Dialectic
ENGINEERING

Commercial Kitchen Ventilation (CKV) Design and Recent Innovations and Developments in the Industry.

Prepared by Dialectic, Inc.

310 W. 20th St., Ste. 200, Kansas City, MO 64108 816-997-9601 DialecticEng.com

INTRODUCTION

Commercial Kitchen Ventilation (CKV) Design and Recent Innovations and Developments in the Industry.

Commercial kitchen ventilation (CKV) can encompass everything from a small stand-alone kitchen hood in a mom and pop restaurant to an array of hoods, appliances, and systems in a corporate kitchen. The kitchen hood in CKV serves the purpose of capturing and containing heat, smoke, volatile organic compounds, grease particles and vapor to avoid health and fire hazards. There is no one-size-fits-all solution to CKV, as different foods require different equipment to prepare.

Dialectic ENGINEERING

310 W. 20th St., Ste. 200, Kansas City, MO 64108 816-997-9601 DialecticEng.com

The ventilation design engineer must be aware of all parameters involved in creating their design to ensure that the exhaust hood functions properly. The CKV industry's latest technological advances require sound design practices. The designer must be experienced in applying a fully integrated ventilation system that results in a positively balanced building where customers and employees dine and work. The knowledgeable designer must produce a system that works effectively, operates efficiently and can be constructed on a budget.

Good CKV design practices complemented with technological innovations in the industry can be applied to all projects small and large within the budget of the client. These innovations can be integrated into any project given proper planning. Understanding the needs of the client and the kitchen processes is paramount to developing an optimized CKV design. The fundamentals of CKV design must be examined before discussing industry advancements and their application.

