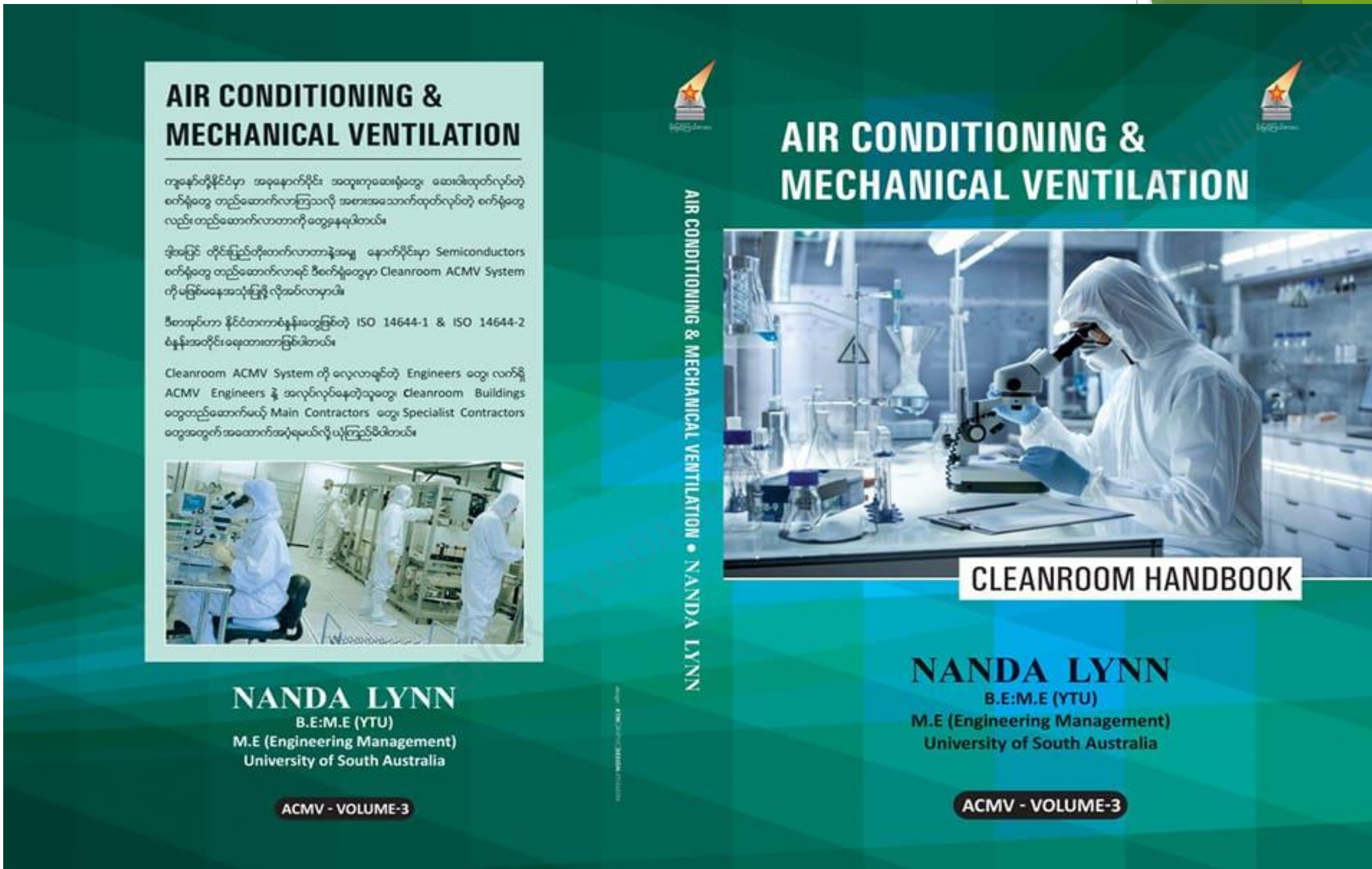

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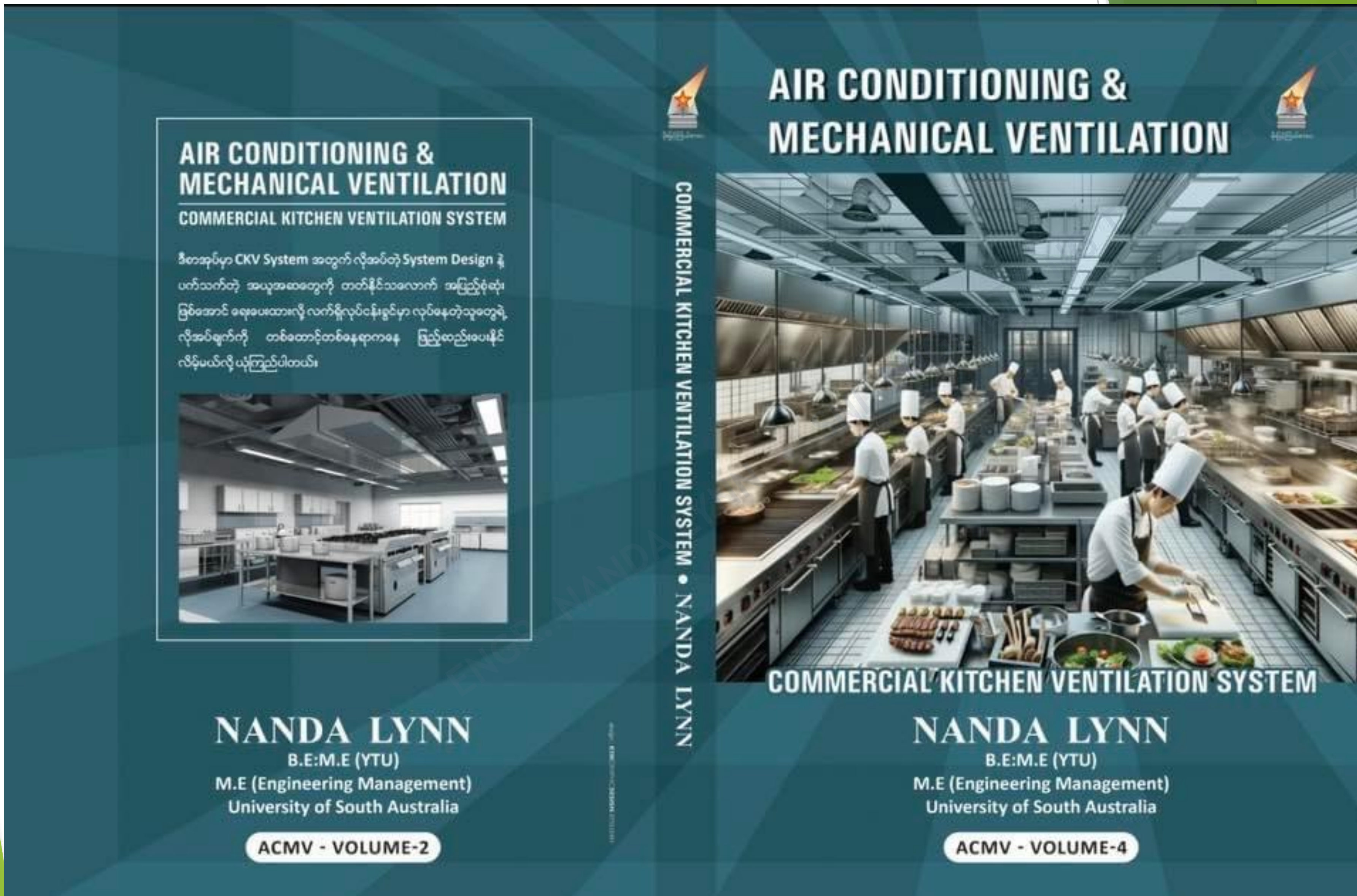
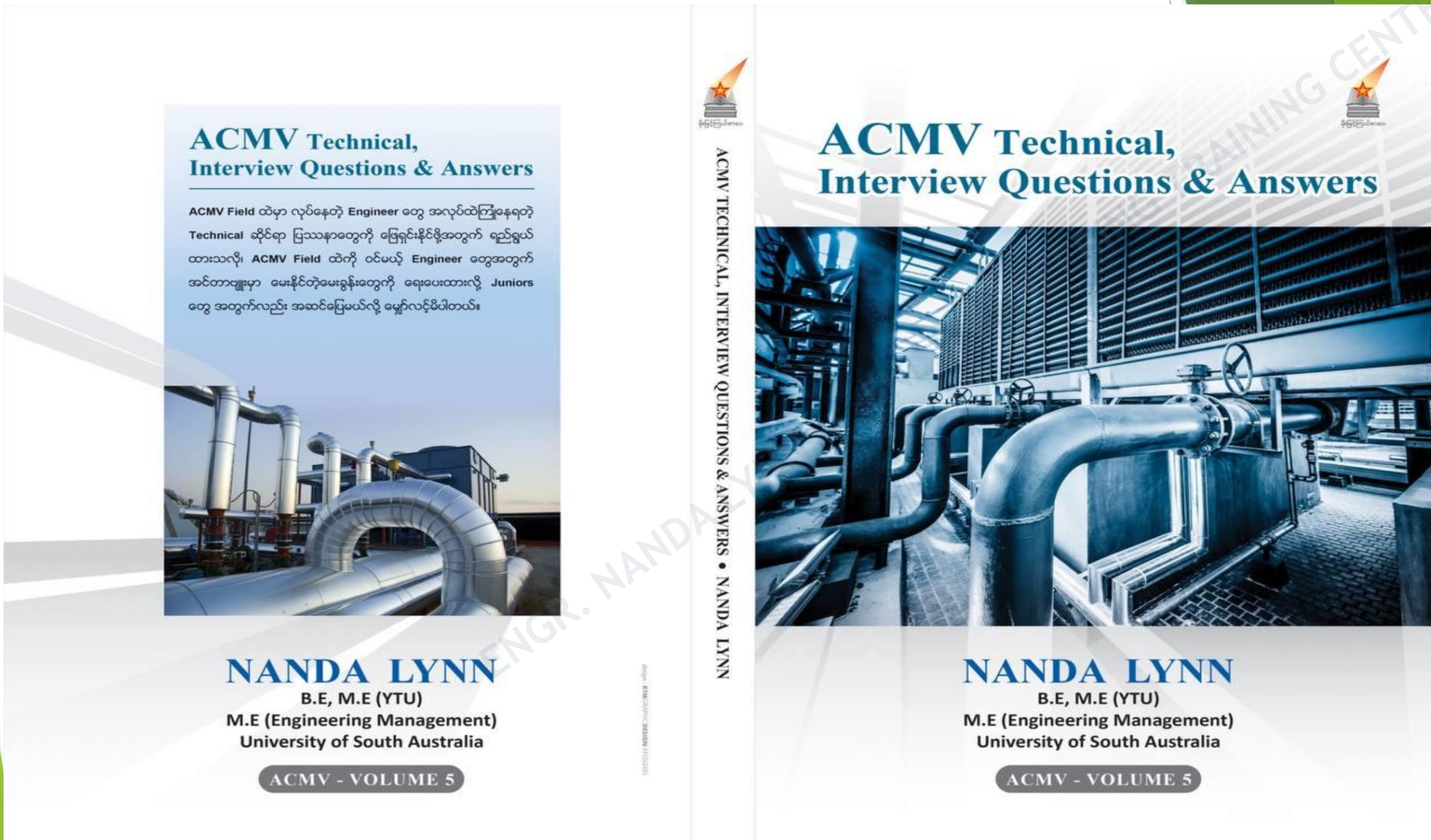
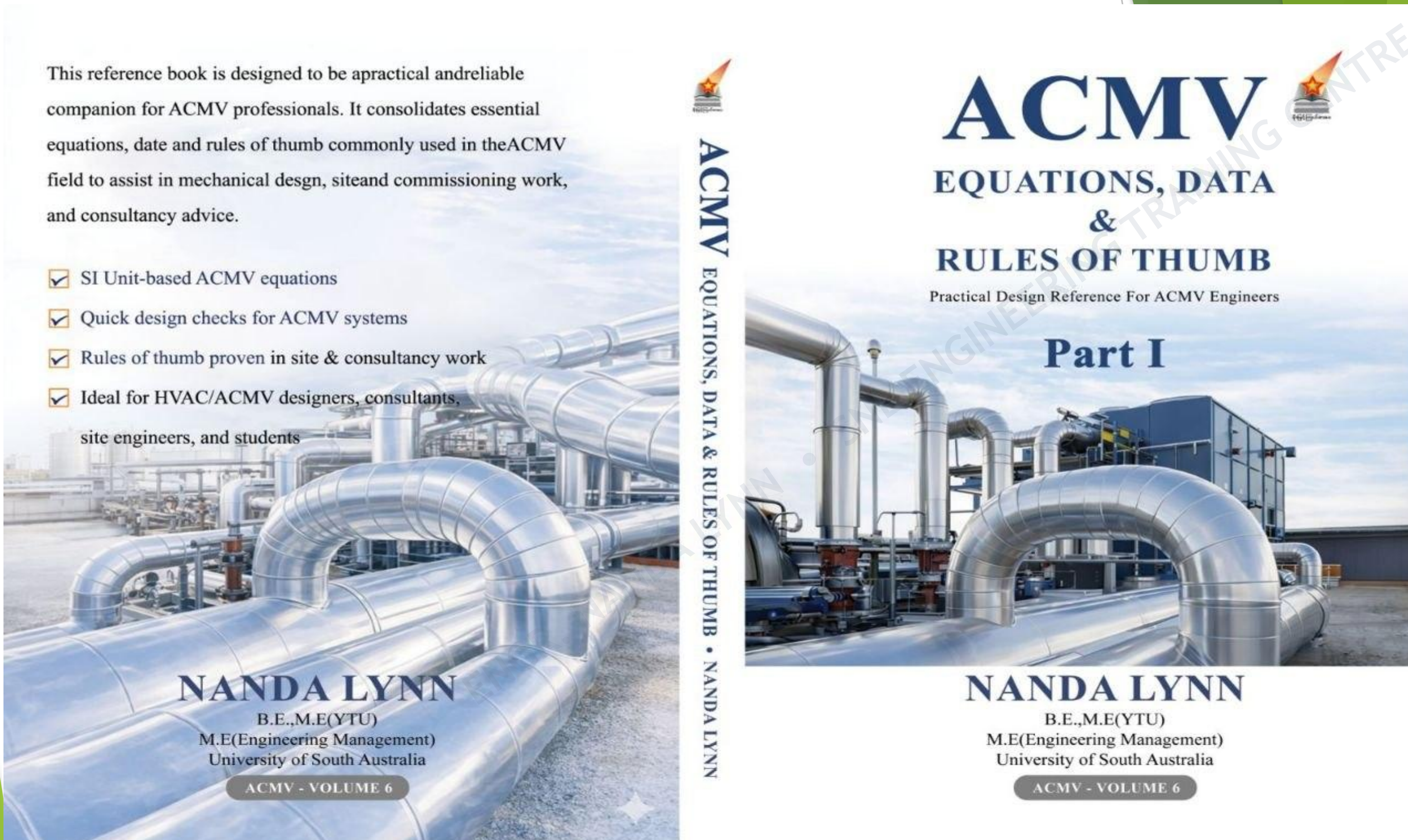


