ASHRAE Hellenic Chapter TEE

DEDICATED VENTILATION APPLICATIONS

INDUSTRIAL - KITCHEN - SMOKE CONTROL - FILTERS

ILIANA GEORGAKAKOU

Senior Mechanical Engineer at LDK Consultants

"ASHRAE Design Guide for Commercial Kitchen Ventilation - Design Approach and Recommendations"

REINER KELCH

Bereichsleiter / Director Systems and Applications Systemair GmbH Germany

"Effect of new published standard 12101-6 on practical implementation"

IOANNIS TZOURALAS

Senior Mechanical Engineer - Consultant MEP Installations Industrial & Building Sector

"HVAC Systems for Cleanrooms (Pharma)"

WEDNESDAY 11/10/2023 | @17:00-21:00

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ASHRAE Design Guide for Commercial Kitchen Ventilation

Design Approach and Recommendations

Contents

- Importance of Commercial Kitchen Ventilation (CKV) design
- Codes and standards
- Key parameters
- Load Calculations
- Exhaust air
- Supply air
- System design recommendations
- Case study
- Energy efficiency

Why CKV design is important

- CKV is a rising industry in Greece
  - malls with tenant restaurants
  - high standard hotels with in-house kitchens
  - new and refurbished restaurants
  - haute cuisine
- Design optimization for
  - health, comfort and safety in a kitchen area (IEQ)
  - treating emissions to outdoors (grease particles and odours)
  - energy efficiency
  - sustainability

Codes and Standards

- ANSI/ASHRAE Standard 154, Ventilation for Commercial Cooking Operation
- ASHRAE Handbook—HVAC Applications, Chapter 34, “Kitchen Ventilation”
- ASHRAE Design Guide for Commercial Kitchen Ventilation
- ANSI/ASHRAE/IES Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- ANSI/ASHRAE Standard 62.1, Ventilation and Acceptable Indoor Air Quality
- ASHRAE Handbook—Fundamentals, Chapter 18, “Nonresidential Cooling and Heating Load Calculations”
- Other international standards

  (NFPA, UL, ASTM,ICC etc)

TC 5.10 KITCHEN VENTILATION

Identifying key parameters

- Location and interaction with neighbors
- Type of kitchen/restaurant (fast-food, full service etc)
- Types of food being prepared
- Hours of operation
- Occupancy
- Ventilation air & exhaust airflows for hoods
- Comfort and safety
- Life-cycle costs
- Codes and standards compliance
- Testing, adjusting, and balancing (TAB) and commissioning