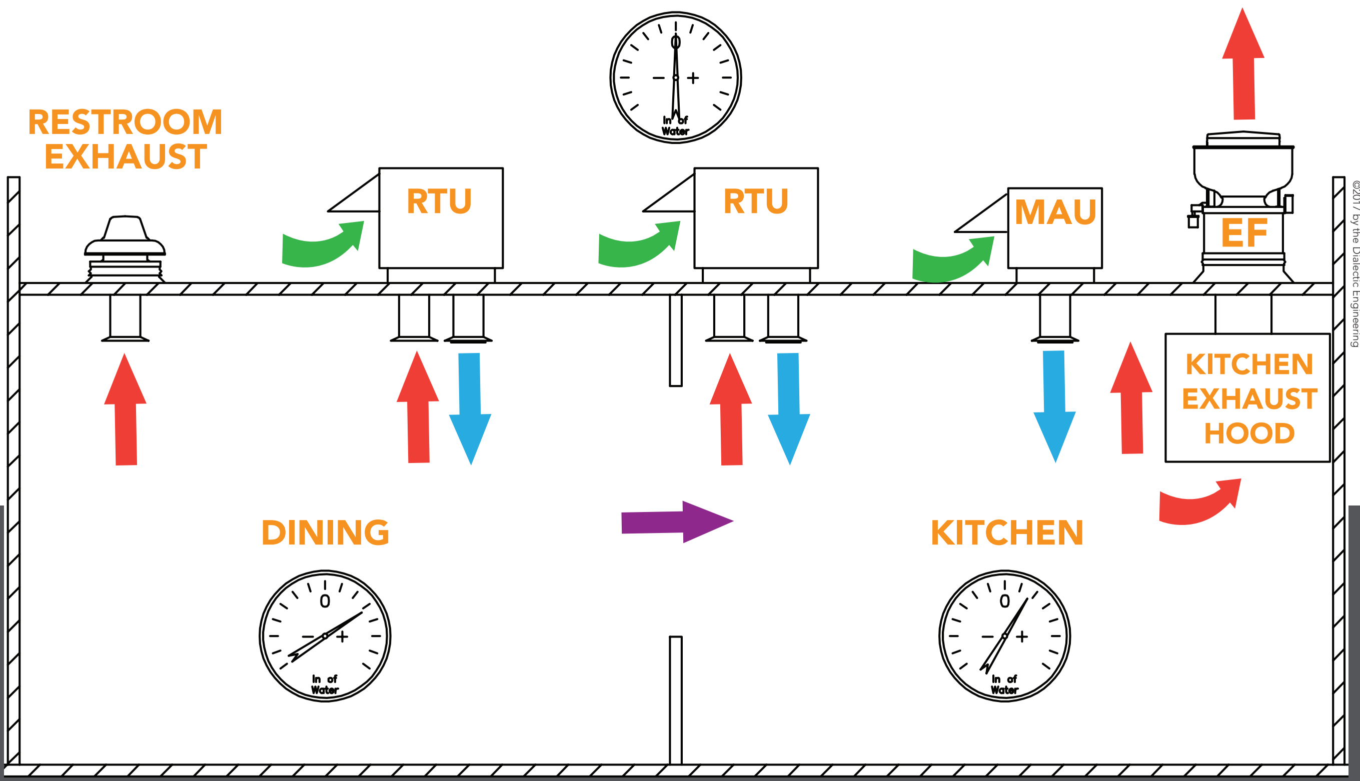

Figure 1: Schematic of a common commercial food service ventilation configuration

Fundamentals of CKV

Ventilation is the single most important factor in the design, construction and operation of commercial kitchens: without adequate ventilation no kitchen will operate efficiently. Makeup air is defined as the replacement air provided to a space to "make up" the air lost to exhaust processes either from a single source or multiple sources. There are several goals a well-designed system must achieve including:

- Ventilation through the kitchen must introduce sufficient amounts of clean air while removing excess hot air for the occupants to breathe adequately and remain comfortable.
- Ventilation must provide sufficient air for complete combustion at natural gas or solid-fuel appliances, otherwise carbon monoxide production may occur.
- Ventilation must dilute and help remove products of combustion from the gas or oil-fired appliances in addition to fumes, odors, vapors and steam from the cooking process, all of which is referred to as effluent.
- Ventilation must be designed to allow the cooking equipment to operate effectively and safely by maintaining effective capture and containment (C&C) of effluent at the exhaust hoods.

The CKV Design Process

Successful application of CKV fundamentals during the design phase requires an understanding of the local building code requirements, the menu, the kitchen's cooking equipment and the overall budget. Coordination with other disciplines on the design team will require early estimates of kitchen parameters such as the amount of exhaust, makeup air, motor horsepower, water supply (where required) and wastewater flow rates. Refinement to the ventilation design will be continual as decisions are made by all parties.

The key steps in the design of a CKV system are:

1. Establish location and task classifications of appliances including menu effects such as grease-producing menu items. Determine or coordinate with the foodservice consultant the preferred appliance layout for optimum exhaust ventilation.
2. Select hood type, style and features (the foodservice consultant may do this but it is good to evaluate these features before proceeding on the design).
3. Compute exhaust airflow rates for each hood required based on the required rating of the hood and the equipment it serves.
4. Select a makeup air strategy. Determine the size of airflows, and lay out makeup air and other comfort and heating supply air diffusers for best C&C, usually in cubic feet per minute of air (CFM).

CKV and Building HVAC Considerations

The commercial kitchen is a place where multiple air transport systems, including exhaust air, makeup air, cooling/heating supply air and return air, must work together. CKV systems work most effectively when the entire building and all its air transport systems are balanced to work as a single CKV system. The CKV system is a subsystem of the overall building heating, ventilation and air-conditioning (HVAC) system where areas outside the kitchen, such as waiting, dining and bar spaces, must be conditioned and ventilated while maintained slightly positively pressurized relative to the kitchen and the outdoors. Common problems caused by an unbalanced HVAC/CKV system include negative building pressure, drafts at entry areas, hot/cold spots in the dining areas, smoke loss at the hoods, a hot cook line among others. The recipe is simple in concept as air that exits the building (through the exhaust hoods and fans) must be replaced with outside air that enters the building, by design or otherwise. Concept to reality is a little more difficult to accomplish if the designer does not consider all variables.