ACMV Technical Questions & Answers



ACMV Equations, Data & Rules of Thumb



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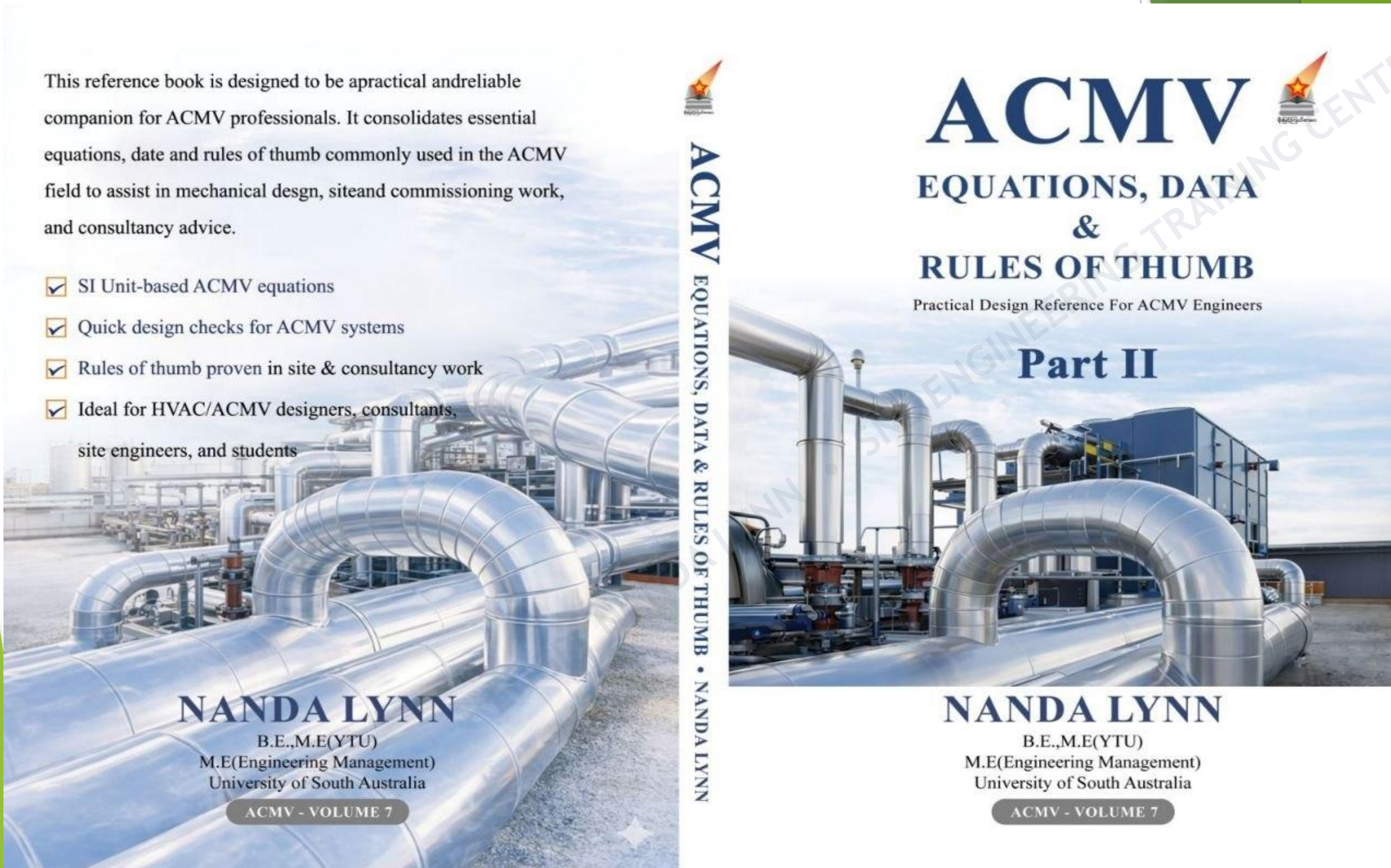
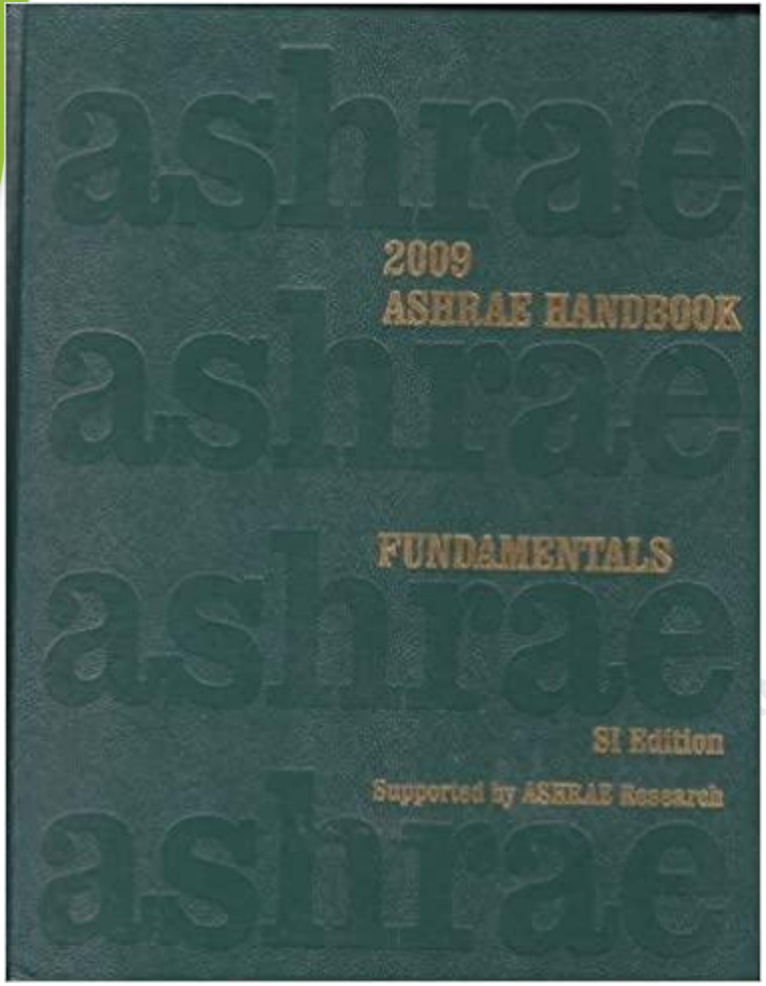
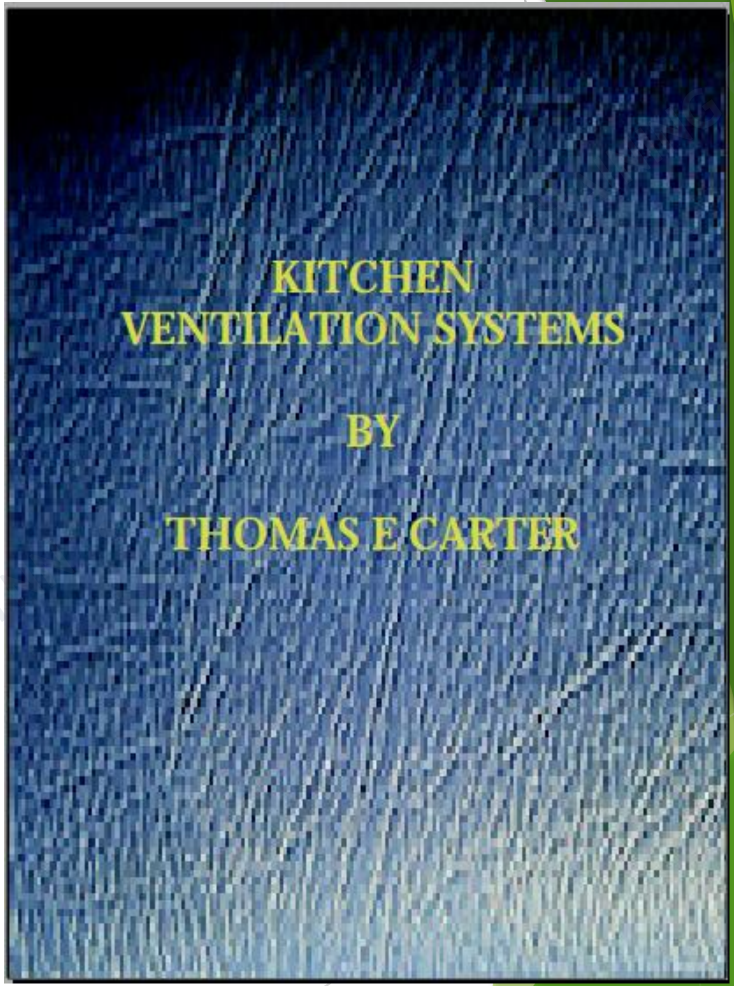


Reference Books for Commerical Kitchen Ventilation System





Reference Book for Commercial Kitchen Ventilation System

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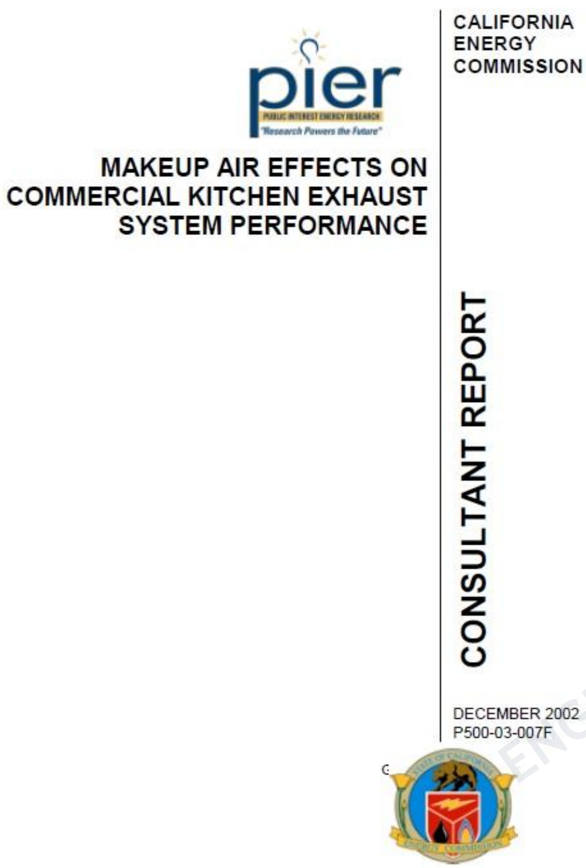
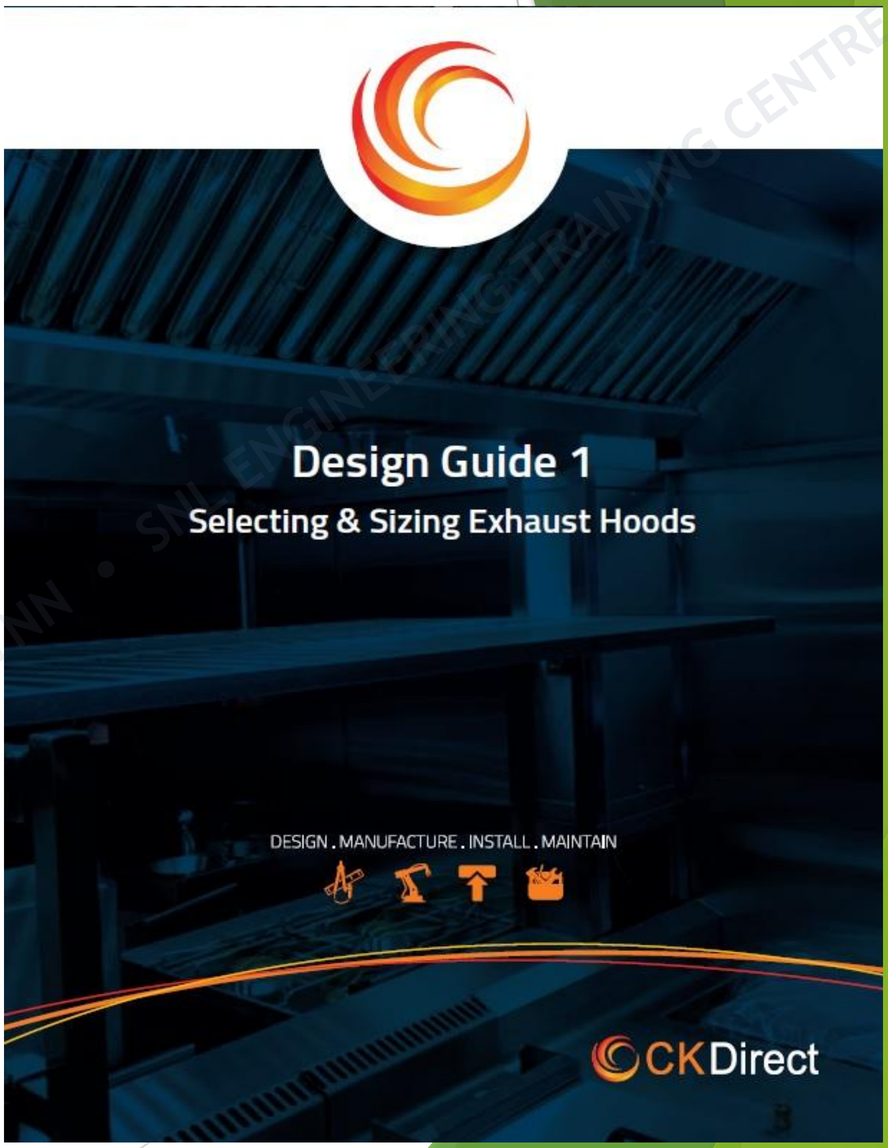




Reference Books for Commercial Kitchen Ventilation System

Kitchen Ventilation Systems

Introduction

1- Purpose of Kitchen Ventilation

- to provide a comfortable environment in the kitchen and

- to enhance the safety of personnel working in the kitchen and of other building occupants.

2- Purpose of Kitchen hood

- to remove the heat, smoke, effluent, and other contaminants.

Hood Nomenclature

-The hood is component of a kitchen ventilation system but an important one whose size is determined by the size and capacity of the equipment being used.

-Three factors determine capacity:

(1) Type of cooking appliances in use

(fryers, ovens, broilers,steam kettles)

(1) Type of heating source

(gas, steam, electricity)

(1) Barriers to air flow

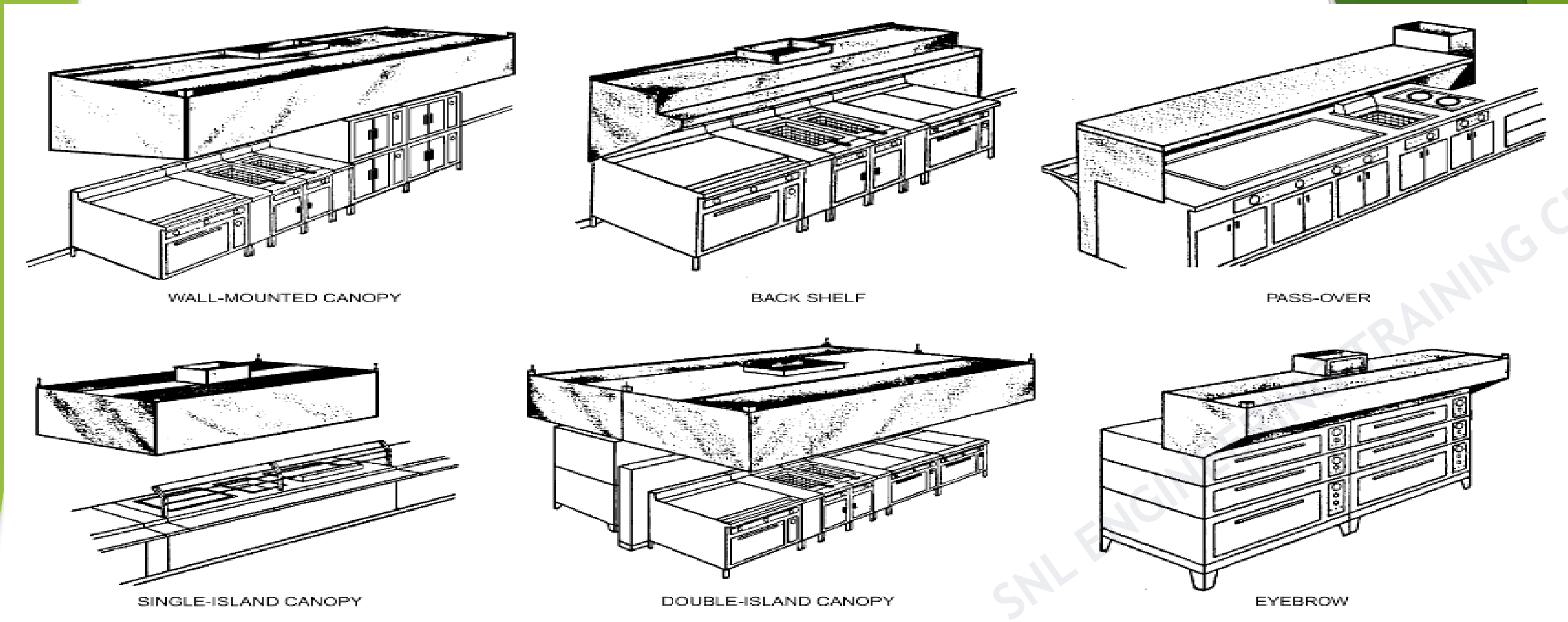
(building walls, fabricated enclosures.

Hood Types

Type I hood is used for collecting and removing grease particulate, condensable vapor, and smoke. It includes (1) listed grease filters, baffles, or extractors for removing the grease and (2) fire-suppression system. Type I hoods are required over cooking equipment, such as ranges, fryers, griddles, broilers, and ovens, that produce smoke or grease-laden vapors.

Type II hood collects and removes steam and heat where grease or smoke is not present. It may or may not have grease filters or baffles and typically does not have a fire-suppression system. It is usually used over dishwashers.

Basic type I Hood



. **Wall-mounted canopy,** used for all types of cooking equipment, located against a wall.
- **Single-island canopy,** used for all types of cooking equipment in, a single-line island configuration.
- **Double-island canopy,** used for all types of cooking equipment, mounted back-to-back in an island configuration.
- **Back shelf/proximity,** used for counter-height equipment typically, located against a wall, but possibly freestanding.
- **Eyebrow,** used for direct mounting to ovens and some dishwashers.
- **Pass-over,** used over counter-height equipment when pass-over configuration (from cooking side to serving side) is required.

Sizing a hood

-The air velocity of 50 fpm is the minimum required to contain a rising thermal column and capture suspended particulate matter released by cooking operations.

-The minimum velocity is called “ capture velocity”

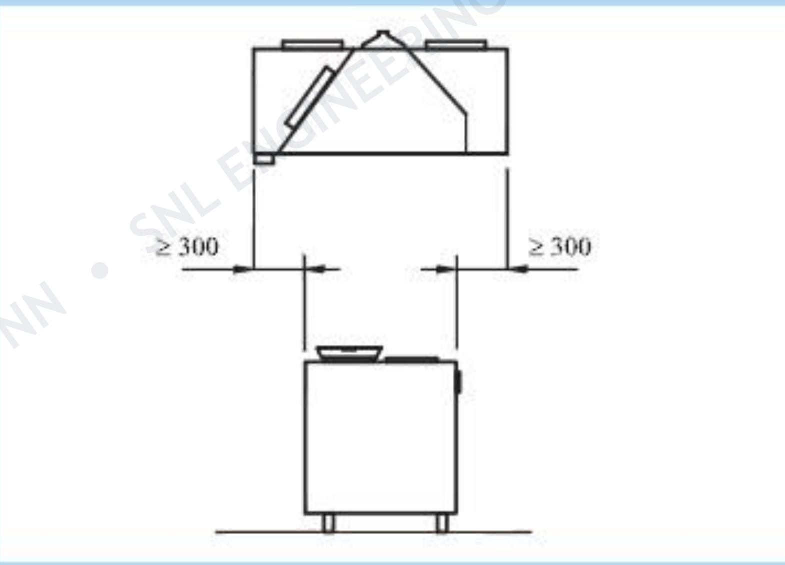
-There are three areas to consider when sizing a hood.

(1) The cooking equipment layout

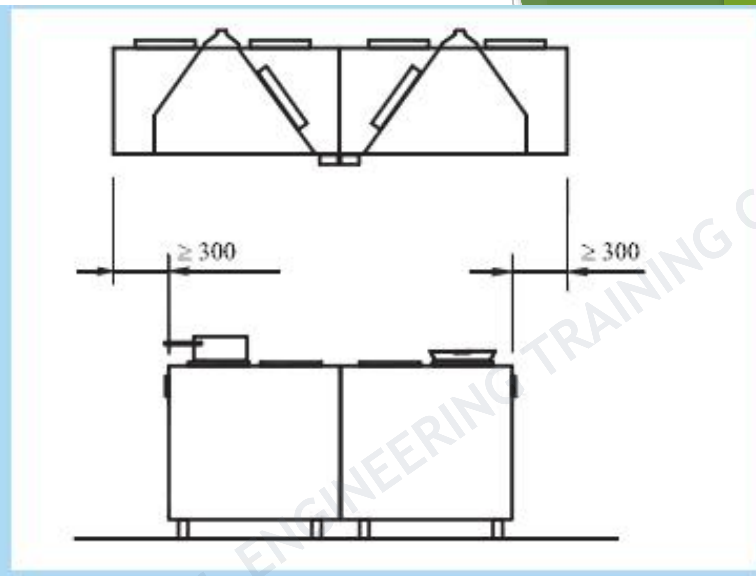
-It is necessary to measure the length and depth of the cooking bank. Most application require 6” overhang on each side of the open cooking surface and 12” overhang is used for char broilers.

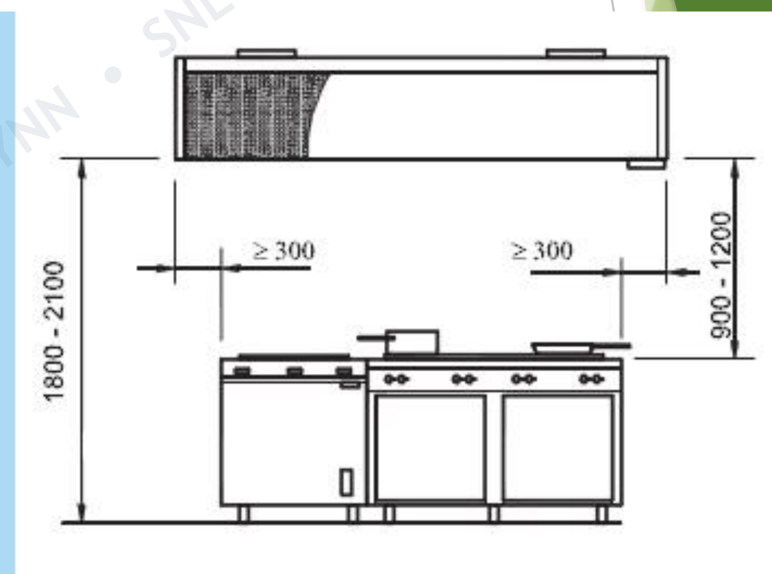
Canopy type

All canopy type kitchen ventilation requires front and end overhangs. In most instances, extending the overhang of a hood system from the typical 300 mm.