Manufacturer requirements

Air Balance

Identifying CKV systems

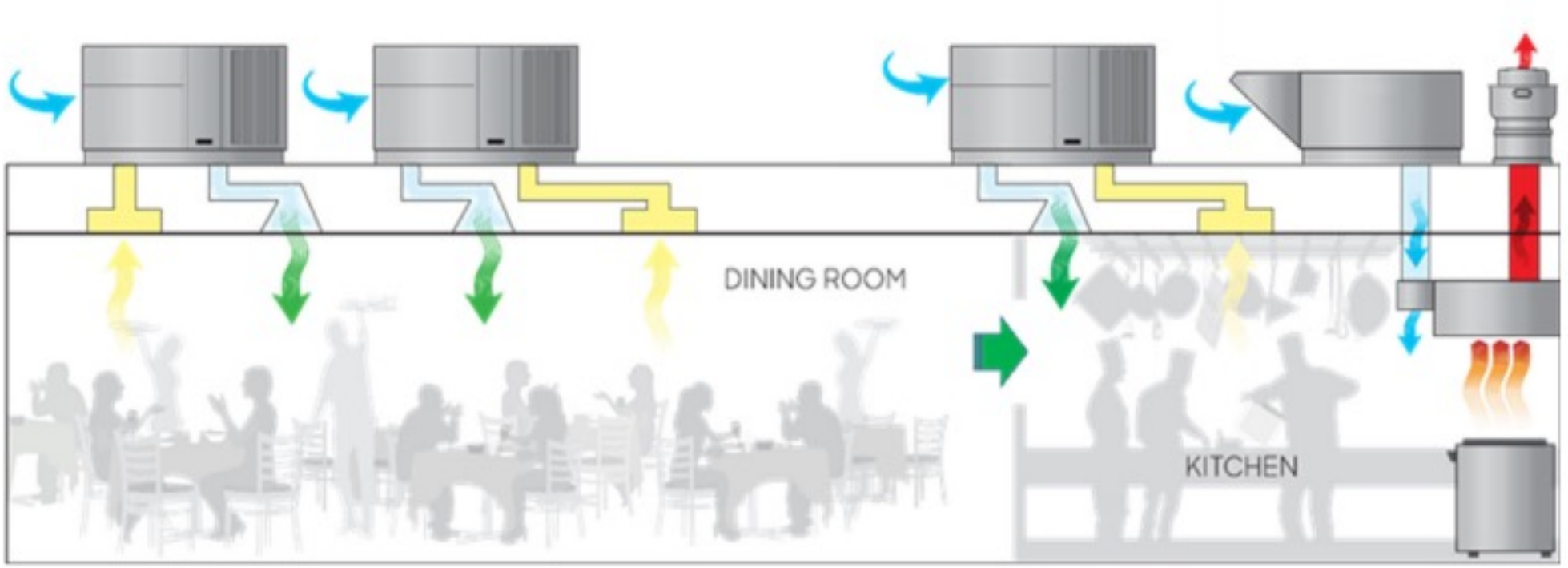

Figure 7.3 ASHRAE Design Guide for Commercial Kitchen Ventilation

Identifying hood style

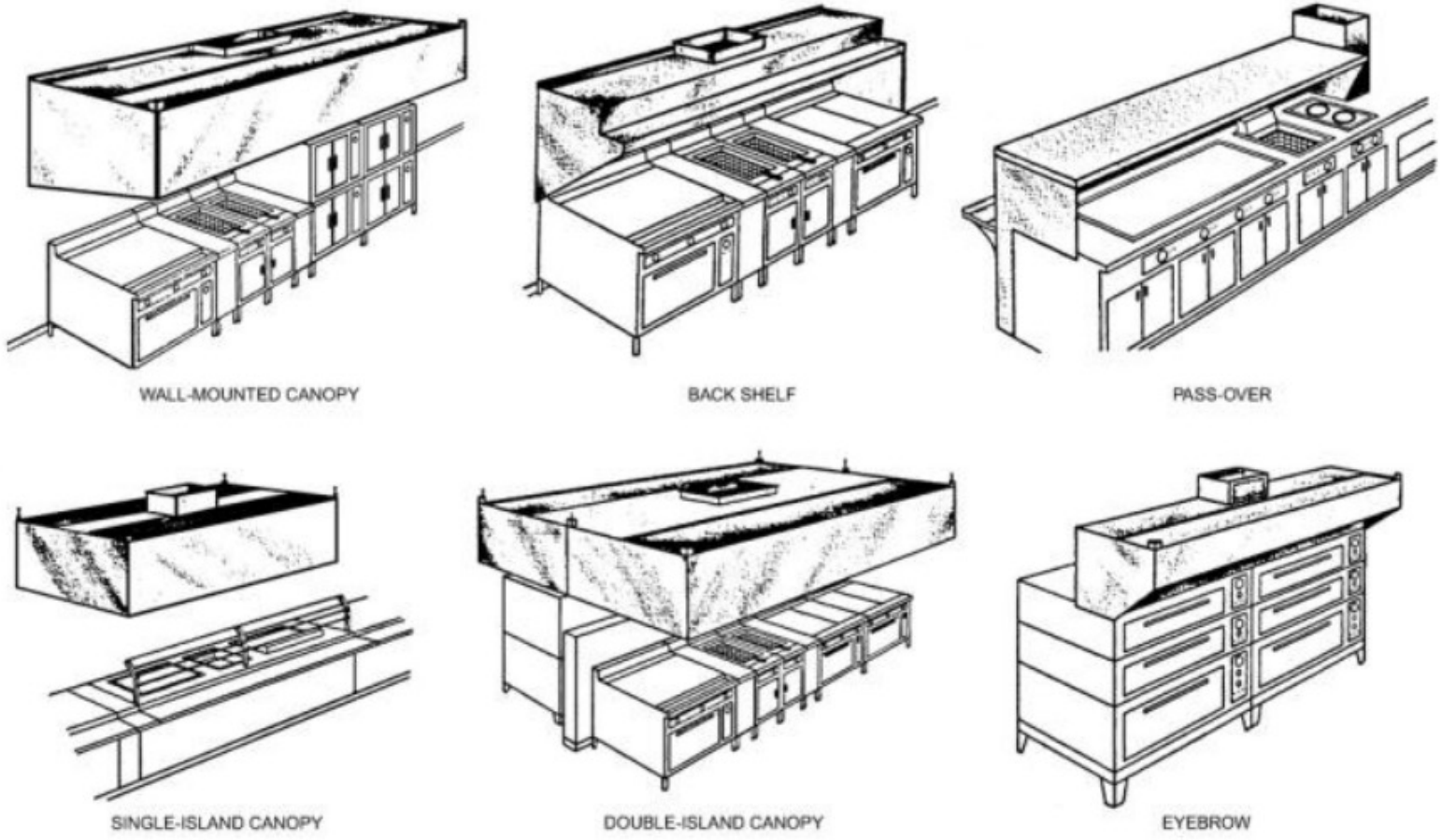

Figure 4 ASHRAE Handbook—HVAC Applications, Ch.34

Load Calculations (1/2)

Design Parameters

- Typical parameters (persons, lighting etc)
- Outdoor air
- Heat gains from both hooded and unhooded equipment
  (manufacturer's specifications / ASHRAE Handbook Fundamentals ch.18)
- Indoor temperature (24^{o}C / special conditions as per supplier)
- Humidity 40%-60%

Load Calculations (2/2)

Design considerations

- Zoning (dining, kitchen) and subzoning (washing, cooking, storage etc)
- Appliances under hood do not produce sensible/latent heat gains but radiant
- Hood design and configuration for optimal exhaust
- Simultaneous coefficient

→ System sizing

Table 7.3 Recommended Values for Simultaneous Coefficient

Building Type	Kitchen Type Simultaneous Coefficient (KSIM) Range
Hotel	0.6–0.8
Hospital	0.5–0.7
Cafeteria	0.5–0.7
School	0.6–0.8
Restaurant	0.6–0.8
Industrial	0.6–0.8

Table 7.3 ASHRAE Design Guide for Commercial Kitchen Ventilation

Exhaust air (1/3)

Airflow =L/s per linear m x linear hood length in m (L/s)

Hood Type

- Type I for grease emissions, vapor and smoke
- Type II for steam emissions or convective heat

Duty (ASHRAE Std 154 Table 1):

- Light (oven)
- Medium (fryer)
- Heavy (boiler, wok)
- Extra heavy (wood-fired oven, charcoal)

Exhaust air (2/3)

Type I Hoods

UL & ASTM

ASHRAE HANDBOOK - APPLICATIONS CH.34

❖Suggested typical airflow

- Wall mounted light duty 150-200 L/s per linear m
- Single island heavy duty 300- 600 L/s per linear m
- Double island heavy duty 250-400 L/s per linear m (per side)