Cooking appliances are categorized as light-, medium-, heavy-, and extra-heavy-duty, depending on the strength of the thermal plume and the quantity of grease and smoke produced. The thermal plume is the heated air and cooking byproduct off-gases that flow up, out and away from the cooktop source and have not yet dissipated and equalized temperature into the surrounding air space. The strength of the thermal plume is a major factor in determining the exhaust rate for each hood. Hotter surfaces and hotter cooking food provide a higher rate of plume. As the plume rises by natural convection, it expands and billows outside of the hood area, unless it is captured by the hood and expelled remotely outside of the building by kitchen exhaust fans. Makeup air is air that comes from outside the building (outside air) to replace the air exhausted by the appliance hoods. This outside air can be introduced directly into the kitchen or through other air conditioning equipment.

HVAC, Makeup Air Sources, Space Layout and Capture & Containment

The layout of HVAC heating and cooling diffusers and makeup air delivery points can affect hood C&C performance. These air sources can inadvertently direct air discharges at the area under the hood, disrupting thermal plumes and hindering C&C effectiveness. Other considerations include the location of delivery doors, service doors, pass-through openings and drive-thru windows, as these can also be sources of cross-drafts that affect hood capture.

Safety factors are typically applied to design exhaust rates to compensate for the effect undesired air movement within the kitchen has on a hood's capture performance. The phrase "minimum capture and containment" is defined as "the conditions of hood operation in which minimum exhaust flow rates are just sufficient to capture and contain the products generated by the appliance in idle or heavy-load cooking conditions, and at any intermediate prescribed load condition. The abbreviation C&C refers to "minimum capture and containment" airflow rate as defined by ASTM F-1704.

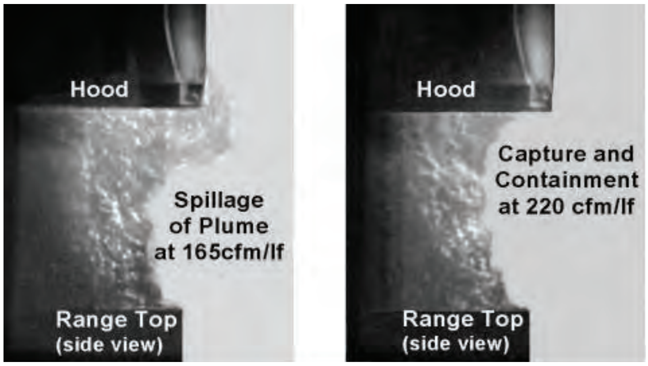

Figure 2. *Schlieren images of hoods at different exhaust rates per linear foot (lf).*

Replacement (Makeup) Air Distribution Options

Air that is removed from the kitchen through the exhaust hood must be replaced with an equal volume of makeup air through one or more of the following pathways:

- Transfer air (from the dining areas)
- Displacement diffusers (floor or wall-mounted)
- Ceiling diffusers with louvers (2-way, 3-way, 4-way)
- Slot diffusers (ceiling)
- Ceiling diffusers with perforated face
- Integrated hood plenums (various styles and combinations)

Makeup air supplied through displacement ventilation diffusers remote from the hood, perforated diffusers located in the ceiling as far as possible from the hood, or as transfer air from the dining room generally works well if air velocities approaching the hood are less than 75 feet per minute (fpm) (22.9 meters per second (m/s). Makeup air introduced near an exhaust hood has the potential to interfere with the hood's capability to capture and contain effluent. The chances of makeup air affecting hood performance increases as the percentage of the locally supplied makeup air (relative to the total exhaust) is increased. The 80% rule-of-thumb for sizing airflow to a kitchen hood is "80% of the hood exhaust airflow rate should be supplied inside the kitchen area as makeup air, with the remaining 20% transferred to the kitchen from adjacent spaces." At one point this was a code prescriptive method for kitchen makeup air. If you supply this 80% through a makeup air unit (MAU) directly supplied at the hood through a plenum or series of diffusers surrounding the hood, this can be a recipe for trouble, particularly if the exhaust-flow rate has been over-specified or selected conservatively high to start with.