The hood should extend a minimum of 300 mm beyond the cooking equipment





Recommended height from the floor to the lower edge of the canopy is 2000 mm.

Sizing a hood

(2) **The wall locations**

- Determine the wall locations around the hood perimeter.

(3) **The structure height limitations**

- The ceiling clearance determines the height of the hood when tapers are required.

The composition of Air

-In a healthy environmental atmosphere, the air we breathe is made up of 78% nitrogen and 21% oxygen. The remaining 1% consists of various gases and impurities.

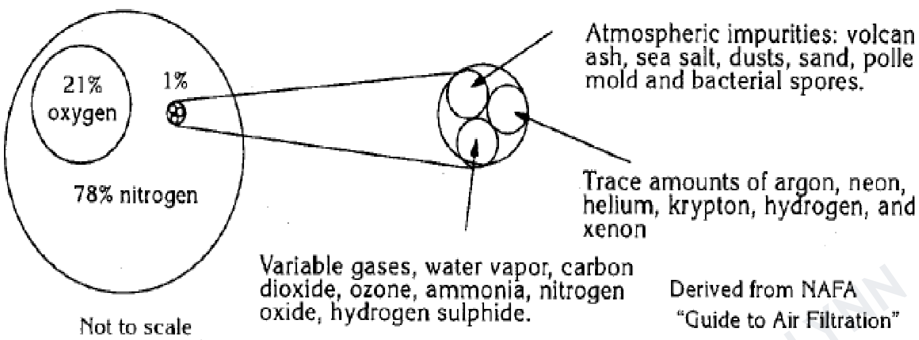


Figure 16 - The composition of air

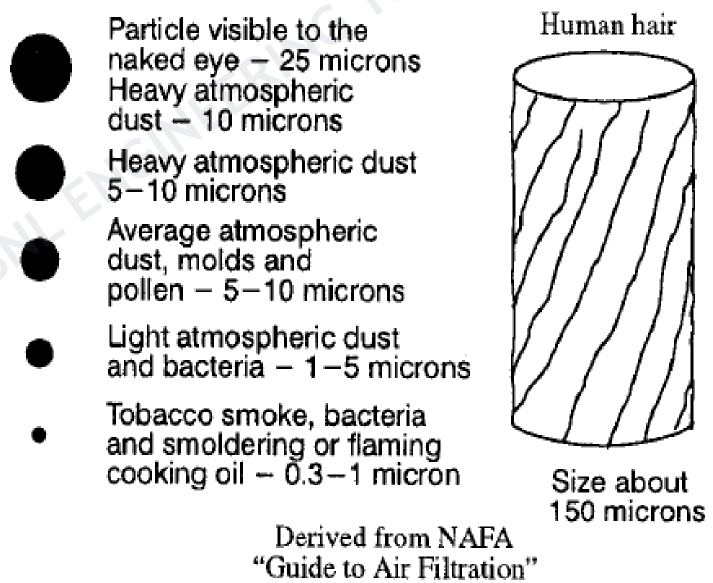
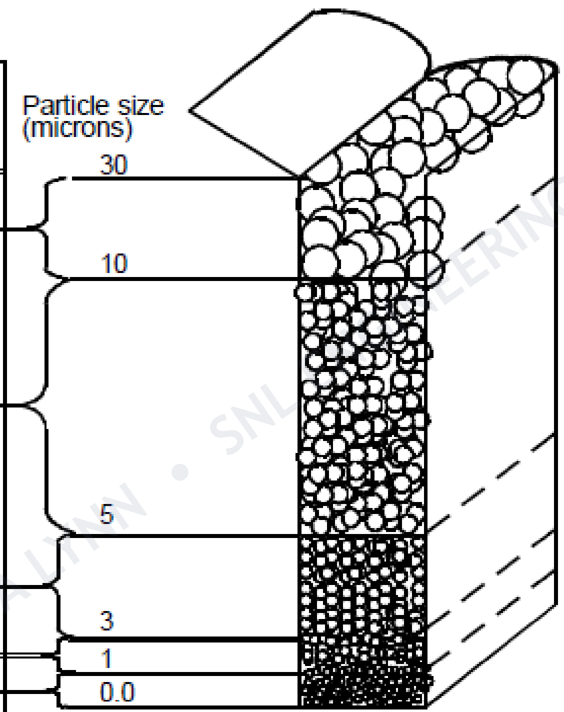


Figure 17 Comparative sizes of micron particles

Particles Size Distribution in Atmosphere

Average particle size (microns)	Per cent by particle count	Per cent by weight
20	0.005	28
7.5	0.175	52
4	0.25	11
2	1.07	6
0.5	98.5	3



Source: NAFA "Guide to Air Filtration"

Figure 18 - Particle size distribution in atmosphere

Particles Size and Element Comparison Chart

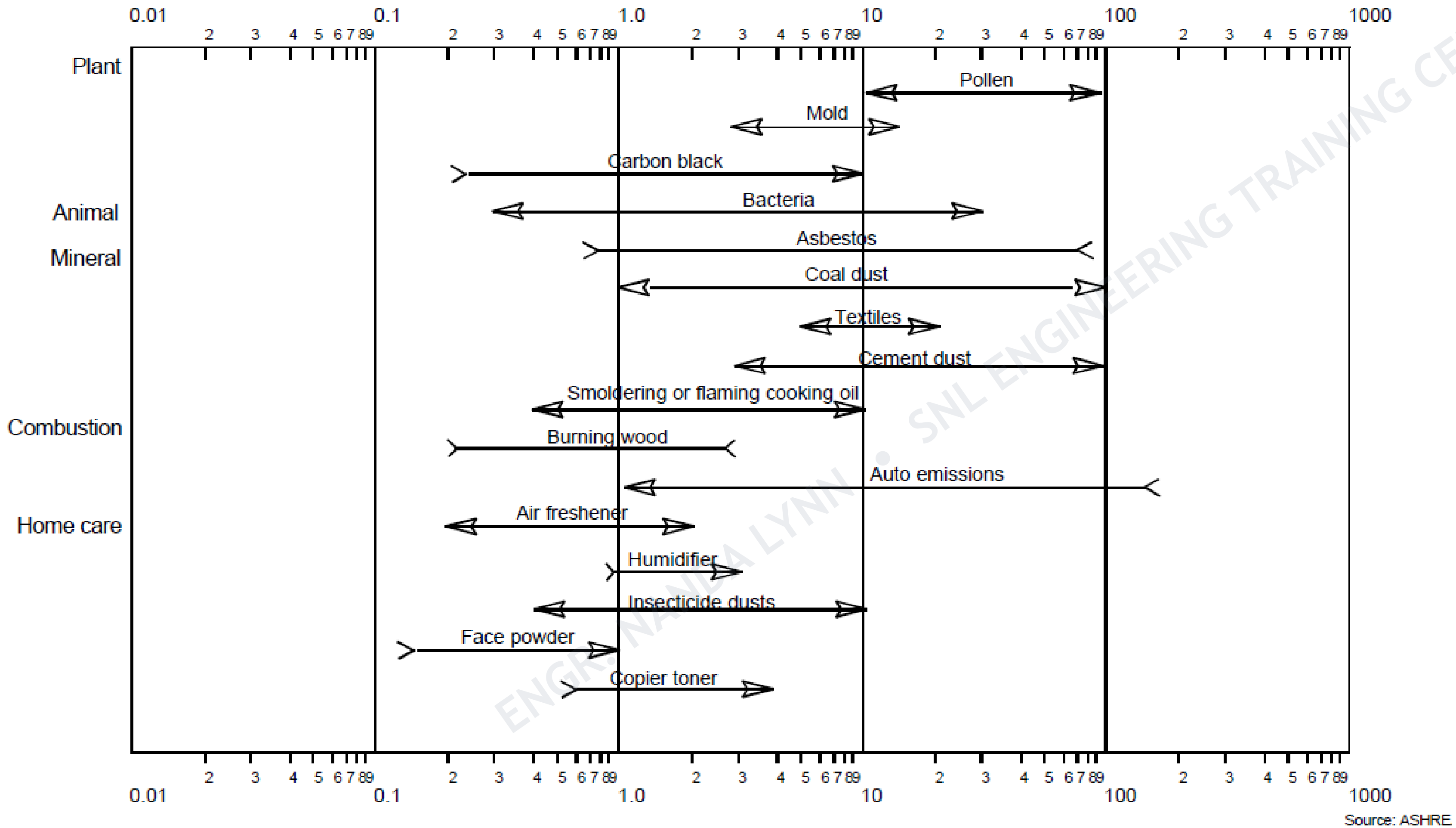
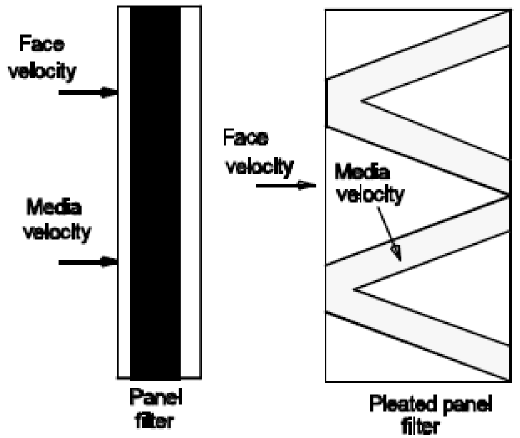


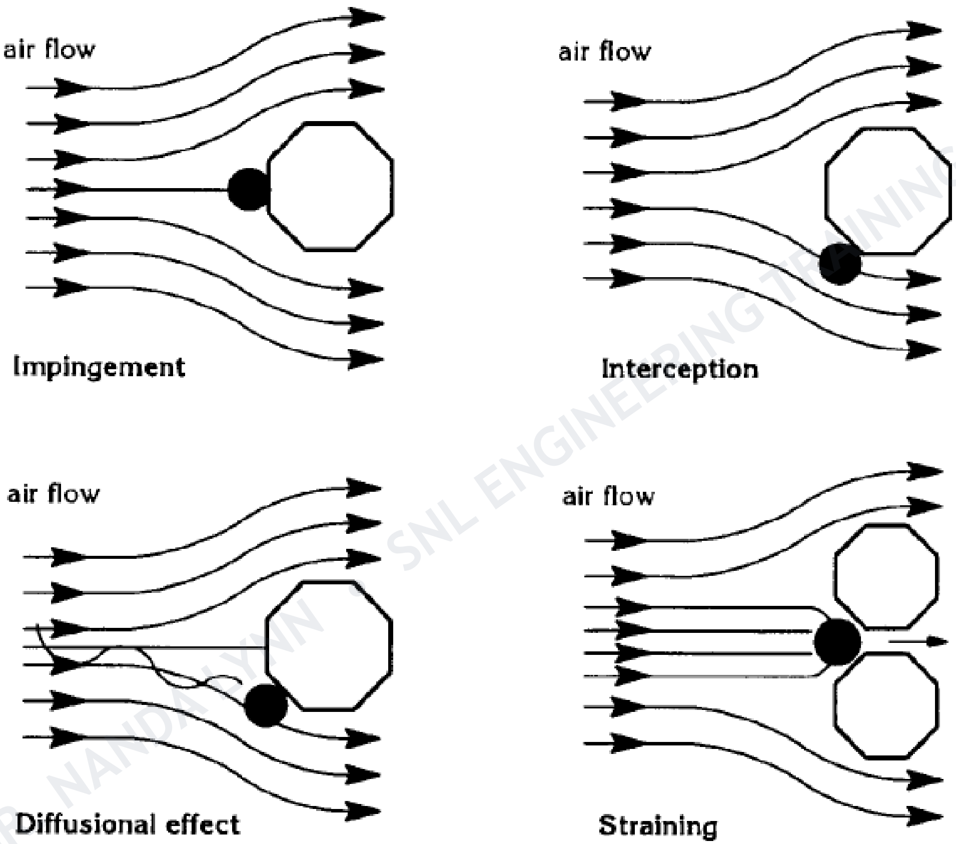
Figure 19 - Particle size and element comparison chart

Face Velocity vs Media Velocity



Source: NAFA
"Guide to Air Filtration"

Figure 20 - Face velocity vs media velocity



Source: NAFA
"Guide to Air Filtration"

Figure 21 – How particles are picked up on the filter media

Terms and Definitions

I. **Dust** is dry particles larger than colloidal size and is generated from the reduction of larger, solid materials. Dust varies in size from <0.1 to >25 microns.

II. **Fumes** are particulate matter consisting of the solid particles generated by condensation from the gaseous state.

III. **Fog** is the condensation of water vapor in the air in sufficient concentration to reduce visibility.

IV. **Mist** is similar to fog except that it is the formation of liquid droplets suspended in or falling through a moving or stationary atmosphere.

V. **Smoke** is dispersion of liquid aerosols formed by the incomplete combustion of organic material in a gaseous atmosphere.

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Terms and Definitions

I. **Gas** is a phase of matter in molecular form, characterized by relatively low density.

II. -**Vapor** is a gas formed by the evaporation of a material in liquid or solid form.

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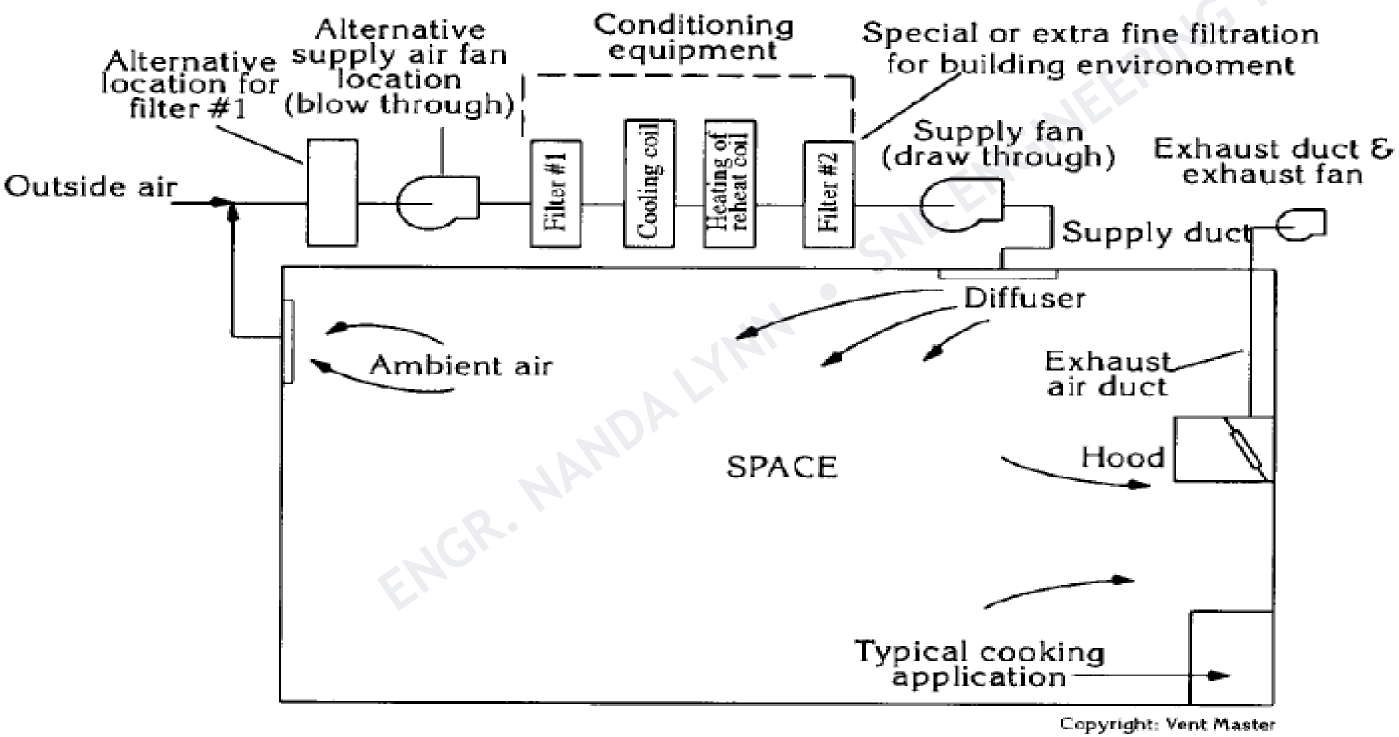


Figure 22 – Components of an air–conditioning system

Grease Removal Devices

-The main requirements for a filter are

(1) Steel construction, tight fitting and firmly held in position.

(2) Easily accessible and easy to remove for cleaning.

(3) Installed at an angle not less than 45 degree from the horizontal.

(4) Equipped with a drip tray pitched to drain into a container having a minimum capacity of 0.13 gallon (0.5 L)

Filter Grease extractor chambers (Cyclo Maze Series

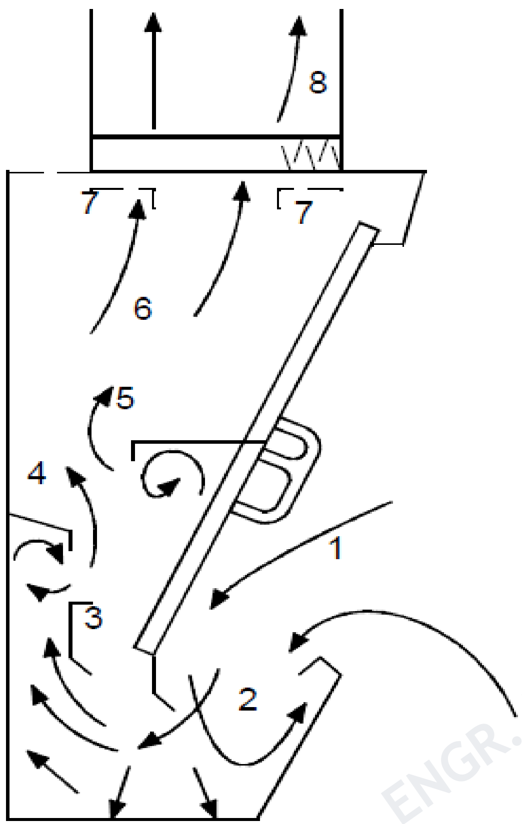


Figure 23 - Air flow in Cyclo Maze dry unit

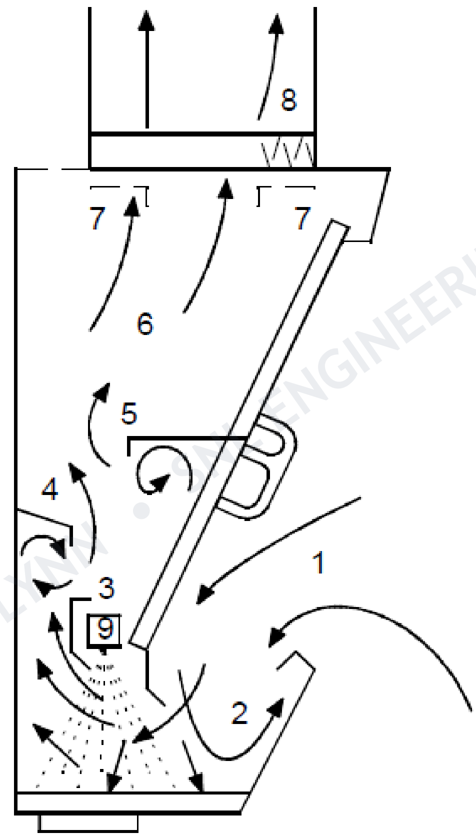


Figure 24 - Air flow in Cyclo Maze cold water mist unit

Ducting

- There are two parts ducting for ventilation system.
- The first one is to exhaust the kitchen air to the outside environment.
- The second one is to deliver outside air to the kitchen space when replacement air is supplied through the ducting system.
- In single story, where air is exhausted through the roof, the size of the ducting is not critical.
- In multi-story, where the duct run length is considerable, the designer must calculate the size of the run with accuracy.
- Kitchen ventilation ducts must not be interconnected with any other ventilation ducting or exhaust system.