❖ASHRAE Standards apply to listed hoods

❖Airflow to be confirmed by equipment/hood manufacturer

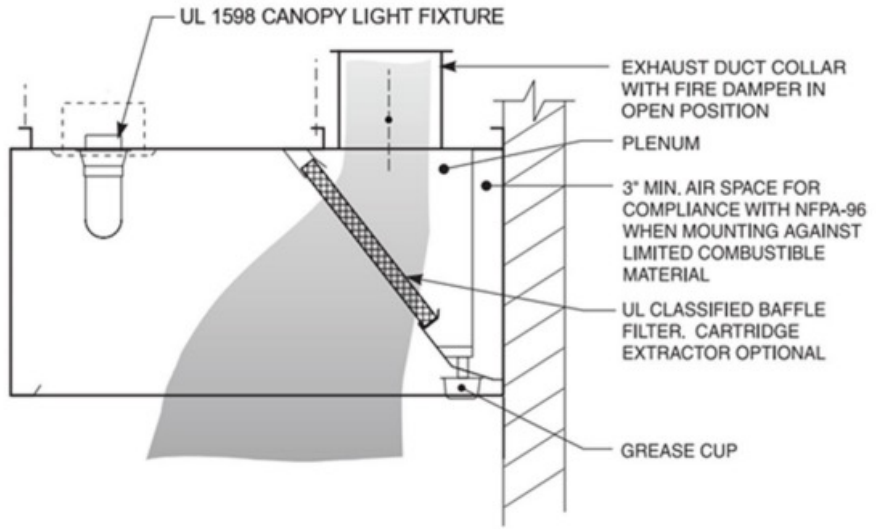

Fig 3.6 ASHRAE Design Guide for Commercial Kitchen Ventilation

Exhaust air (3/3)

Type II Hoods

ASHRAE STD 154

❖Suggested min airflow

- Wall mounted light duty 310 L/s per linear m
- Wall mounted medium duty 465 L/s per linear m
- Single island medium duty 775 L/s per linear m

❖Min requirement 155 L/s/m

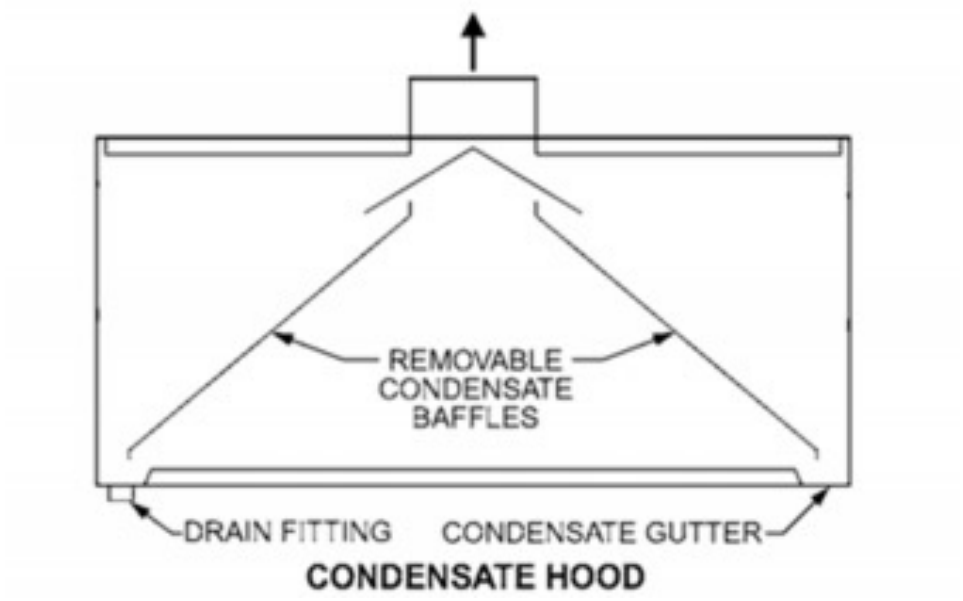

Fig 3.2 ASHRAE Design Guide for Commercial Kitchen Ventilation

Supply air (1/2)

Make up Air Units (MAU)

- 100% fresh air
- air volume less than exhaust
- velocity 0.381m/s
- tied to exhaust systems
- recommended T_{muaair} to match T_{space}

Rooftop units (RTU)