Temperature of the locally supplied makeup air can affect the performance of the hood as the air density differences (between cooler and warmer air) effect the dynamics of the air movement around the hood. The primary recommendation for locally supplied makeup air so that hood performance is not adversely affected is to minimize the velocity (fpm) of the makeup air as it is introduced near the hood. This can be accomplished by minimizing the volume of makeup air through any one pathway, by maximizing the area of the grilles or diffusers through which the makeup air is supplied, or by using a combination of pathways. Pre-engineered hoods with integrated makeup air are a viable CKV solution, but it may not always be the best approach to an effective and optimized kitchen. It is an available option for the client that may save time and/or costs and moves responsibility for the hood's performance to the manufacturer.

The photos that follow show the effects that certain exhaust hood configurations and methodologies of C&C have on the thermal plume. The primary take-away from these images is the effect that makeup air velocities directed at the hood have on the plume and C&C performance. Figures 3 and 5 show poor application and Figures 4 and 6 show good application with a description of each system.

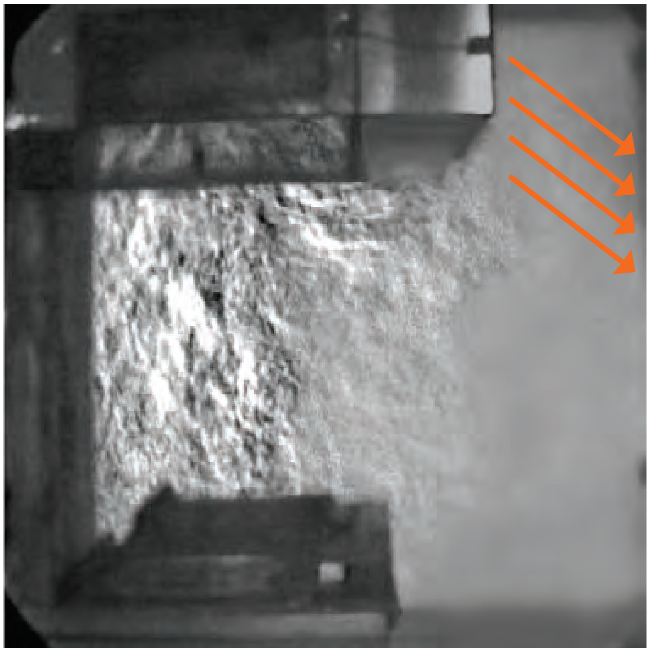

Figure 3. *Schlieren image shows the thermal plume being pulled outside the hood by a poorly engineered front face supply.*

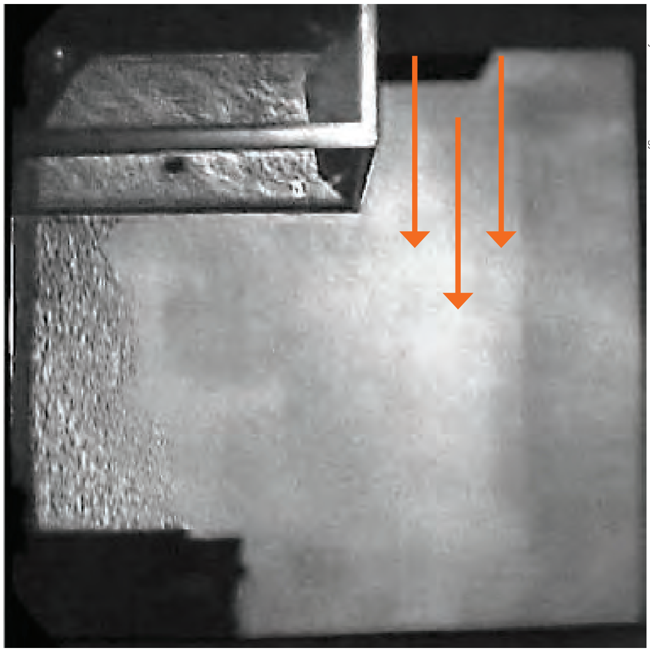

Figure 4. *Schlieren image shows effective thermal plume capture with makeup air supplied by a 16-inch-wide perforated perimeter supply.*