Ducting & Ventilation Rates

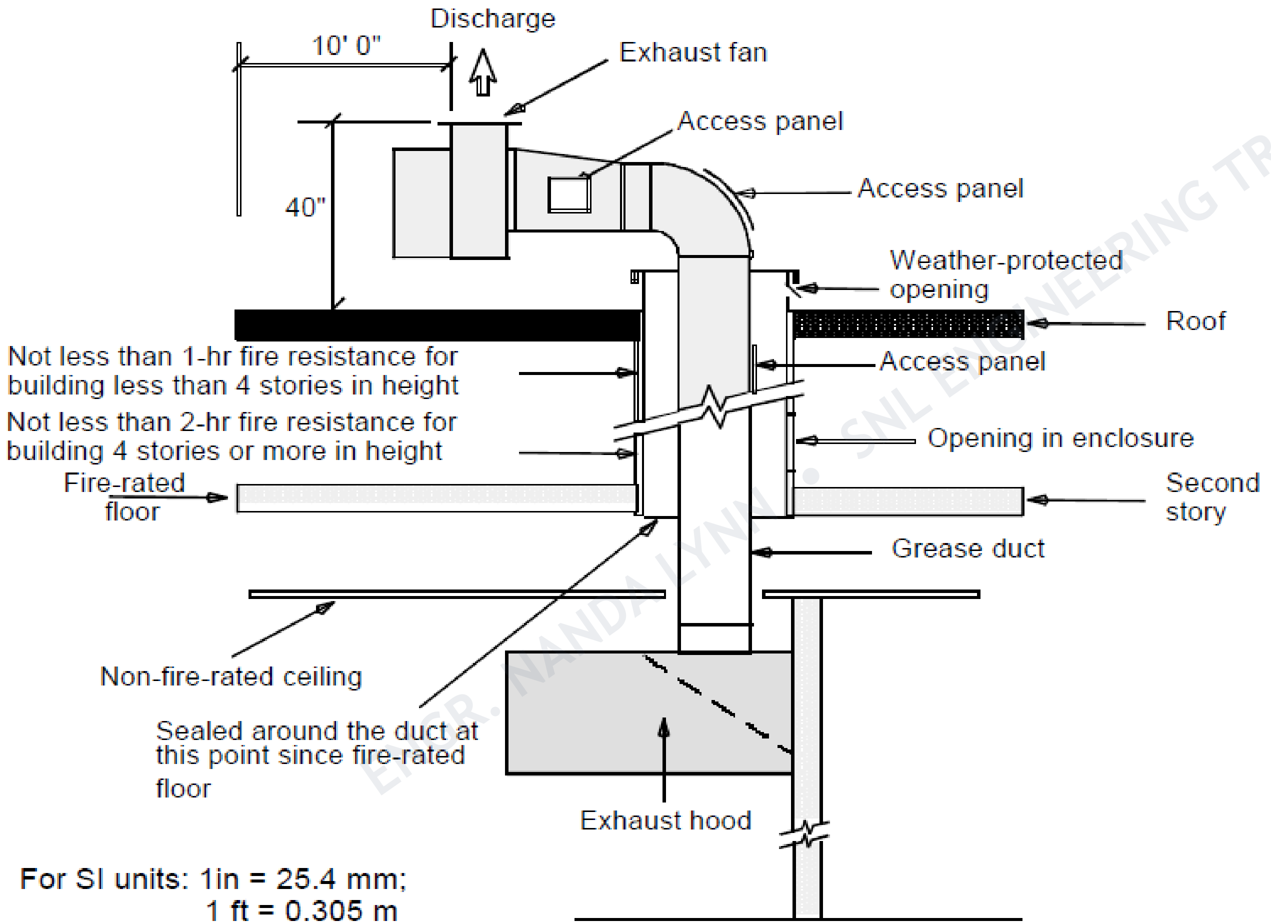
Operation	Hood size	CFM value
Hamburgers	2 – 4' hoods	2,400
Mexican food	1 – 8' hood	900
Chinese fare	1 – 14'hood	2,400
Fish & chips	1 – 6' hood	4,000
Fries only	1 – 6' hood	1,800
Pizza	1 – 5' hood	1,800
Deli	1 – 5–6'hood	1,500
Fried chicken	1 – 8' hood	2,600
	Total cfm	17,400

Table 3

- Using the value tabulated in Table 3 for the eight kiosks, there is an average cfm value of 17,400/8 = 2,175 cfm
- Therefore, it is safe to work on average Value of 2,500 cfm per kiosk.

Ducting Installation

-According to NFPA 96 Appendix A, Installation requirements for a typical commercial cooking exhaust system.



Source: NFPA 96, 1994 Edition

Figure 28 - Typical section view for building with two stories or more with non-fire-rated ceiling and fire-rated floor

Ducting Installation

-According to NFPA 96 Standard, construction assemblies containing noncombustible, limited combustible and combustible materials.

Type of wall assembly	Classification for determining hood and grease duct clearance*		
	Noncom-bustible	Limited combustible	Combustible
Brick, clay tile, or concrete masonry products	√		
Plaster, ceramic or quarry tile on brick, clay tile or concrete masonry products	√		
Plaster on metal lath on metal studs	√		
Gypsum board on metal studs		√	
Solid gypsum board		√	
Plaster on wood lath or metal lath on wood studs			√
Gypsum board on wood studs			√
Plywood or other wood sheathing on wood or metal studs			√
Type of floor–ceiling or roof–ceiling assembly			
Plaster applied directly to underside of concrete slab	√		
Suspended membrane ceiling			
(a) with noncombustible mineral wood or acoustical material	√		
(b) with combustible fibrous tile			√
Gypsum board on steel joist, concrete slab		√	
Gypsum board on wood joists			√

Source: NFPA 96 1994 Edition

*NFPA 96 1994 Edition specifies clearance requirements

Notes:

1. Wall assembly descriptions assume same facing material on both sides of studs
2. Categories are not changed by use of fire retardant-treated wood products
3. Categories are not changed by use of Type X gypsum board

Air Flow for Commercial Kitchen Ventilation

❖ The following are some basic principles of commercial kitchen ventilation:

1: Impurities and excess heat should be removed with efficient local exhaust.

2. Supply air should be brought to the working area in such a way that it first refreshes workers and then replaces convective flows.

3. Where workers are subjected to large heat radiation, supply air should be introduced directly to the working space.

Air Flow for Commercial Kitchen Ventilation

Make-up air supplied direct from ACMV System

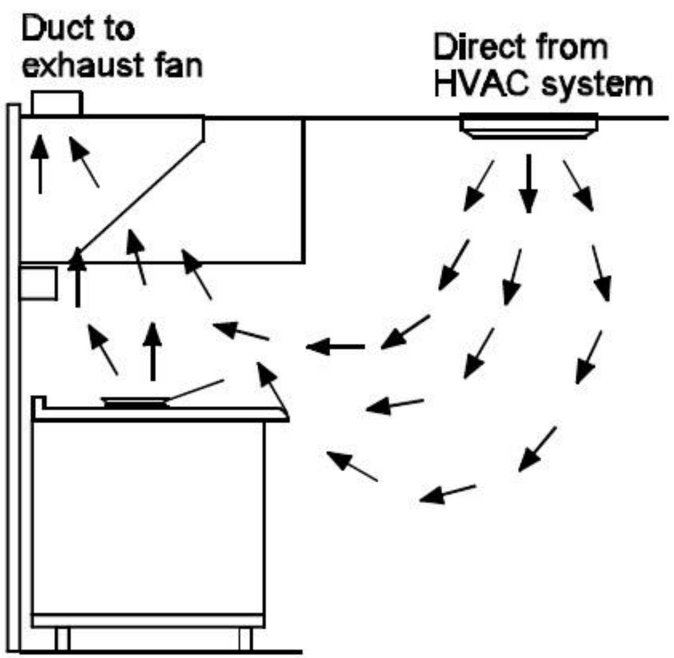


Figure 29 Make-up air supplied direct from HVAC system

- ❖ Every commercial kitchen requires make-up air to compensate for the air ventilated from the kitchen space to remove heat, cooking odors and grease created by cooking operations.
- ❖ Ventilation is also essential to maintain a comfortable work environment.
- ❖ Make-up air can be taken from the building HVAC system of which the kitchen area is usually a part as illustrated in Figure 29.
- ❖ This method is an expensive and inefficient method of replacing exhausted air.
- ❖ Make-up air can come from the room HVAC system, either outlets near to the hoods or integrated into the hood.
- ❖ The use of cooled or heated make-up air is expensive and utility bills can double and triple.

Air Flow for Commercial Kitchen Ventilation

Down discharge supply air designs

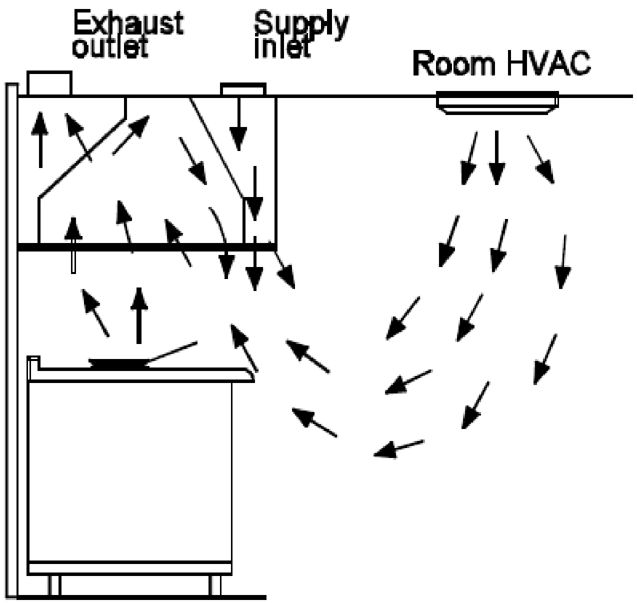


Figure 30 - Integrated system, down discharge type

- The advantage of using integrated make-up air is that in large measure it reduces the burden on the building ACMV Systems.
- Make-up air is supplied by a down discharge duct and blower close to the cooking surfaces.
- Even though there are three disadvantages.
- 1.The air velocity from the hood supply air opening is greater than that of heated air rising from the cooking surface, which results in spillage of contaminated air held within the hood.
- 2. The lower temperature of the make-up air combined with the greater velocity causes the air to drop rapidly, pulling contaminant into operator's face.
- 3.The direct down discharge can make it uncomfortable for kitchen staff, especially in cold climates. As a consequence, operators often shut off the make-up air system, nullifying its usefulness.

Air Flow for Commercial Kitchen Ventilation

Short Cycle Supply Air

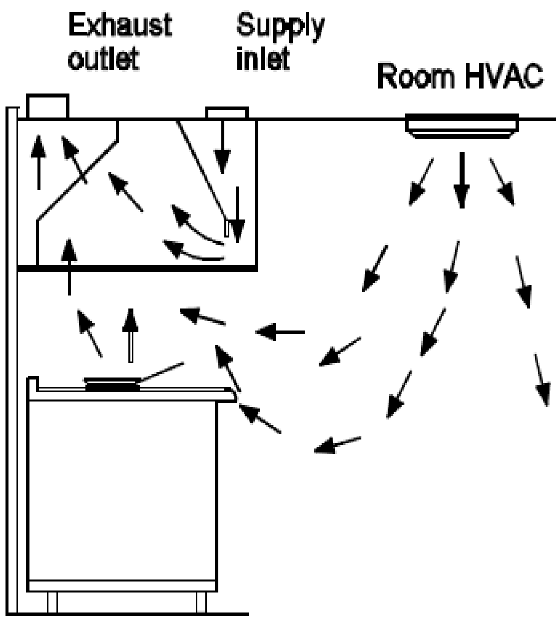


Figure 31 - Short cycle type

- The short cycle method of supplying make-up air provides some untampered outdoor air within the hood enclosure to reduce the amount of air the ACMV system must supply.
- This may seem to reduce the cost of using the HVAC System, but unless the velocity of the supply air is strictly controlled its velocity can exceed the velocity of the exhaust air and cause smoke emission from the hood cavity.
- The difference between discharging make-up air into the kitchen space from the hood from lip and the short cycle method lies in the discharge exist of the two arrangements.
- In addition to the chance of emitting smoke, safety problems can rise with short cycle hoods.

Air Flow for Commercial Kitchen Ventilation

Front Panel Type

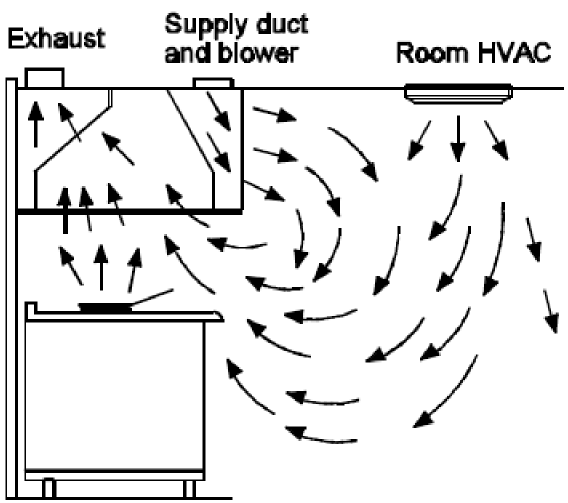


Figure 32 - Front panel type

- The front panel type of make-up air is effective for virtually all applications and climates.
- A perforated stainless steel plate keeps the air flow velocity between 1.5 m/s to 2.5 m/s.
- This permits the supply of a large volume of air at the hood, with little or no effect on the kitchen environment.
- The low velocity of make-up air means that it is felt only 3 to 4 feet from the hood face.
- During winter months, it may be necessary to heat the air of front panel type make-up air (10°C-15°C is recommended).
- During the summer period, the need to cool the air is negligible because the incoming air provides evaporative cooling to kitchen staff working under the effect of radiant heat generated by the cooking operations.

Down discharge supply air designs

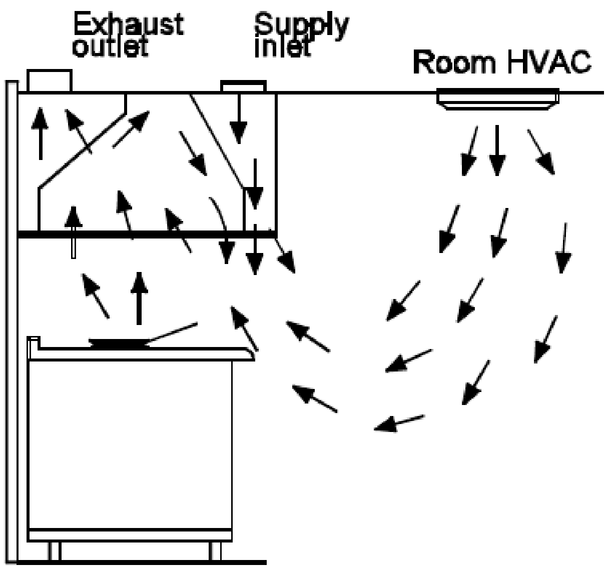


Figure 30 - Integrated system, down discharge type

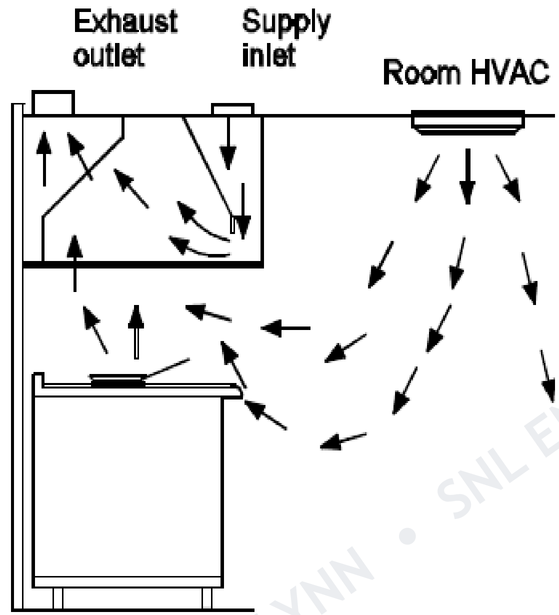


Figure 31 - Short cycle type

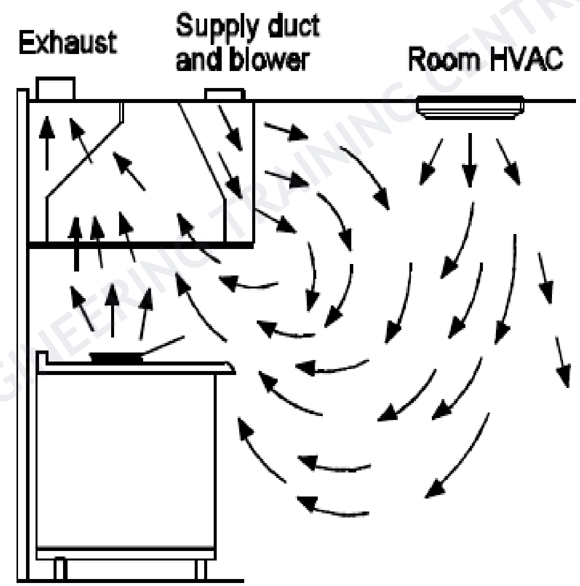


Figure 32 - Front panel type

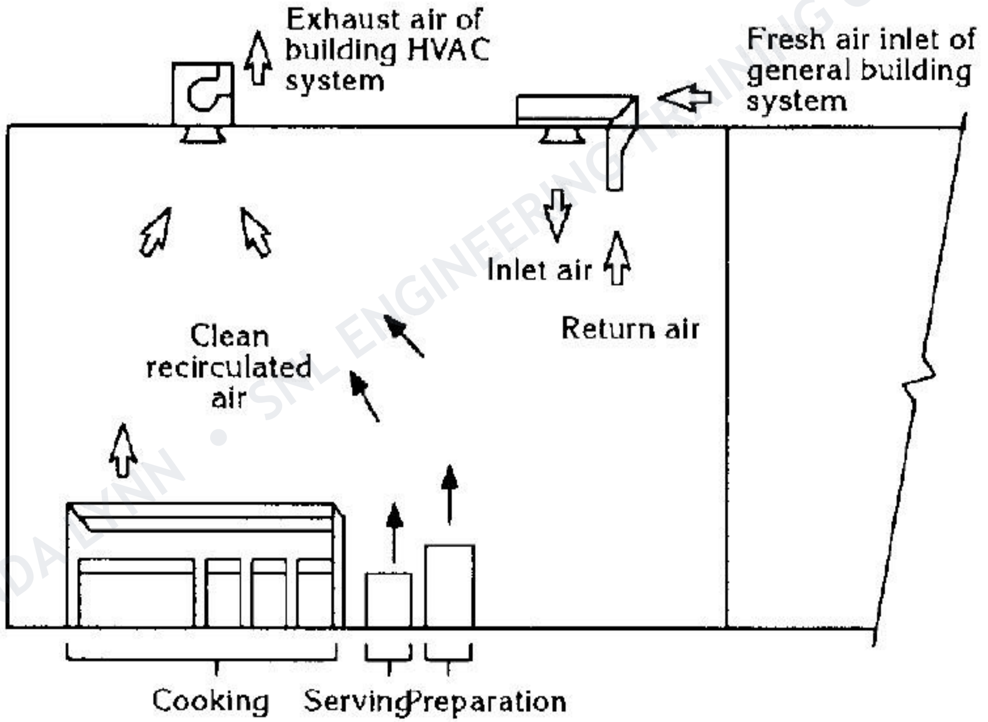
Exhaust and make-up air limitations

- If one site provides ample access for duct shafts to exhaust to the roof and provide outdoor make-up air back to the kitchen, there are others with restricted access.
- With no obvious solution to providing the required air changes or to providing exhaust to the roof, and with space limitations that make the installation of equipment difficult, the designer has many problems to overcome.
- A number of options are available. The options shown in Figure 33 illustrate that even in demanding circumstances there can be more than one answer.
- The option chosen will depend on the particular circumstances of each project.