- fresh air (~25%) & recirculation
- usually supplement system

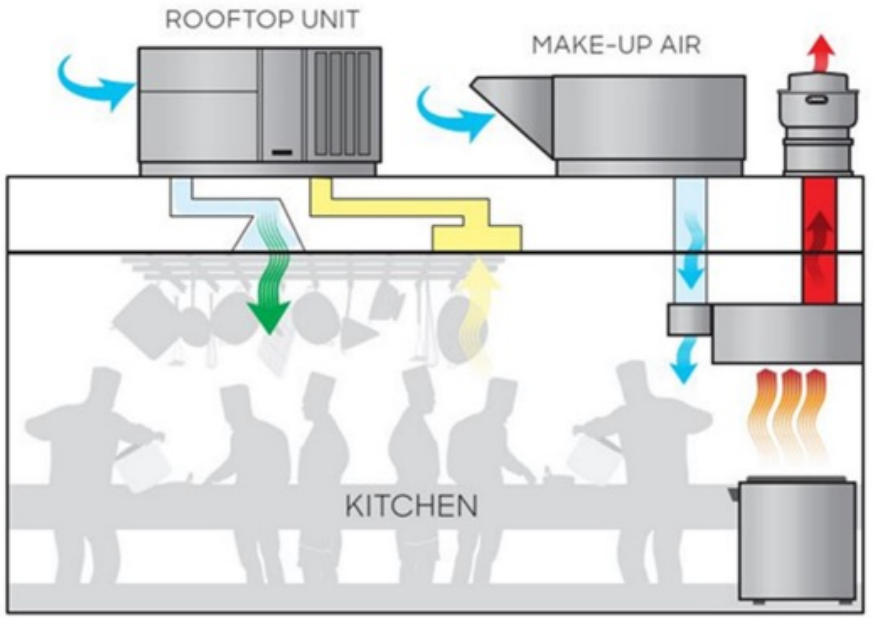

Fig 7.4 ASHRAE Design Guide for Commercial Kitchen Ventilation

Supply air (2/2)

DOAS

- high air volume (air conditioning - dehumidification)
- recirculation capability
- even distribution of air
- tied to exhaust systems & other controls

Transfer air

- HVAC system of an adjacent area
- wall openings, grilles or transfer duct above ceiling
- air without contaminants/odors
- velocity 0.254m/s