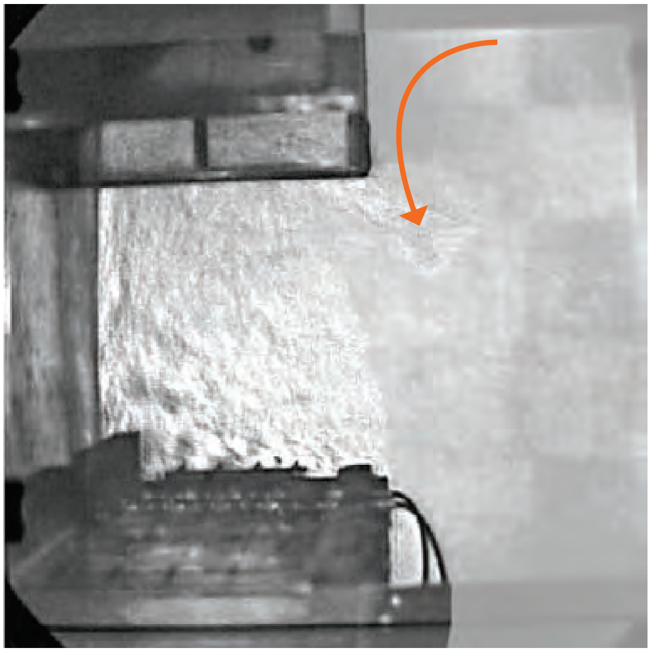

Figure 5. *Schlieren image shows the thermal plume being pulled outside the hood by the air discharged from a 4-way diffuser.*

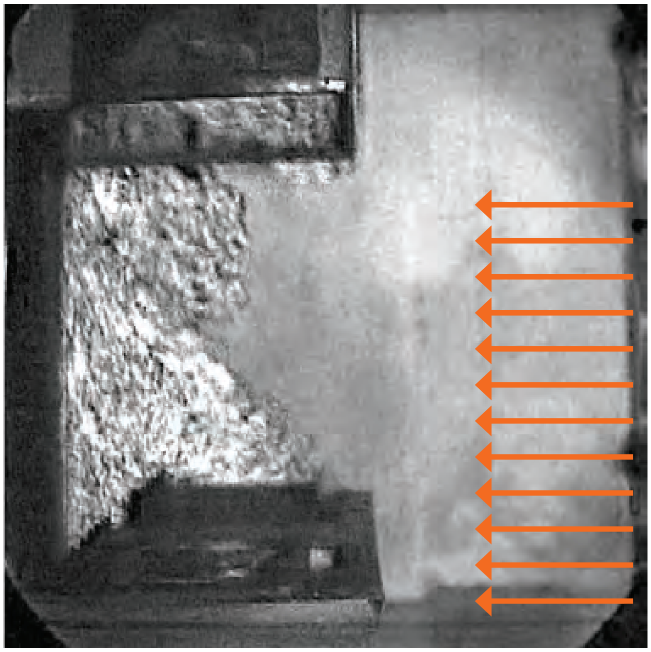

Figure 6. *Schlieren image shows the thermal plume being effectively captured when makeup air is supplied at low velocity from displacement diffusers and dining transfer air.*

The question that follows is now, “How does the ventilation designer reduce makeup air to the kitchen?” Here we take the steps in optimizing the ventilation system.

Reduce Makeup Air: Step 1

The first step in reducing the makeup air requirement is to minimize the design exhaust rate. Use prudence in selecting and applying UL-listed hoods, and take advantage of the “exhaust flow” recommendations from hood suppliers based on their listing for the cookline or individual appliances (the hood serves) being considered. This results in the least amount of air exhausted due to the testing required of the hood to achieve a UL listing for the manufacturer’s prescribed capture airflow rates. Exhaust hood manufacturers’ sales and engineering departments have a lot of experience that CKV design consultants can use to minimize the “safety factor” applied to exhaust rates resulting in less makeup air required for the kitchen.