Exhaust and make-up air limitations

Option 1

If there is adequate general ventilation available, an approved recirculating exhaust, air–cleaning unit may be the answer. This will remove the grease vapors and treat the odors, and leave the general ventilation system to serve that space as would be normal for any similar space in the structure.

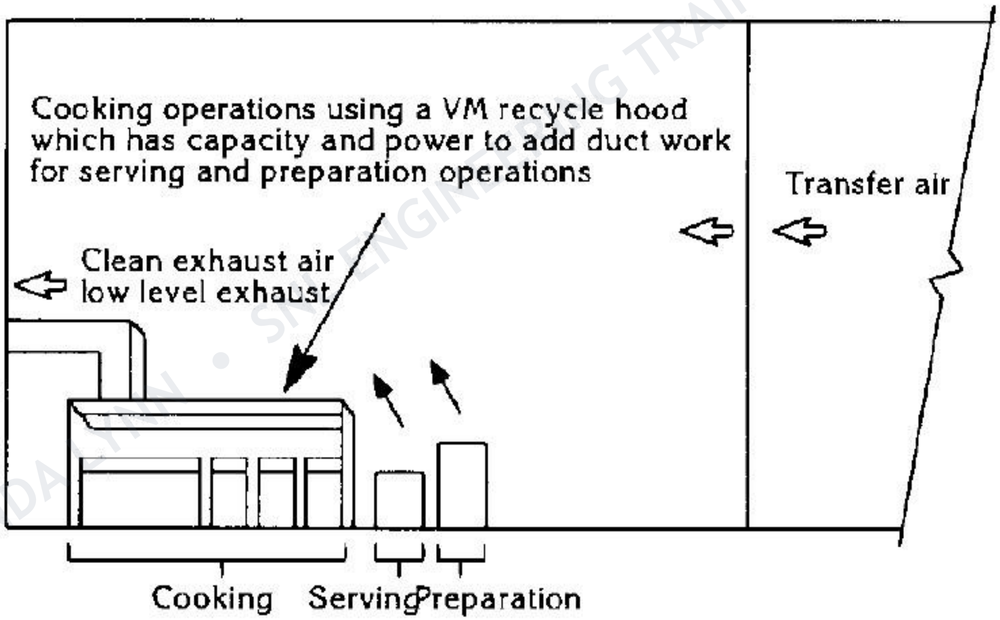


Exhaust and make-up air limitations

Cooking Serving Preparation

Option 2

If there is no existing space ventilation, it is possible that cleaned exhaust air can be vented to an exterior wall of the building for low level exhaust. The clean air unit now maintains a negative pressure in the kitchen and provides a means of exhausting and ventilating the commercial cooking equipment.



Exhaust and make-up air limitations

Option 3

If the only exhaust available is through existing duct work with low volume capacity, then partial recycling and exhaust with an approved air cleaning unit may be the solution.

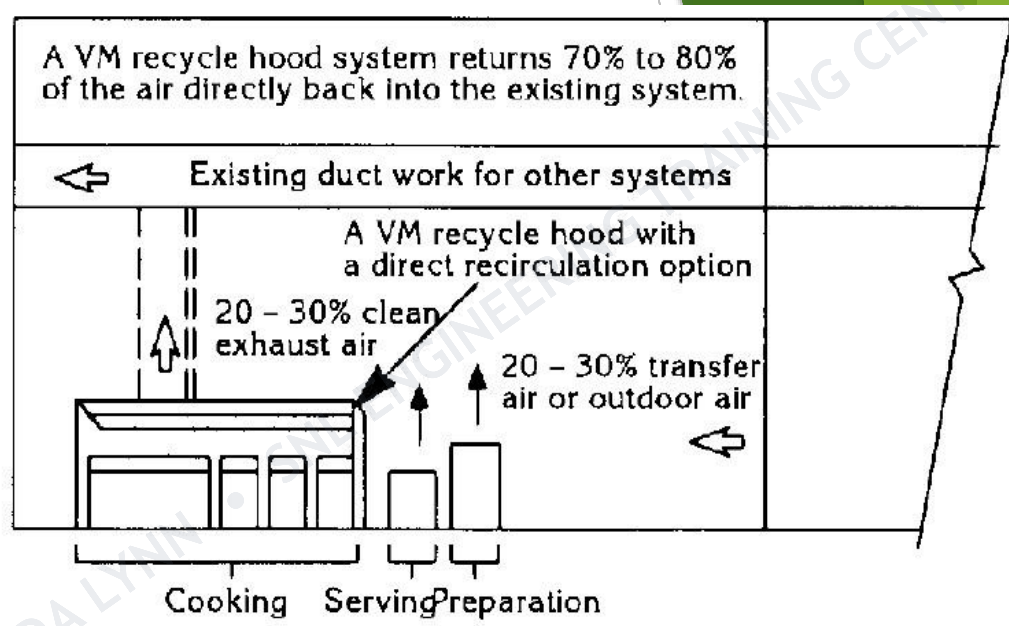
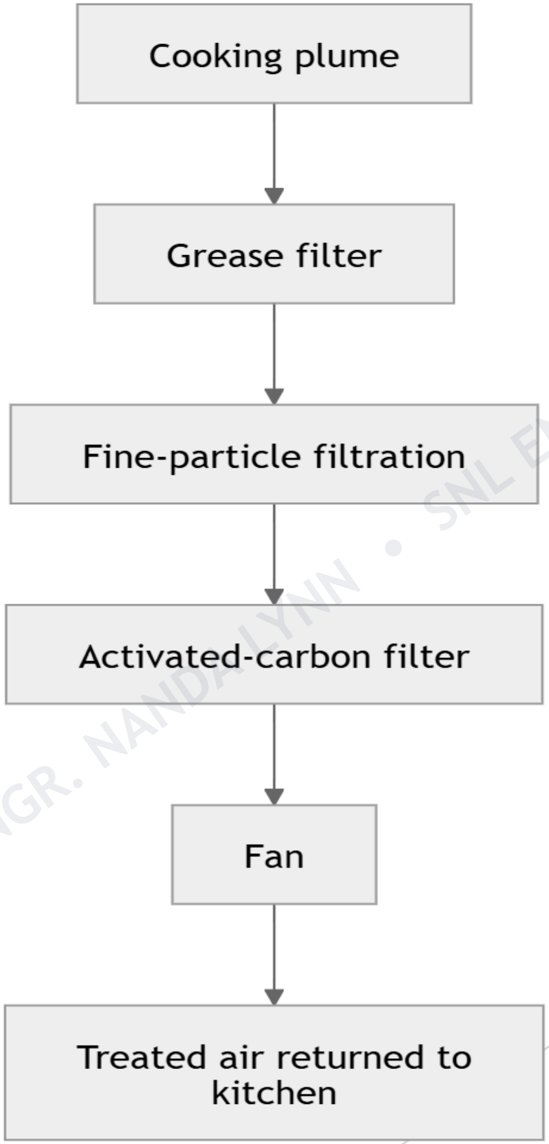


Figure 33 – Exhaust and make-up air options

Ventless or Recirculating Hood

VM means ventless/ recirculating hood, The hood captures cooking fumes and passes the air through several treatment stages:



Ventless or Recirculating Hood

Depending on the manufacturer, it may include:

I. Stainless-steel baffle or mesh grease filter

II. Electrostatic precipitator—ESP

III. HEPA or fine-particle filter

IV. Activated-carbon filter for odour

V. UV-C or ozone treatment in some advanced systems

VI. Automatic fire-suppression system

VII. Interlock between the hood and cooking equipment

VIII. Because the treated air is **returned to the kitchen**, it is called a recycled or recirculating hood. It normally does not require a conventional grease exhaust duct to outdoors.

Ventless or Recirculating Hood

Important limitation

The system may reduce grease, smoke and odour, but it generally **cannot adequately remove cooking heat, water vapour, CO_2 or combustion gases** from the kitchen.

Therefore, the kitchen still needs:

I. General mechanical ventilation

II. Outdoor fresh-air supply

III. Space cooling for cooking sensible and latent heat

IV. Separate exhaust where required by local codes

V. CO monitoring if fuel-burning equipment is involved

VI. For Yangon's hot and humid climate, returning air to the kitchen means nearly all cooking heat and moisture remain part of the air-conditioning load.

Ventless or Recirculating Hood

Suitable applications

A certified recirculating hood can be considered for:

I. Electric ovens

II. Light-duty electric griddles

III. Induction cooking

IV. Small food kiosks

V. Locations where an external grease duct is impossible

Why Ventilation Systems are essential

- Cooking produces heat, odors, smoke, vapors, airborne grease and other pollutants.
- When a ventilation system breaks down, the kitchen atmosphere soon becomes stifling and impossible to work in. Hence, a constant supply of fresh, clean air is essential.
- The ventilation system must exhaust the heat produced and remove the odors and pollutants.
- A kitchen which specializes in producing light snacks, sandwiches and salads generates less heat and odors than kitchens producing heavier fare: steaks, hamburgers, and French fries.

Venting Cooking Equipment

- Gas, electric and steam cooking equipment must be allowed to breathe.
- Proper air flow is required for combustion, to exhaust fumes and odors and to prevent moisture and heat build-up in control cabinets.
- Too must exhaust can suck the heat out of an oven, preventing it from properly baking or roasting the product.
- Too little exhaust can cause a control cabinet to overheat and burn out expensive equipment.
- The ventilation system must exhaust the heat produced and remove the odors and pollutants.
- A kitchen which specializes in producing light snacks, sandwiches and salads generates less heat and odors than kitchens producing heavier fare: steaks, hamburgers, and French fries.

Rule of Thumb Calculation for Air Flow Rate of Exhaust Hood

Extra Heavy Duty Cooking Appliances:

The minimum net air flow for Type I hoods

Type of hood

CFM per linear foot

- Wall-mounted canopy

550

- Single Island canopy

700

- Double Island canopy

500

Heavy Duty Cooking Appliances:

The minimum net air flow for Type I hoods

Type of hood

CFM per linear foot

- Wall-mounted canopy

Rule of Thumb Calculation for Air Flow Rate of Exhaust Hood

Medium Duty Cooking Appliances:

The minimum net air flow for Type I hoods

Type of hood

CFM per linear foot

- Wall-mounted canopy

300

- Single Island canopy

500

- Double Island canopy

300

- Backshelf/pass-over

300

- Eyebrow

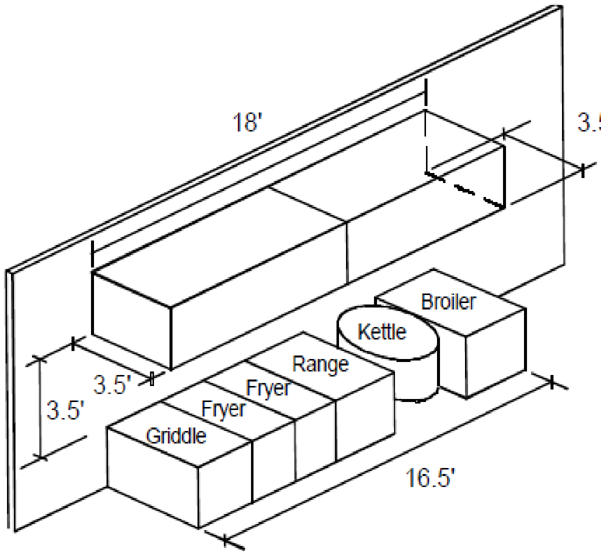
250

Lighty Duty Cooking Appliances:

The minimum net air flow for Type I hoods

Type of hood

Sample Calculation for Air Flow Rate of Exhaust Hood



Note:

Using a rule of thumb for medium duty cooking of 300 cfm/linear foot of hood, the total cfm is

= 300 x 18 = 5400 cfm

Min. exhaust cfm = (W1 + W2 + L) x H x 50 broiler + fryer + griddle
= (3.5 + 3.5 + 18) x 3.5 x 50 + (225 + 75 + 75 + 150)
= 4375 + 525
= 4900 cfm (min.)

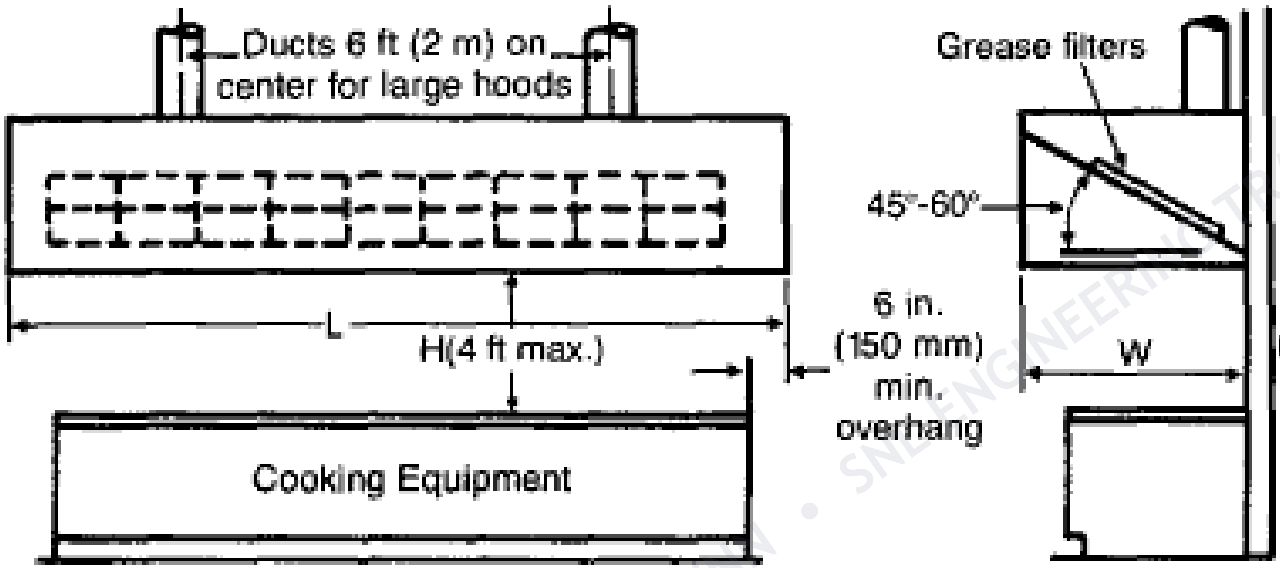
Figure 34 - Sample cfm calculation

Equipment	Gas Equip.	Elect. Equip.
Broilers	+225	+150
Fryers	+75	+50
Griddles	+150	+150
Tilting skillets	+150	+150
Conveyor broilers	+200	+150
Live charcoal broilers	+350	---
Mesquite broilers	+350	----
Salamanders	+50	+50
Ovens	-300	-300
Steam generators	-200	-200

Table 5 - CFM Correction factors

Exhaust flow rate calculation with SMACNA

Hood, Canopy Island or Range



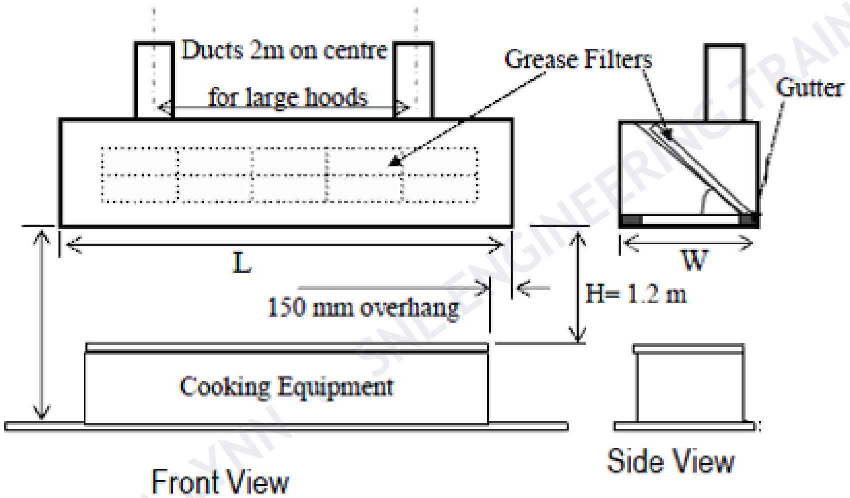
Minimum airflow = 50 × (2W + 2L) × H (cfm)
Minimum airflow = 254 × (2W + 2L) × H (l/s)
Minimum face velocity = 125 fpm (0.62 m/s)
Minimum duct velocity = 1000 fpm (5 m/s)
(Use minimums from local codes where applicable)
W, L, H in feet (U.S.), in metres (metric)

Exhaust flow rate calculation with SS 553

Sample Exhaust Air Flow Calculation for a Island Hood

$Q = A \times V$

$Q = 1.4V \times 2(L+W)H \times F$



Where;

V = Capture Velocity, 0.3 m/s

L = Length of cooking surface, m

W = Width of cooking surface, m

H = Distance of Hood to emitting surface, Maximum 1.2m.