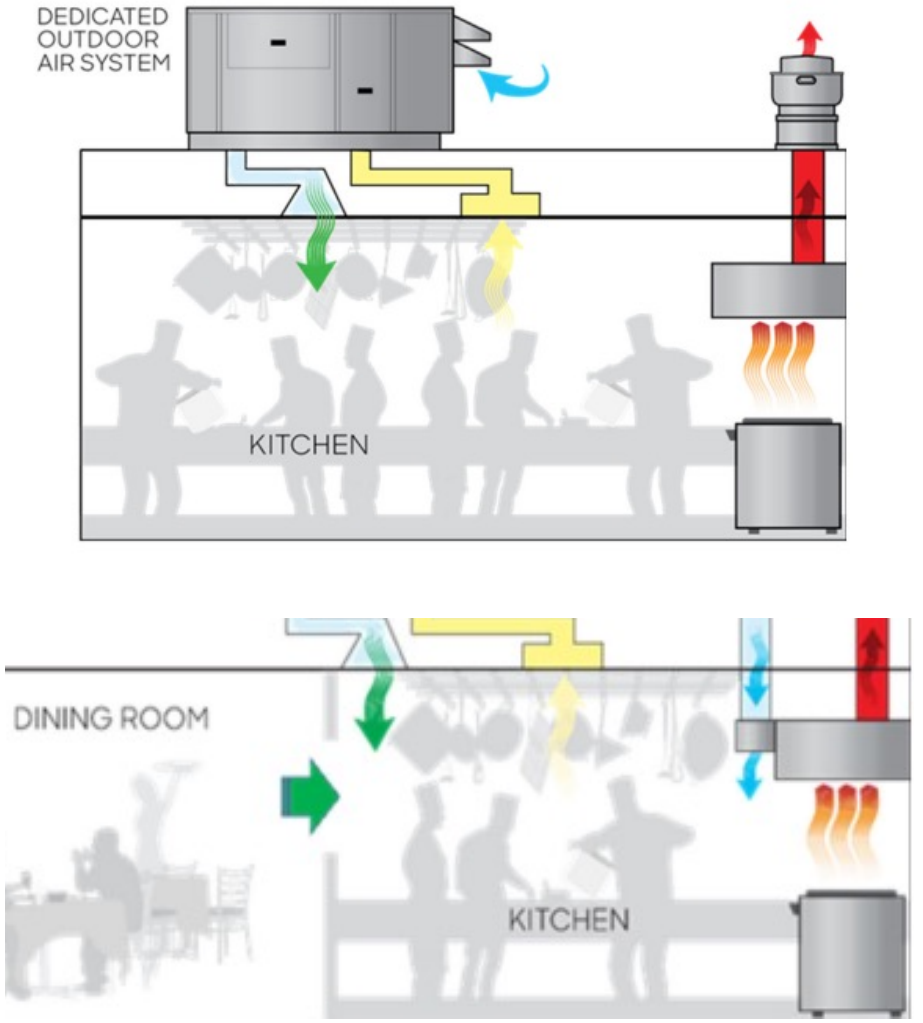

Fig 7.5 &7.3 ASHRAE Design Guide for Commercial Kitchen Ventilation

System design recommendations

Ducts of Type I and Type II separated

Duct velocity: 7.5-9m/s (min 2.5 m/s - max 12.7m/s)

St. pressure calculation to consider all parts and equipment

Distance of kitchen exhaust:

- 5m from fresh air inlet for non grease hoods
- 10m from fresh air inlet for grease hoods
- 3m from property line