Reduce Makeup Air: Step 2

The second step in reducing the makeup air is to take account of the outside air that must be supplied by the HVAC system(s) to meet code requirements for ventilating the adjacent spaces (dining room, bar, lounges, etc.). It may be practical to transfer most of the makeup air from these adjacent spaces when the architectural layout allows. Rather than supplying 80-90% of the makeup air through one strategy, the designer should try to keep this ratio below 60% (the remaining 40% of the replacement air must come from other sources such as transfer air, HVAC supply or another local strategy). The hood performance will be superior and the kitchen environment will benefit from the cooling contribution of the “recycled” dining room air. Since the outside air required by code is usually conditioned before it is introduced into the building it makes sense to use this outside air as makeup air credit in the design.

Reduce Makeup Air: Step 3

The third step in reducing the makeup air is to select a configuration for introducing the local makeup air into the kitchen that compliments the style and size of the hood(s). If transfer air is not an option, consideration should be given to a combination of makeup air strategies such as backwall supply and perforated ceiling diffusers. This approach reduces the velocity of air being supplied through each local pathway, reducing potential problems with hood capture and allowing the hood to operate effectively. Options (at 60% or less) include front face supply, backwall supply and perforated perimeter supply. Short-circuit supply is not recommended, and air curtains should be used with extreme caution. There are pros and cons to all of the different makeup air configurations that our engineers can discuss in detail with each client. Some of these configurations are illustrated in Figures 3-6 above. The simple governing factor in avoiding detrimental effects to hood capture and containment is to minimize makeup air discharge velocity.

Makeup Air Units with Heating and Cooling

A common design practice is to supply at least 80% of replacement air using an independent and dedicated makeup air unit (MAU) with the remaining 20% supplied by conditioned outside air from HVAC rooftop units (RTU) serving the kitchen and/or transfer air from adjacent spaces. This keeps the kitchen under a negative pressure (relative to dining areas) to prevent cooking odors from migrating into the dining area. In many cases the replacement air from a MAU is not conditioned which may create uncomfortable conditions (too hot and/or too cold) in the kitchen. The addition of heating and/or cooling in a MAU is primarily for employee comfort of the kitchen staff standing directly under the exhaust hood. Cooling the makeup air (via the dedicated MAU) is costly since most of the air is immediately exhausted. This is a newer trend to keep chefs more comfortable and fresher when they are standing in the makeup air path into the hood. The air can be cooled down to around 80-85°F (26.7–29.4˚C) and provide comfort to those working under the hood. Consideration for this option should be given in hot temperature location such as the worst case of low desert areas where temperatures can exceed 150°F (65.6˚C) on roofs where the outdoor air is drawn. In other cases, the makeup air is typically heated, which results in simultaneous heating (by the MAU) and cooling (by the RTU) of the kitchen during shoulder seasons. Heating of the makeup air is recommended in cold climates to a reasonable temperature such as 60°F (15.6˚C). The engineer or hood supplier should be able to prepare an economic analysis of energy consumption, service and maintenance costs required to make an informed decision.

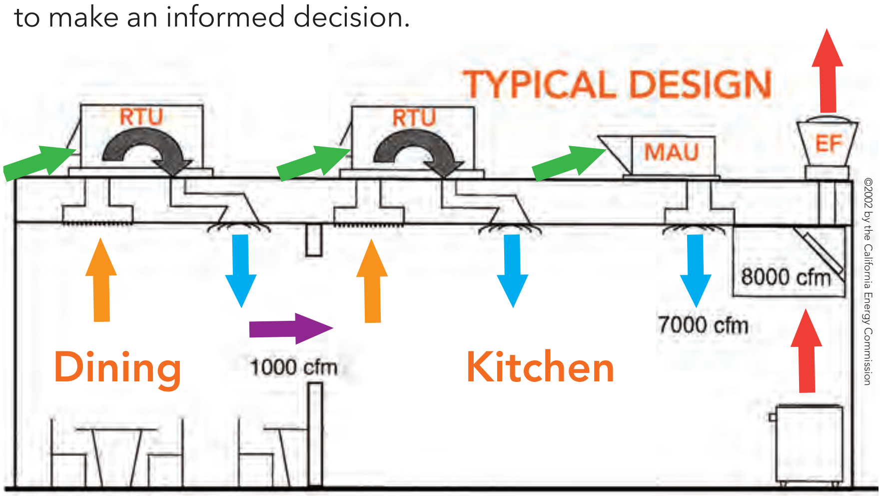

Figure 7. Typical HVAC equipment arrangement for a restaurant.