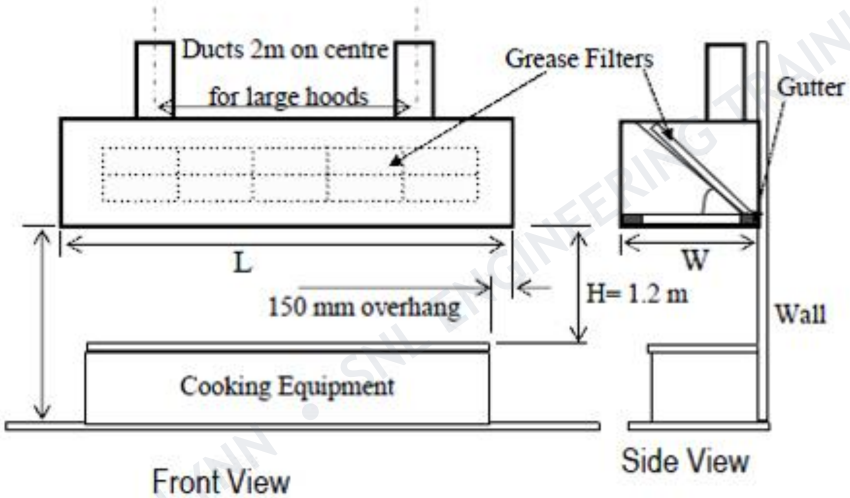
F = Cooking Factor, 1 for Heavy Duty and 0.7 for Light Duty

Exhaust flow rate calculation with SS 553

Sample Exhaust Air Flow Calculation for a Wall Mounted Hood

$Q = A \times V$

$Q = 1.4\underline{V} \times \underline{(L+2W)H} \times F$



Where;

V = Capture Velocity, 0.3 m/s

L = Length of cooking surface, m

W = Width of cooking surface, m

H = Distance of Hood to emitting surface, Maximum 1.2m.

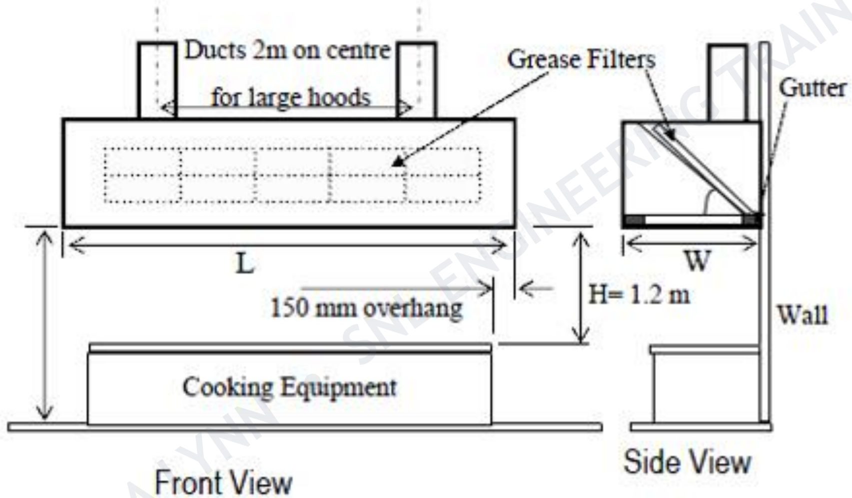
F = Cooking Factor, 1 for Heavy Duty and 0.7 for Light Duty

Exhaust flow rate calculation with SS 553

Sample Exhaust Air Flow Calculation for a Wall Mounted Corner Hood

$$Q = A \times V$$

$$Q = 1.4V \times (L+W)H \times F$$



Where;

V = Capture Velocity, 0.3 m/s

L = Length of cooking surface, m

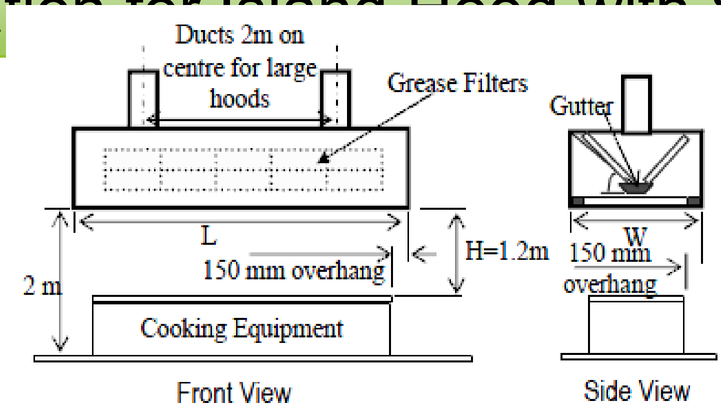
W = Width of cooking surface, m

H = Distance of Hood to emitting surface, Maximum 1.2m.

F = Cooking Factor, 1 for Heavy Duty and 0.7 for Light Duty

Exhaust flow rate calculation for Island Hood with SS 553

$$Q = 1.4\underline{V} \times \underline{2(L+W)H} \times F$$



Exhaust Air Flow Rate Calculation

- Exhaust Air Flow Rate, Q = 7.6 CMS
  = 27,216 CMH

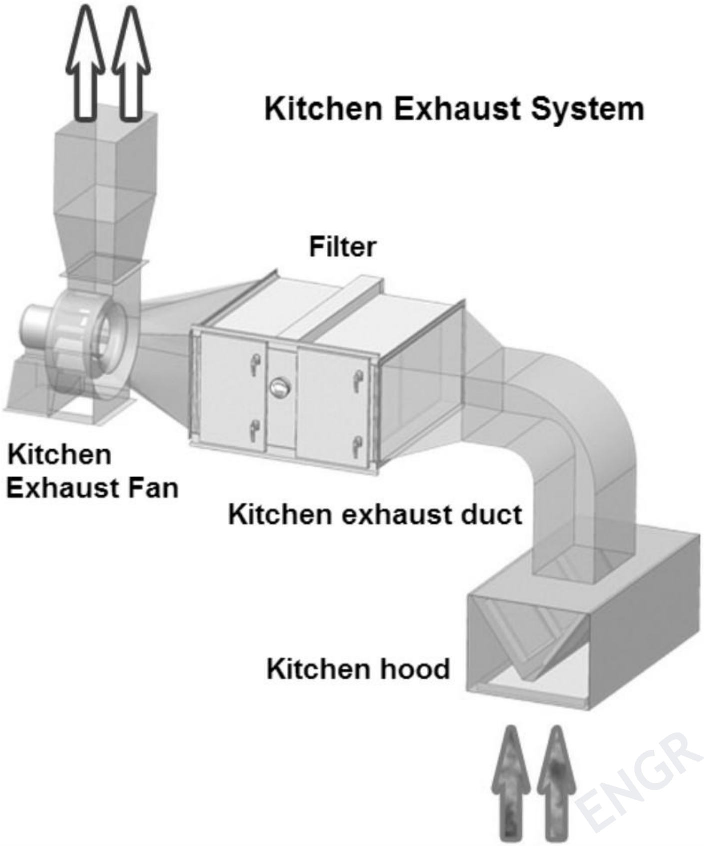
- Air Change Rate (Operation) = 20
- Air Change Rate (no operation) = 10
- Room Width = 6.0 meter
- Room Length = 6.0 meter
- Room Height = 3.0 meter
- Room Volume = 108 m^3
- Total Fresh Air Volume = 2,160 CMH

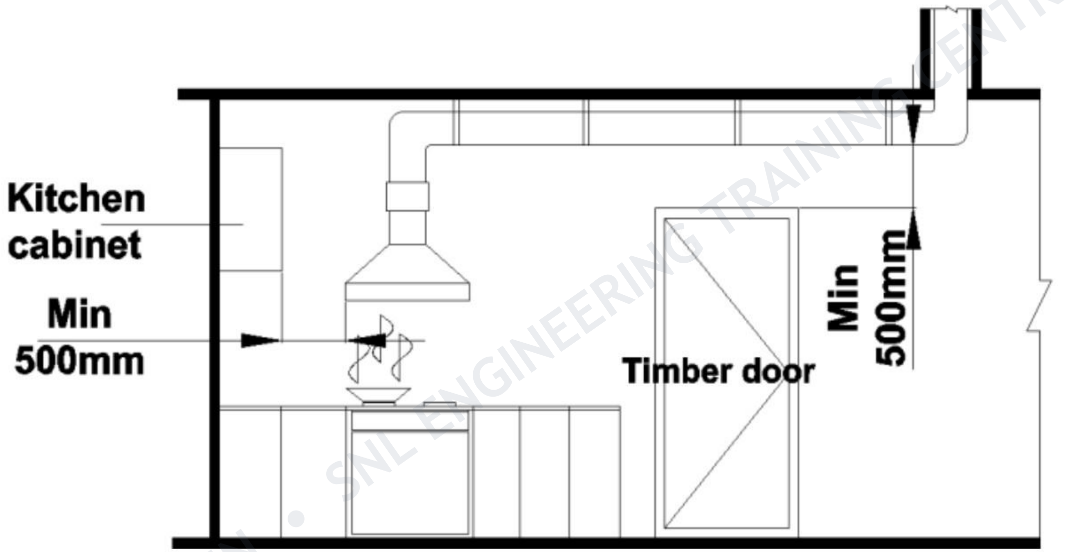
Rule of thumb for Duct Design

1- Rule of thumb is that the amount of air exhausted from the kitchen should be at least 10% higher than the supply air flow into the kitchen.

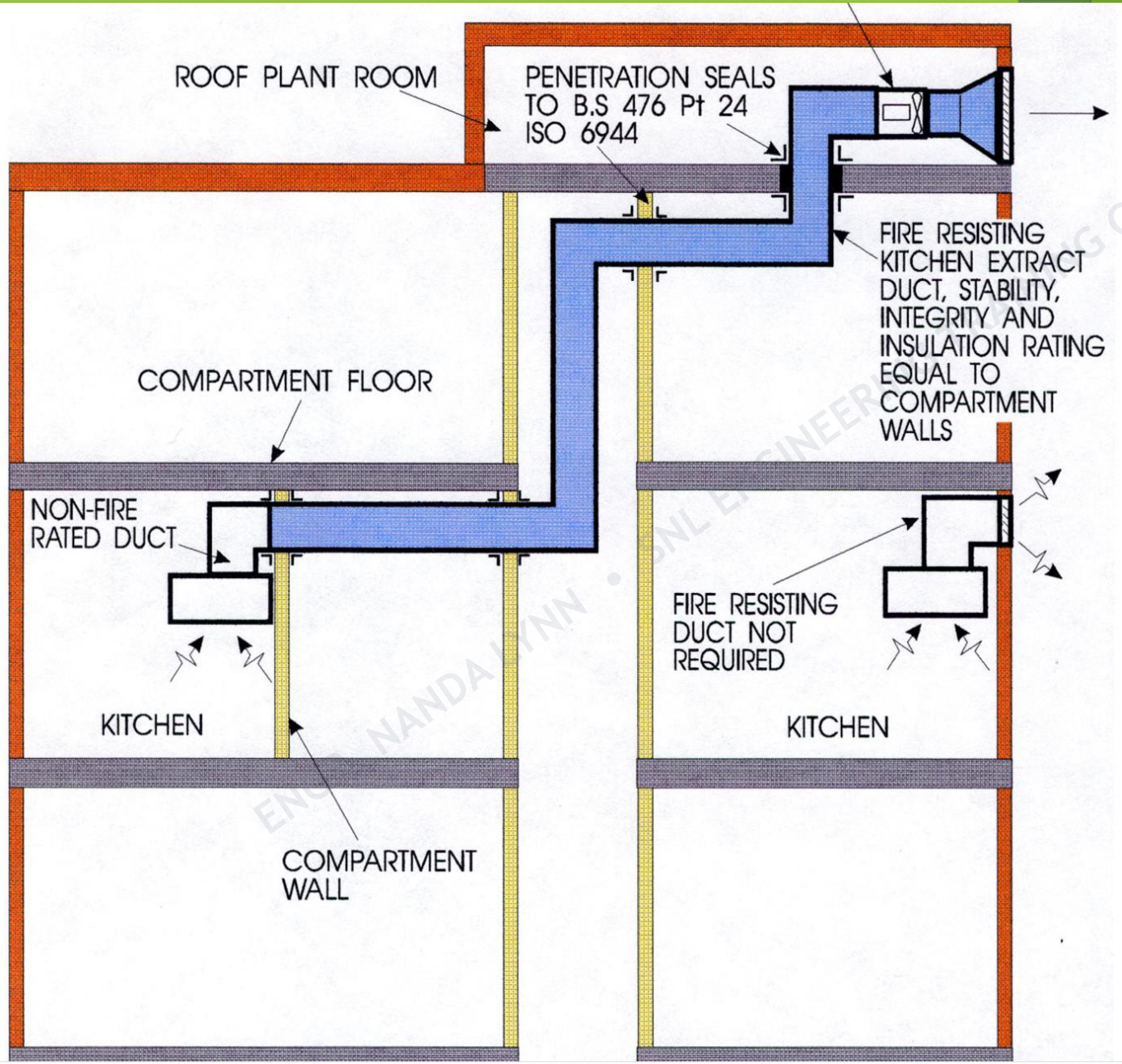
2- Recommended design duct velocity between 7.5 and 9 m/s.

Kitchen Exhaust Duct Installation

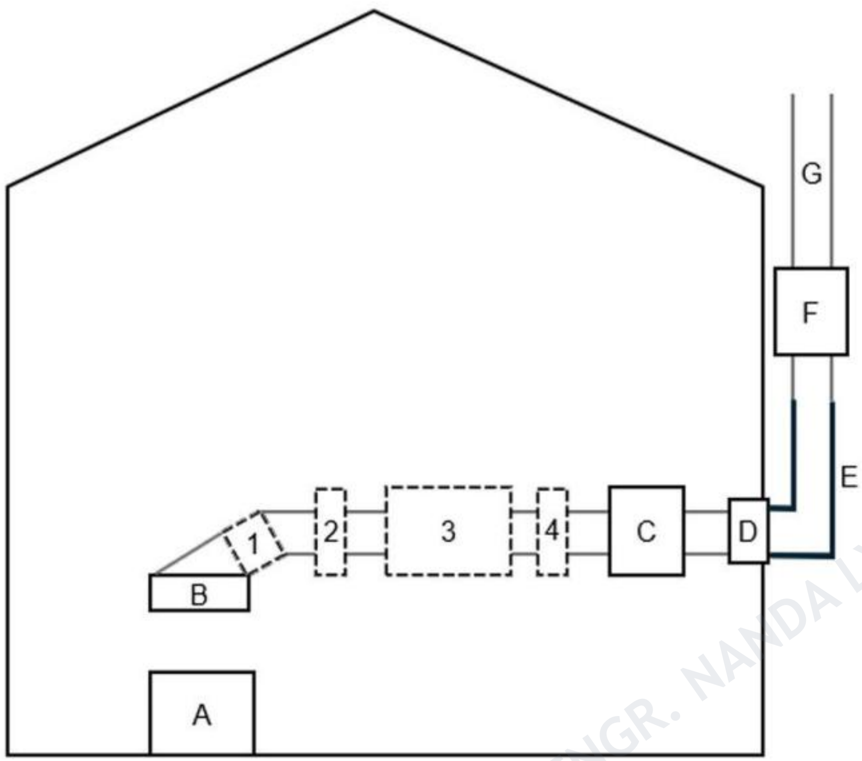




Kitchen Exhaust Duct Installation



Kitchen Exhaust System Installation based on SS 553 2026



Key :

Parts of the kitchen exhaust system

A. Cooking area

B. Cooker hood/canopy

C. Fan/motor unit

D. Acoustic lagging

E. Anti-vibration mounting

F. Noise attenuator

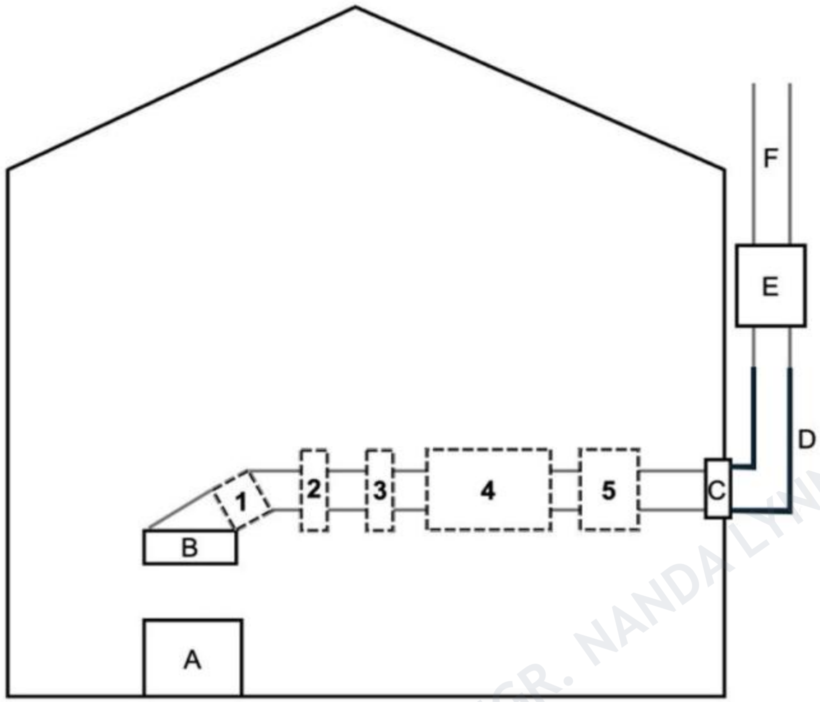
G. Exhaust flue/stack

Components for the 4 stages in air-cleaning

1. Grease removal (e.g. baffle/cyclone filter)
2. Grease mist removal (e.g. UVC)
3. Smoke removal (e.g. ESP)
4. Gaseous pollutant removal (e.g. Activated carbon/ozone)

Figure C.1 − Example configuration for air-cleaning system 1

Kitchen Exhaust System Installation based on SS 553 2026



Key :

Parts of the kitchen exhaust system

A. Cooking area

B. Cooker hood/canopy

C. Fan/motor unit

D. Anti-vibration mounting

E. Noise attenuator

F. Exhaust flue/stack

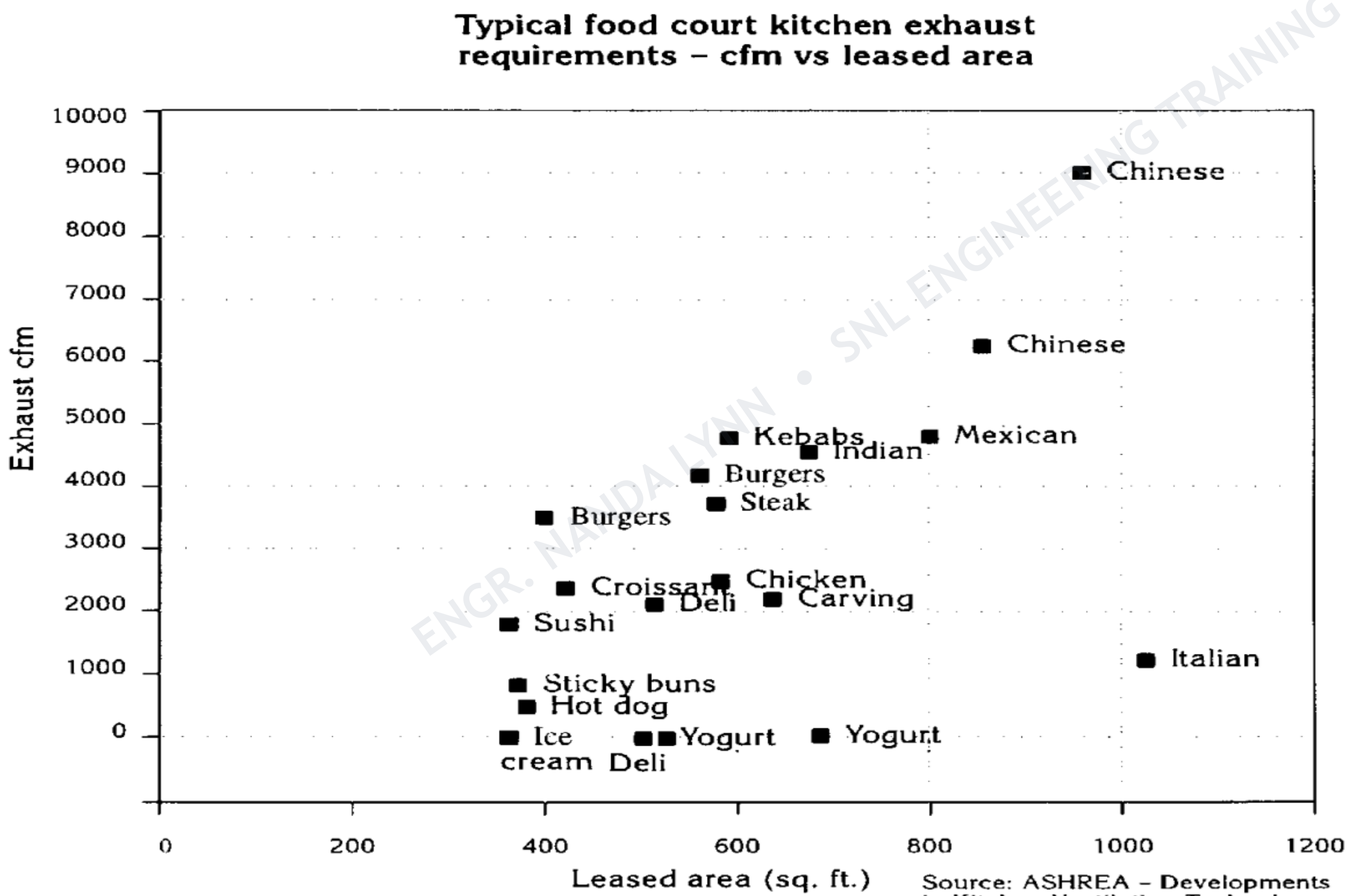
Components for the 4 stages in air-cleaning

1. Grease removal (e.g. baffle/cyclone filter)
2. Grease mist removal (e.g. UVC)
3. Gaseous pollutant removal (e.g. ozone generator)
4. Smoke removal (e.g. ESP)
5. Gaseous pollutant removal (e.g. activated carbon filter)

Figure C.2 − Example configuration for air-cleaning system 2

Exhausting Multiple Kiosks in Food Court Applications

- Food Court using multiple kiosks present designers with a number of options for exhaust fan arrangements.
- Following are four possible arrangements together with the advantages of each.
- The comparison chart shows typical food court exhaust requirements for a variety of food court operations.