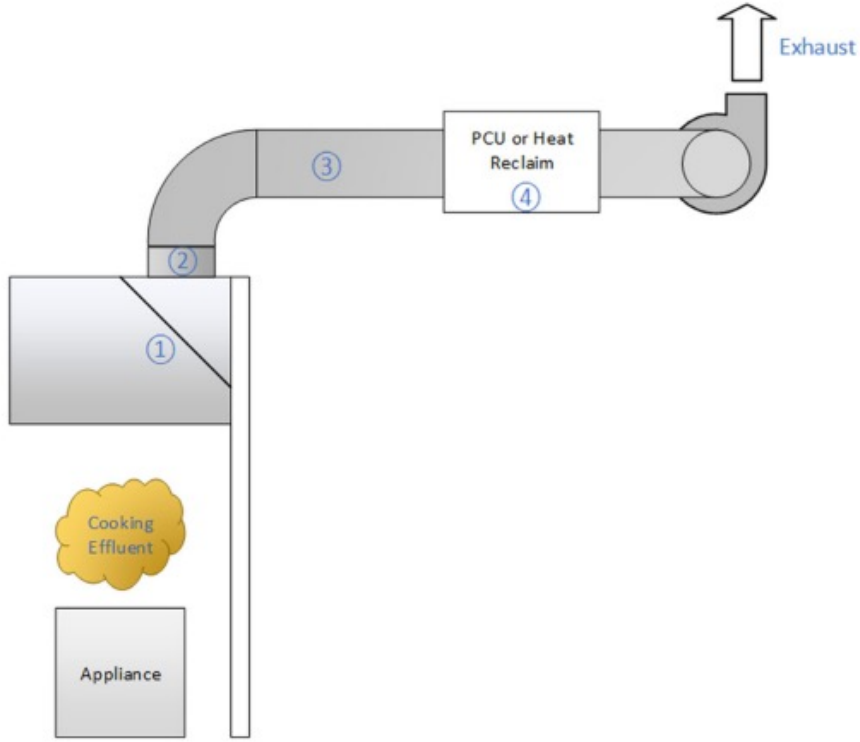

Fig 4.21 ASHRAE Design Guide for Commercial Kitchen Ventilation

CKV case study

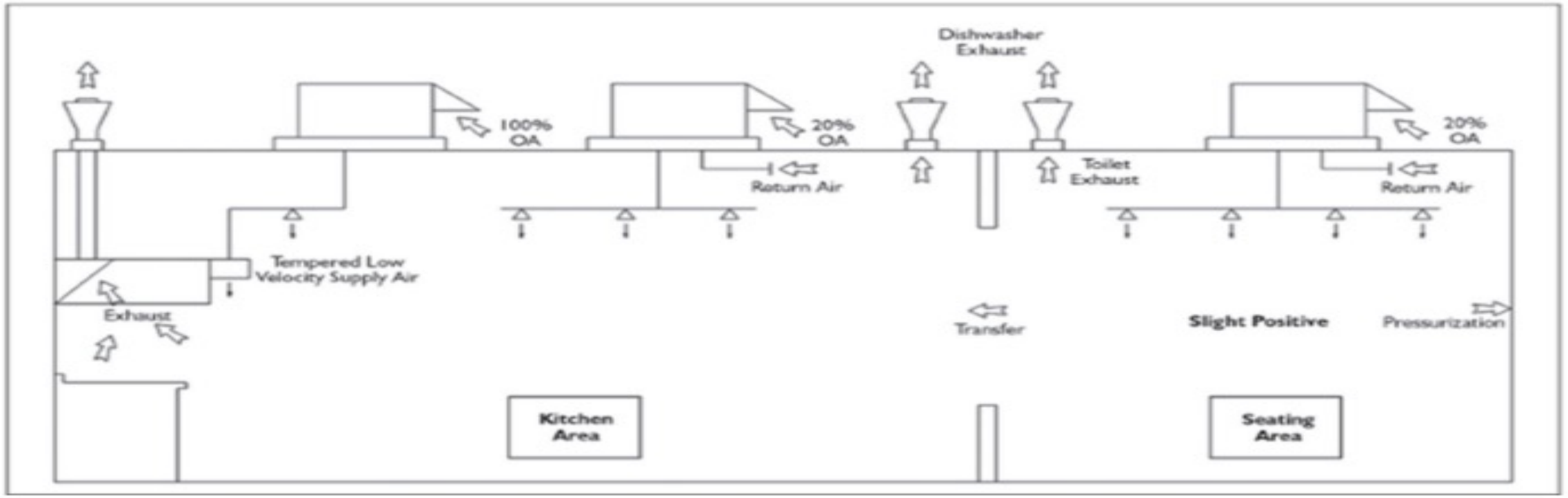

Fig 7.7 ASHRAE Design Guide for Commercial Kitchen Ventilation

CKV case study

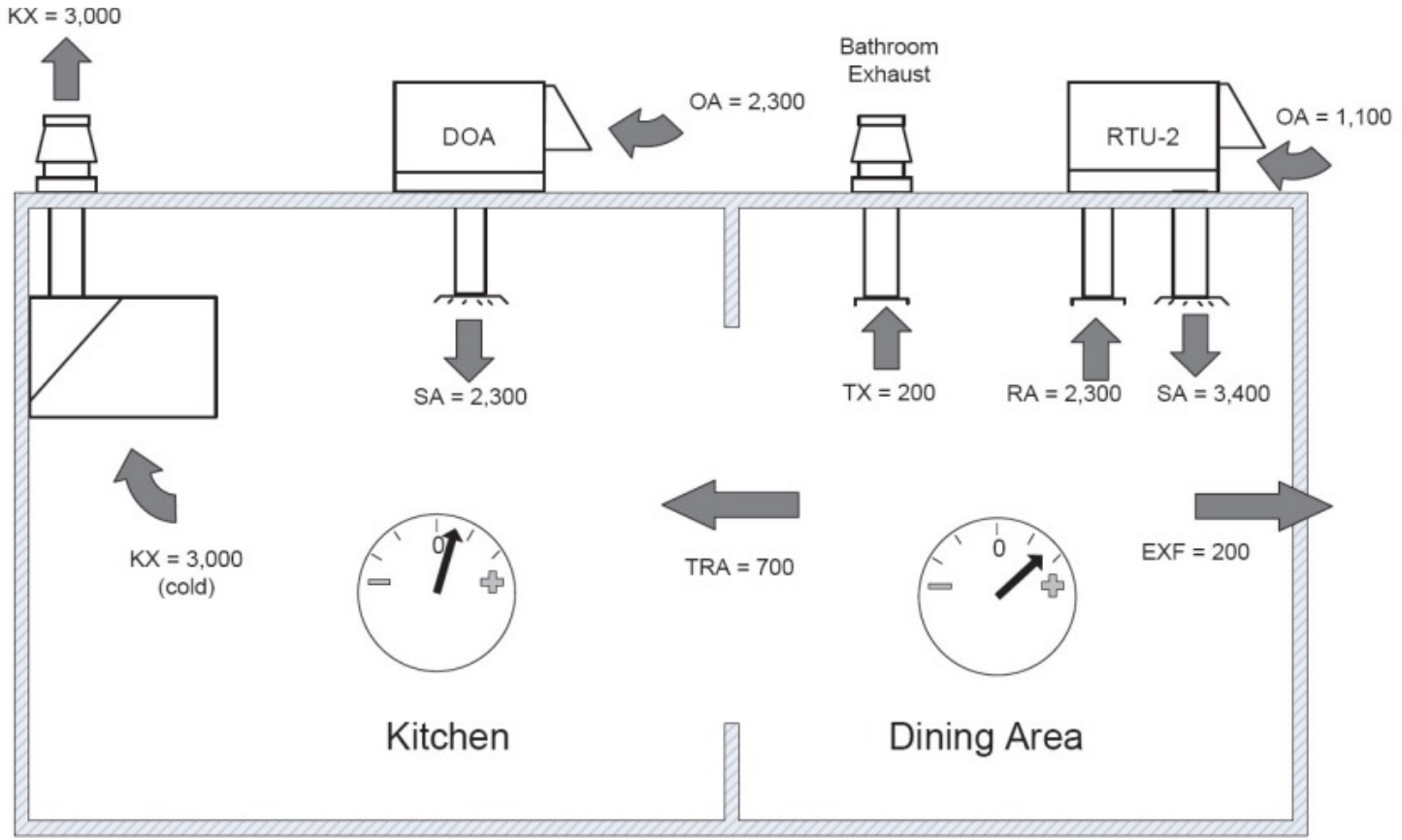

Fig A-2 ASHRAE STD154

Energy efficiency

Demand Controlled Kitchen Ventilation

Transfer air/ treatment of makeup air

Energy recovery

Energy Efficiency Measures	90.1	IgCC/189.1	Title 24
Applies when kitchen has an airflow greater than X	X = 5000 cfm (2360 L/s)	X = 2000 cfm (950 L/s)	X = 5000 cfm (2360 L/s)
Transfer air	At least 50% of replacement air	At least 50% of replacement air	At least 50% of replacement air
DCKV	Installed on 75% of exhaust air	Installed on 75% of exhaust air	Installed on 75% of exhaust air
Energy recovery devices	An energy recovery ratio not less than 40% on at least 50% of the exhaust airflow	An energy recovery ratio not less than 40% on at least 50% of the exhaust airflow	An energy recovery ratio not less than 40% on at least 50% of the exhaust airflow
At least 75% of makeup air must met these criteria	Not applicable	Not applicable	• Be unheated or heated to no more than 60°F (15.6°C) • Be uncooled or cooled without using mechanical cooling

Table 4.10 ASHRAE Design Guide for Commercial Kitchen Ventilation

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THANK YOU! / Q&A

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