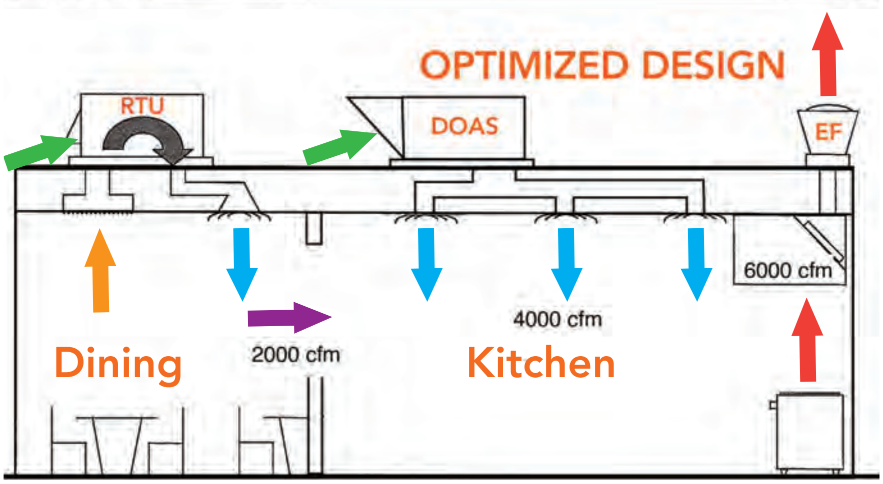

Figure 8. Optimized HVAC equipment arrangement for a restaurant.

Conventional design practice does not take full advantage of the high rate of occupancy ventilation air that is introduced into the dining and adjacent spaces. The designer must take the opportunity to use code-required outside air supplied to the occupied spaces as replacement air, thereby reducing or possibly eliminating the fraction of replacement air from the dedicated MAU. As this ventilation air is conditioned by the RTU in most cases, transferring it to the kitchen as makeup air improves the overall thermal comfort in the kitchen. The challenges in employing this strategy are easily overcome by our design team as we have years of experience in kitchen ventilation design.

Restaurant HVAC is typically provided by constant volume, packaged, single-zone air conditioning units (commonly called rooftop units, or RTUs, since that is where they are usually located). The cooling/heating capacity and the number of RTUs selected for a restaurant depend on the estimated thermal loads, thermal zoning, ventilation loads, cost considerations and building code requirements. The capacities of the RTUs are chosen based on the hottest and coldest days expected during a typical year with the cooling load sized based on the peak business day with peak cooking loads.

The first cost (purchase and install) of an RTU depends on the cooling capacity, supply air capacity and the options/features included or not included and the sophistication of the unit controls. Building codes have increasingly demanded better energy efficiency, improved air quality and quantity from packaged HVAC units. Increases in required minimum efficiency ratios (EERs and IEERs), duct sealing, improved thermostats and unit controls and air or water economizers are examples of this trend.

There are typically two different options when it comes to cooling the makeup air in CKV: direct expansion (DX) and evaporative cooling. DX is used in most climates. Evaporative cooling can be used in very dry climates. However, more maintenance is involved with an evaporative cooling unit and it requires a more knowledgeable maintenance staff than a DX unit. An evaporative cooling unit is a lot cheaper to run though has a much shorter life expectancy and requires high-quality water to operate.