Source: ASHREA – Developments in Kitchen Ventilation Technology Vol 8, No. 4

Option A
Central Fan for all Kiosks

Option A
System diagram and budget pricing

Note:

The installation may require two or more shafts to balance the air flow if the duct runs are too long or too difficult to size properly.

Budget Pricing:

Exhaust fan 16,000 cfm	$?
Welded duct work and fire-rated enclosures	?
Indirect gas fired make-up air heater 16,000 cfm rooftop unit	?
Installation cost for above equipment	?
Shaft requirements	
Loss of rentable floor space for shafts	?
Relocation costs of exhaust fan and shaft extension if additional floors are planned for the future	. ?
	$

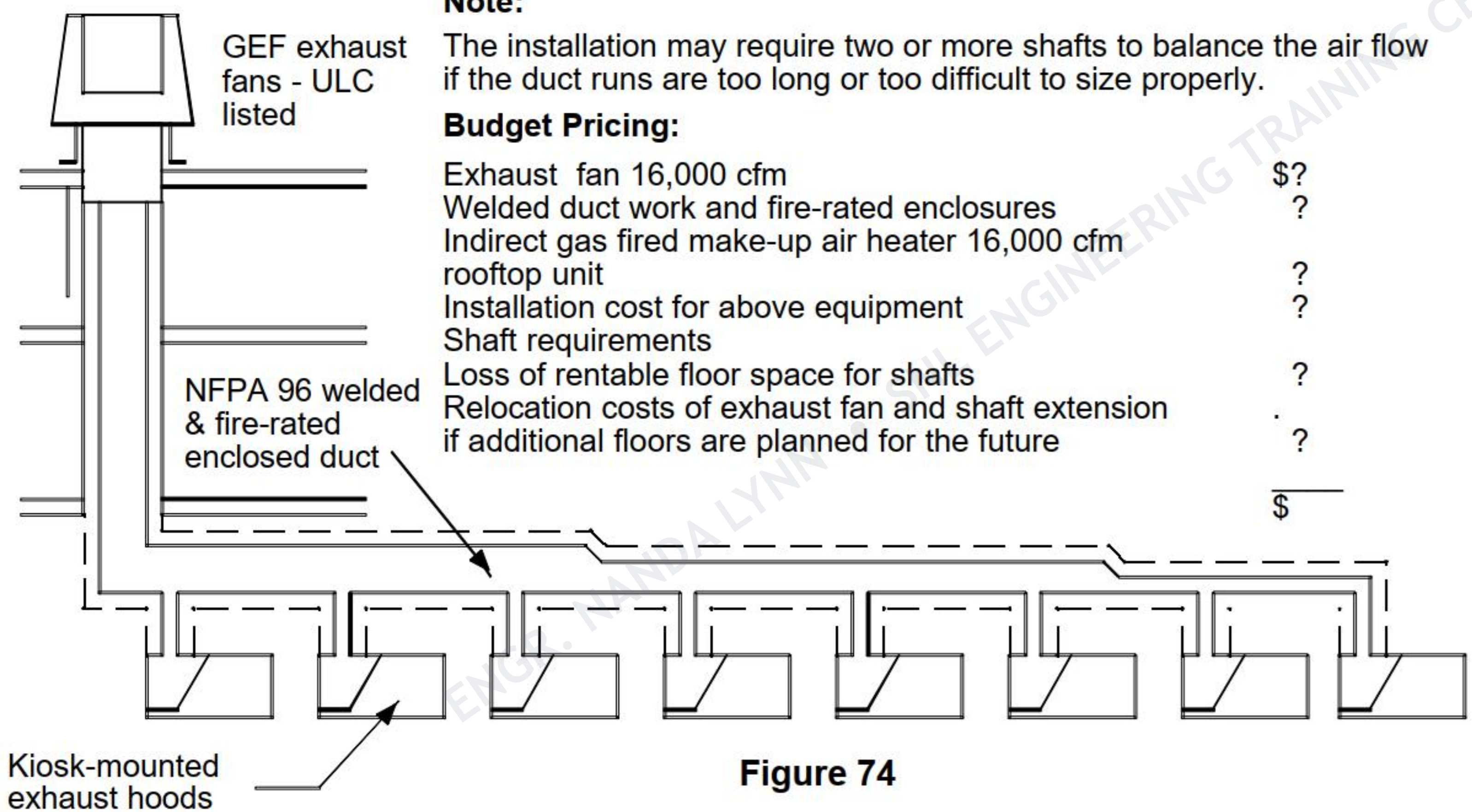


Figure 74

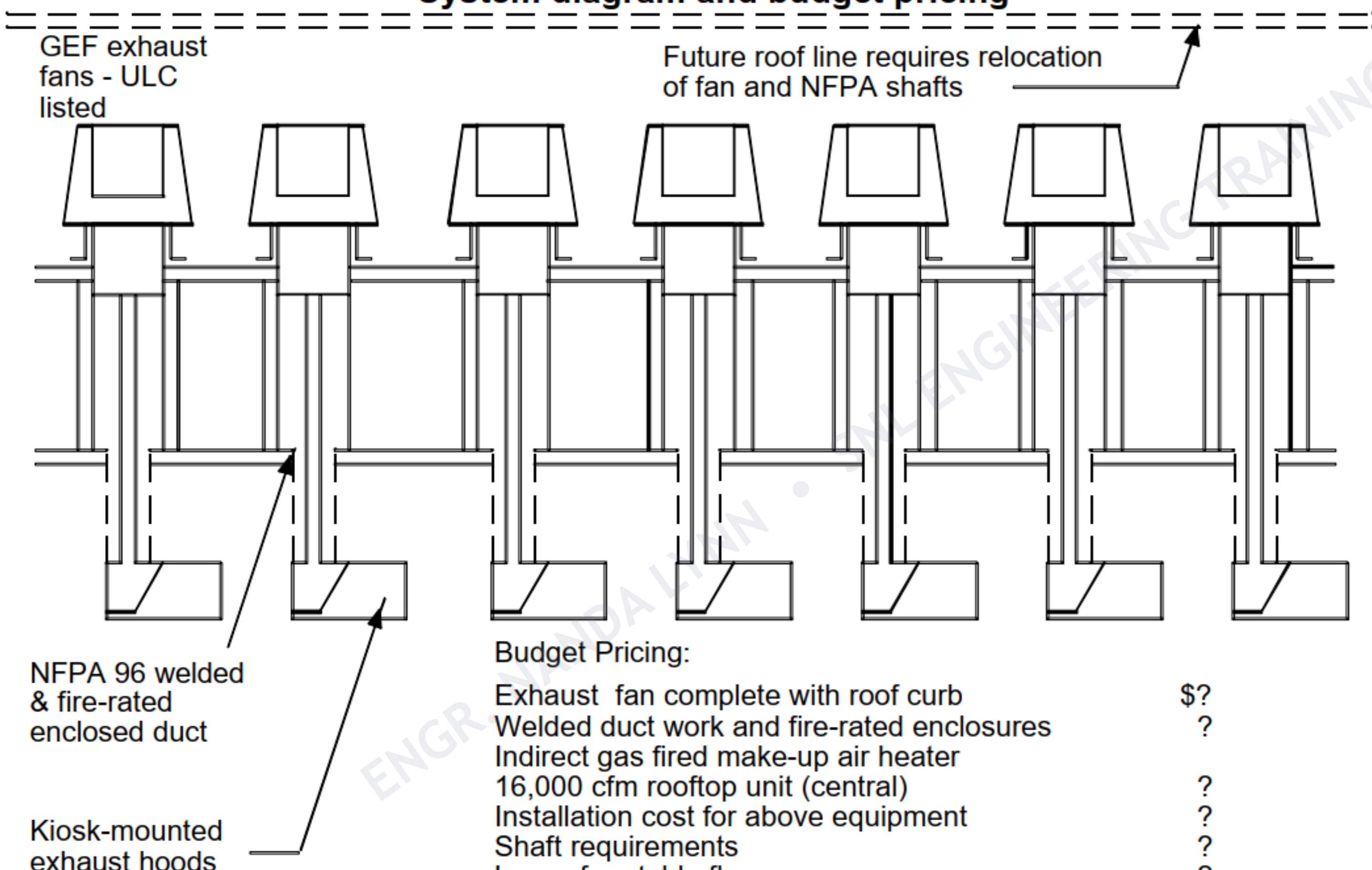
Option A
Central Fan for all Kiosks

- Under this option, a single, roof-mounted fan connected to a main exhaust duct serves each kiosk area via the branch ducts.
- <u>Advantages</u>
- (i) It is the least expensive option.
- (ii) It saves space because a single duct requires less floor and ceiling space for exhaust shafts and fire-rated enclosures as required by codes.

- **<u>Disadvanges</u>**
- (i) Difficult to balance exhaust cfm of each kiosk, as balancing dampers are not permitted in ducts.
- (ii) Difficult to change once installed, duct runs sized for originally designed cfm and ducts welded.
- (iii) If one kiosk shuts down due to fire, the exhaust velocity may fall below the minimum of 1,500 fpm allowed by code and require a shutdown of the entire system.
- (iv) Local jurisdictions may not permit other kiosks to run when one is shut through fire.
- (v) A kiosk shut down by fire is not protected should fire occur in another kiosk. On single fan systems, fire protection systems work as one and shut off all equipment until the fire system is recharged.

Option B
Separate exhaust for each kiosk

Option B
System diagram and budget pricing



Budget Pricing:

Exhaust fan complete with roof curb	$?
Welded duct work and fire-rated enclosures	?
Indirect gas fired make-up air heater 16,000 cfm rooftop unit (central)	?
Installation cost for above equipment	?
Shaft requirements	?
Loss of rentable floor space	?
Future relocation costs for fans if required	?
Interlocking of exhaust fans	?
	$

Figure 75

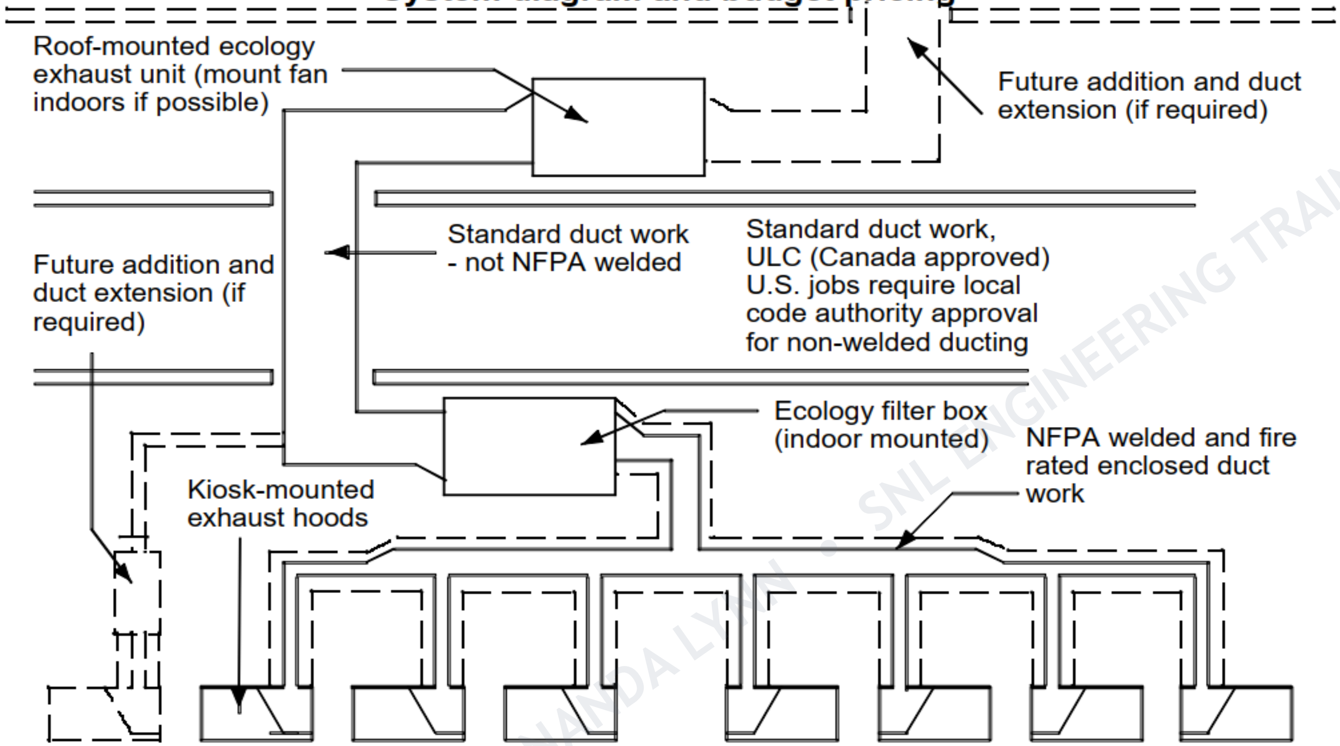
Option B
Separate exhaust for each kiosk

- Under this option, each kiosk has a separate exhaust hood and roof-mounted fan,
- **Advantages**
- Easily balanced by adjusting the fan rpm.
- Easy to adjust provided ducts are sized to accommodate cfm changes within a fixed range.
- As each kiosk operates independently, it does not need to be shut down for fire in another unit.

- **Disadvanges**
- Supply and installation of multiple exhaust shafts and fans is expensive, although its flexibility makes this the most commonly used system.
- Fans occupy a large roof area.
- Separate systems are too small to justify the cost of a future heat recovery installation.
- The relocation of fans to accommodate change in equipment layout is required.
- If a central make-up air system is used, exhaust should be interlocked to a timer system. Alternatively, separate make-up air systems are needed for independent operation. Independent operation requiring increased roof area is common, but code exhaust outlets and make-up air inlets must be 10 ft apart.

Option C
Central ecology system

Option C
System diagram and budget pricing



Budget Pricing:

VM Ecology B-20 exhaust fan, 20,000 cfm roof mounted	$?
VM Ecology EF-20 filter box, indoor mounted	?
VM odor control	?
Duct work - NFPA welded and standard	?
Indirect gas fired make-up air heater, 20,000 cfm rooftop unit	?
Installation costs of this equipment	?
Extra cost to add heat recovery section (optional)	?
Benefits to add odor control	?
Savings to add future kiosks without relocating fans	?
Savings for duct cleaning and roof replacement	?
	$?

Figure 76

Option C
Central ecology system

- The central ecology system option serves all kiosks in much the same manner as the common fan of option A. The difference is the addition of the filter unit, which can be located indoors if need be.
- The ecology system eliminates grease and smoke from exhaust air.
- Odor control is an optional addition.
- The use of an ecology unit eliminates the need for roof top discharge of exhaust air as well as welded duct work on secondary side of the filter box.

Advantages

- The exhaust air and ducts on the secondary side of the filter unit are clean.
- Because the exhaust is clean, it can be discharged through a building side wall and does not have to exit through the roof.
- The equipment is less expensive than separate filters.
- A single shaft occupies less space than multiple shafts required for option B.
- Standard duct work between the filter box and building exit does not require welding nor a fire-rated enclosue.
- Heat recovery equipment can be added without the wash down features
- Increased fire safety can reduce insurance costs.

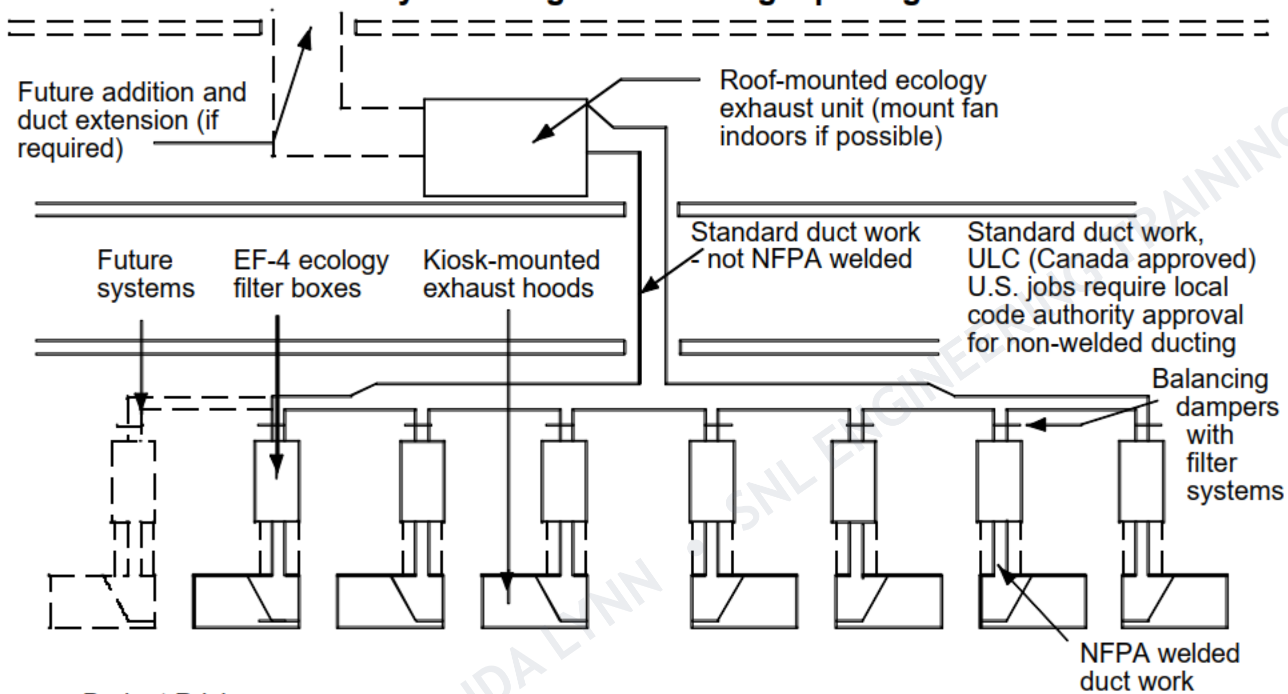
Option C
Central ecology system

- **Advantages**
- Odor control is easily added.
- Reduced expense in installing a single exhaust duct.
- If a kiosk is added, additional filter boxes can be tied into the existing system.
- If a new level is added to the building, the ecology unit need not be relocated. A duct extension will accomplish the change or be directed through a side wall.
- The cleaning of ducts is minimized.
- The discharge air is clean and grease free.

- **Disadvantages**
- Increase capital equipment cost.
- As with option A, air balancing is difficult.

Option D
Central Fan and Separate Filters

Option D
System diagram and budget pricing



Budget Pricing:

VM Ecology B-30 exhaust fan (total 8 units x unit price)	$?
VM EF-4 Ecology filter boxes (total 8 units x unit price)	?
VM odor control mounted on roof	?
Duct work - NFPA welded and standard	?
Indirect gas fired make-up air heater Temprite TDM-20, 20,000 cfm rooftop unit	?
Installation costs of this equipment	?
Extra cost to add heat recovery section (optional)	?
Benefits to add odor control	?
Savings to add future kiosk	?
Savings for duct cleaning and roof replacement	?
Benefits to balance system easily	?
	$?

Figure 77

Option D
Central Fan and Separate Filters

- This option consists of a single roof-mounted exhaust unit and a separate filter unit for each kiosk.
- **Advantages**
- Ducts and the exhaust air are clean.
- Standard duct work between the filters and fan need not be welded or fire rated.
- With a 4,000 cfm filter box per kiosk, there is room for future expansion.
- A single main exhaust shaft occupying less space than multiple shafts reduces costs.
- Additional kiosks easily added.
- Future heat recovery and odor control easily added.
- Again, improved fire safety can reduce insurance costs.
- Kiosks are independently operable with fire protection shut down.

- **Disadvanges**
- Increased capital equipment cost.

Calculation of The Filter Requirement

Example

- Exhaust hood CFM requirement 3500 cfm
- Divide by each filter open area 2.4 sq.ft.
- Divide by design filter velocity 250 fpm

3500Divided by 2.4 divided by 250 = 5.83 or

6 filters required

Calculation of The Filter Requirement based on SS 553 2026

Example

- Exhaust hood CMH requirement , Q = 4,000 CMH
  = $1.11 m^3/s$
- Dimension of baffle filter = 500 mm x 330 mm
  Dimension of filter open area = 400 mm x 245 mm
  = $0.098 m^2$
- Design filter velocity = 1.8 m/s

(Optimum face velocity for filter)

Total surface area of filter needed = $1.11 m^3/s \div 1.8 m/s$

= $0.617 m^2$

Total filter needed = $0.617 m^2 \div 0.098 m^2$

Velocity reading on Exhaust Hoods

Example

- The specification is for 2250 CFM on a 9’ ventilator
- OPN = 107’ x 3.5 “ (Standard Cyclo Wash Opening)

  = 374.5 / 144

  = 2.6 sq.ft

- Velocity = 2250 / 2.6

  = 865 FPM

Measuring Intake Velocity by Meters

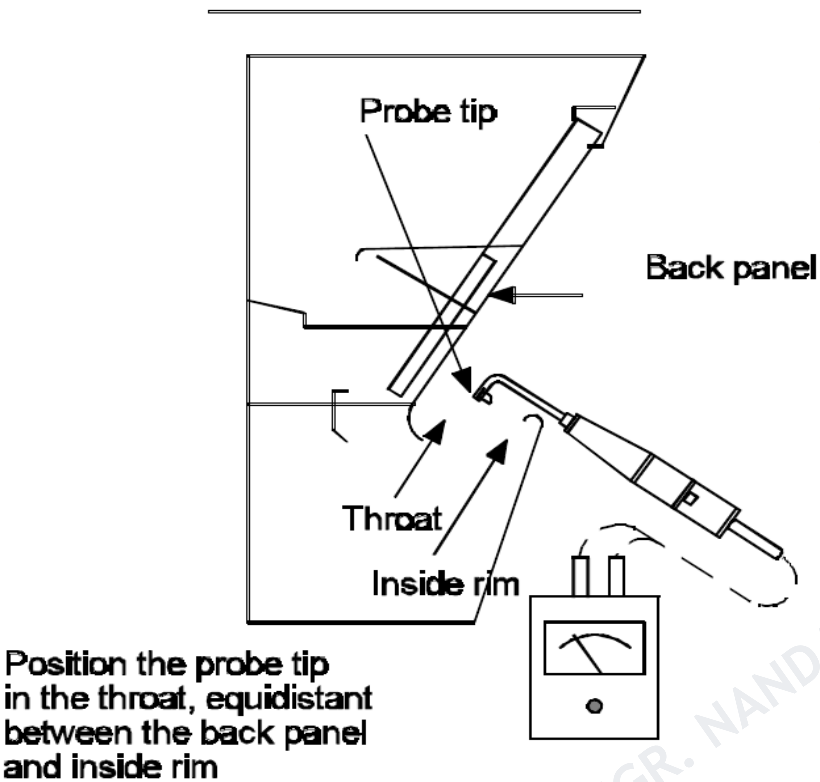


Figure 35 - Measuring
with an Alnor 6000

Measuring Intake Velocity by Meters

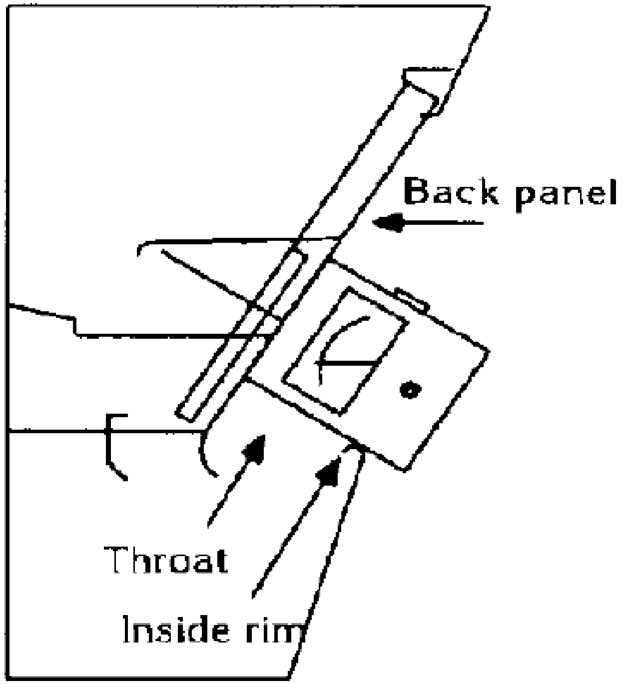


Figure 36 – Measuring with an Alnor Jr. velometer

Low Velocity or Displacement Ventilation

The cooler-than-surrounding supply air is distributed with a low velocity to the occupied zone. **(0.3- 0.5 m/s)**

In this way, fresh air is supplied to where it is needed.

Because of its low velocity, this **supply air does not disturb the hood function.**

High velocity or Mixing Ventilation

Everything that is released from the cooking process is mixed with the supply air.

Obviously impurities and heat are mixed with surrounding air.

Also the high velocity supply air disturbs the hood function.

Problem consideration

Problem is not expecting with Air draught with open door problem.

What is the Solution??

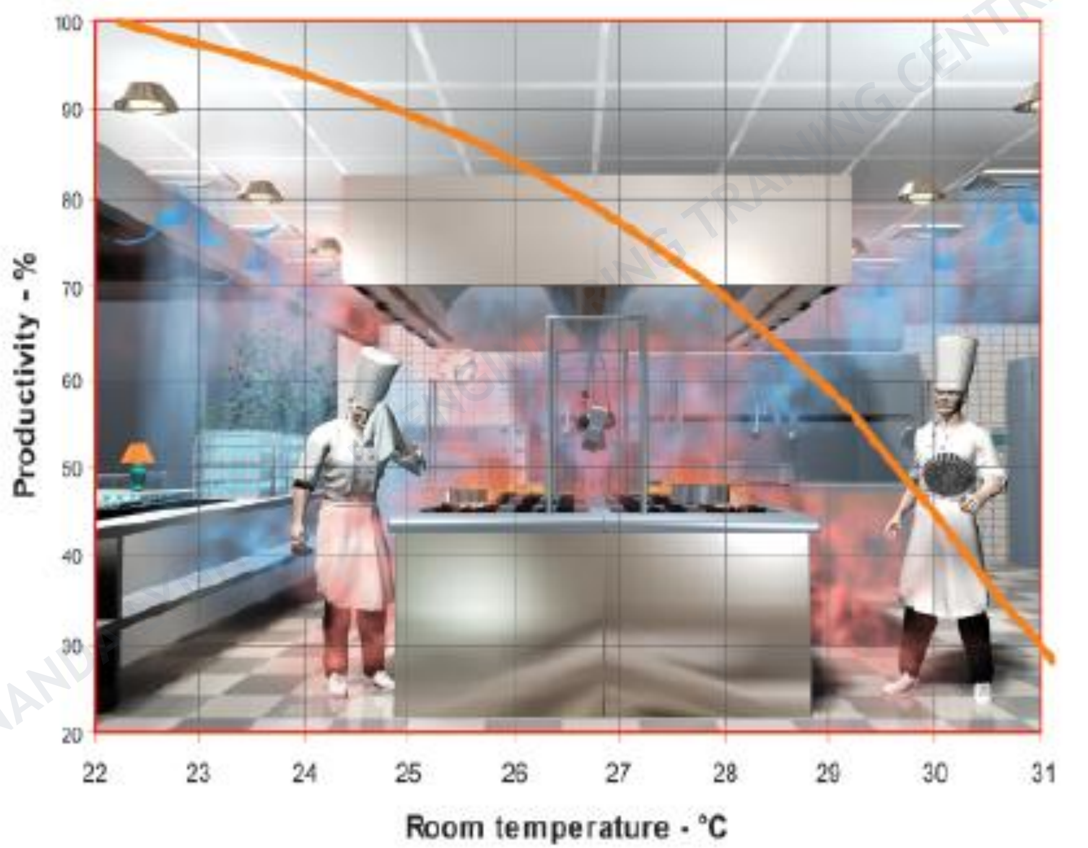
Experience has shown that such air draughts can have a much greater effective throw distance to produce a greater detrimental effect on the capture envelope than one would normally expect.

Return Air System Pressures

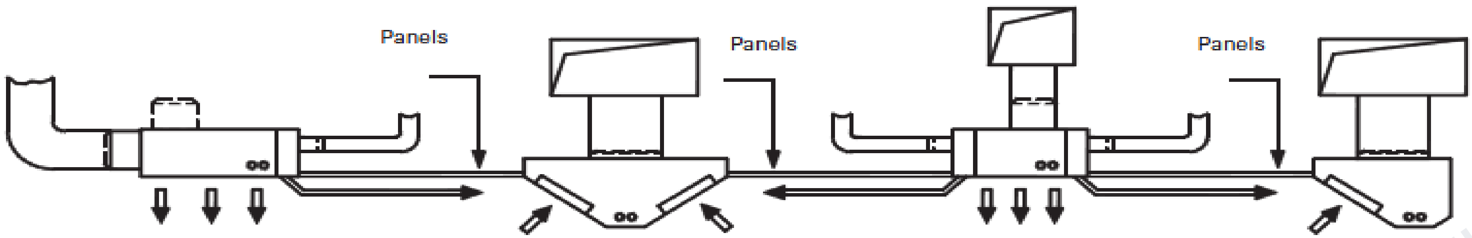
1- Air Draught with open door problem

Productivity vs. Room Air Temperature

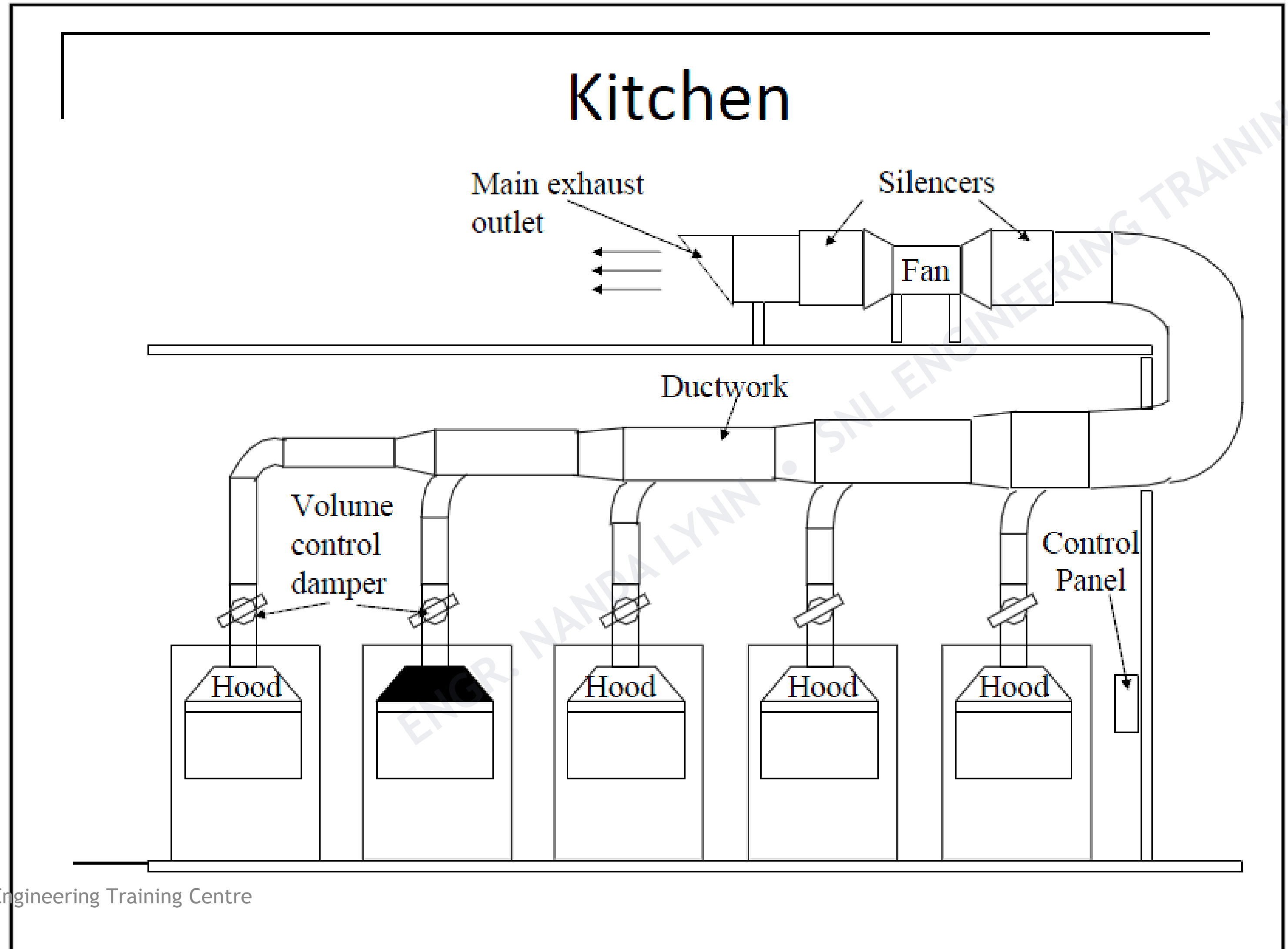
Room air temperature affects a person’s capacity to work. Comfortable thermal conditions decrease the number of accidents occurring in the work place.



When the indoor temperature is too high (over 28 °C in commercial kitchens) the productivity and general comfort diminish rapidly.


Panels
Panels
Panels

System configuration



Fire Protection System for Kitchen

1.Dry Chemical Systems

2. Wet Chemical Systems

3.Water Sprinkler Systems

i. A water mist sprinkler installation is preferred means of providing fire

ii. Protection in a kitchen.

iii. Water mist sprinkler systems are easily interconnected to a building’s sprinkler system

Maintenance for Kitchen Ventilation System

Cyclo-wash and Cyclo-Maze Wash

- ❖ It is important to clean and maintain the equipment because accumulated grease poses a serious fire risk.
- ❖ If a ventilator hood is not properly maintained, accumulated grease
- ❖ Becomes a serious fire hazard.

Automatic Cleaning

- ❖ When the Stop push button on the Cyclo wash unit is operated, the exhaust fan and cold water solenoid are switched off, a pre-set timer energizes the hot water solenoid and detergent pump system for a short cleaning cycle.
- ❖ The hot water and detergent mixture is sprayed through a series of nozzles to scour the interior of the unit.

Maintenance for Kitchen Ventilation System

Daily

-Clean the exterior of the ventilator.

Weekly

-Check the water nozzles to make sure they are working properly.

-Check the detergent container (inside the control panel) and keep it topped up with detergent.

-**Monthly**

-Clean the water line strainers: on both hot and cold water models,.

-If water nozzles become clogged with scale, remove and immerse them in vinegar for half an hour.

-Check the solenoids and relay click when the START and STOP push buttons are energized.

Maintenance for Kitchen Ventilation System

<u>Monthly</u>

- ❖ Pour a pint of full strength detergent in the bottom of each ventilator section and let it sit overnight.
- ❖ Check the ductwork.

<u>Twice a year</u>

- ❖ Clean the unit thoroughly and related ductwork to remove grease.
- ❖ A commercial cleaning service is recommended for this work.
- ❖ The frequency of cleaning will depend on the type of operation being used.

Maintenance for Kitchen Ventilation System

<u>Non-water wash hoods</u>

Daily/Weekly as required

❖ Use hot water and detergent to clean the ventilator and remove any surface grease.

❖ Remove and clean the access panels to inspect and clean the interior of the unit.

❖ Clean the grease collection pans.

Twice a year

❖ Thoroughly clean the unit and related ductwork to remove grease.

❖ A commercial cleaning service is recommended for this work.

❖ The frequency of cleaning will depend on the type of operation being used.

Thank You