100% OA Units for MAU and Kitchen Cooling

A less common option for makeup air in a kitchen is to use a dedicated outdoor air system (DOAS) to provide makeup air and cooling for the kitchen. While the DOAS unit may be slightly more expensive than a typical MAU or RTU, it would only require one unit instead of two separate units. This would lead to more simplified ductwork, a lower structural impact, and simplified controls. These units are also better built to deal with the higher humidity that comes with outdoor air, resulting in increased space comfort.

Reduce Exhaust with All MAUs Through RTUs

Another option is to decrease the amount of required exhaust so that all the makeup air can be supplied through the outdoor air on the rooftop units. Proprietary technology exists that can do this by creating an air curtain around the hood to aid C&C. This helps to keep in the effluent and lowers the total amount of required exhaust. By doing this, sizes of exhaust fans are decreased, electrical service size is decreased, the need for a separate makeup unit is eliminated, and total energy consumption is lowered.

There is also a proprietary solution that can lower the exhaust rate by lowering the hood closer to the cooking surface. There are similar benefits as with the previously discussed system, although there may be decreased flexibility in the cooking space with the hood being so close to the cooking surface. This option is not available for all types of cooking.

Demand Control Variable Volume Systems
Typical ventilation controls consist of a manual on/off switch that operates the fan(s) at either 100% speed or not at all. This system is still operating in the dark ages – turn it on, turn it off. Demand-controlled kitchen ventilation (DCKV) uses state-of-the-art, microprocessor-based systems to automatically vary fan speed based on cooking load and/or time of day. The system provides only the amount of ventilation needed and can reduce fan and heating and cooling energy costs significantly.

Changing Standards
Appliances idle for a better part of the day in a kitchen. Using two-speed or variable exhaust flow rates to allow reductions in exhaust and makeup while the appliances are idling would also reduce operating costs. An experimental investigation (ASHRAE Research Project: RP-1033) of exhaust velocity effects on grease deposition in kitchen exhaust ducts has influenced changes to the NFPA 96 (Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations) and International Mechanical Code (IMC) minimum exhaust requirement. The standard has been amended to allow a minimum exhaust duct velocity of 1,500 fpm (7.6 m/s) to 500 fpm (2.5 m/s). The new standard maintains or improves the safety aspect of minimizing grease build-up, while allowing engineers more flexibility in both retrofit and new kitchen design, including variable flow kitchen exhaust. Technology developments have made demand control kitchen ventilation (DCKV) more feasible and cost effective using variable frequency drives (VFDs).

Food service facilities have high energy consumption with restaurant equipment and CKV being the primary energy consumers in a restaurant. Exhaust hood airflow drives energy consumption for CKV, so the first step in reducing this exhaust airflow is designing high efficiency hoods with low capture and containment (C&C) airflow rates.

Food service facilities have high energy consumption with restaurant equipment and CKV being the primary energy consumers in a restaurant. Exhaust hood airflow drives energy consumption for CKV, so the first step in reducing this exhaust airflow is designing high efficiency hoods with low capture and containment (C&C) airflow rates. DCKV allows the further reduction in exhaust airflow when cooking is not taking place under the hood. The exhaust is activated or increased from low demand to where the appliances are hot and in use.

Airflow reduction is not the sole objective of a DCKV system. It also must ensure exhaust airflow and the corresponding supply airflows are increased to C&C levels as soon as cooking starts (to avoid spillage of convective heat and cooking effluent into the kitchen space). The current NFPA-96 Standard and International Mechanical Code require that a hood operate at full design airflows whenever full-load cooking activity occurs underneath an exhaust hood. DCKV has evolved from simple two-speed fan control systems to proportional control with VFDs based on exhaust temperature. This improvement allows for varying airflows throughout the day. Optical infrared sensors were added to the temperature-based control to detect actual cooking activity taking place under the exhaust hood to improve variable speed control and enhance system performance.

Energy Savings is the Driver

The latest system introduced to the market added measurement of exhaust airflow and automated balancing of multiple exhaust hoods connected to a single fan (or a dedicated fan) and modulation of replacement air for the space. Future systems need to be designed to consider the entire kitchen status to maximize energy savings.

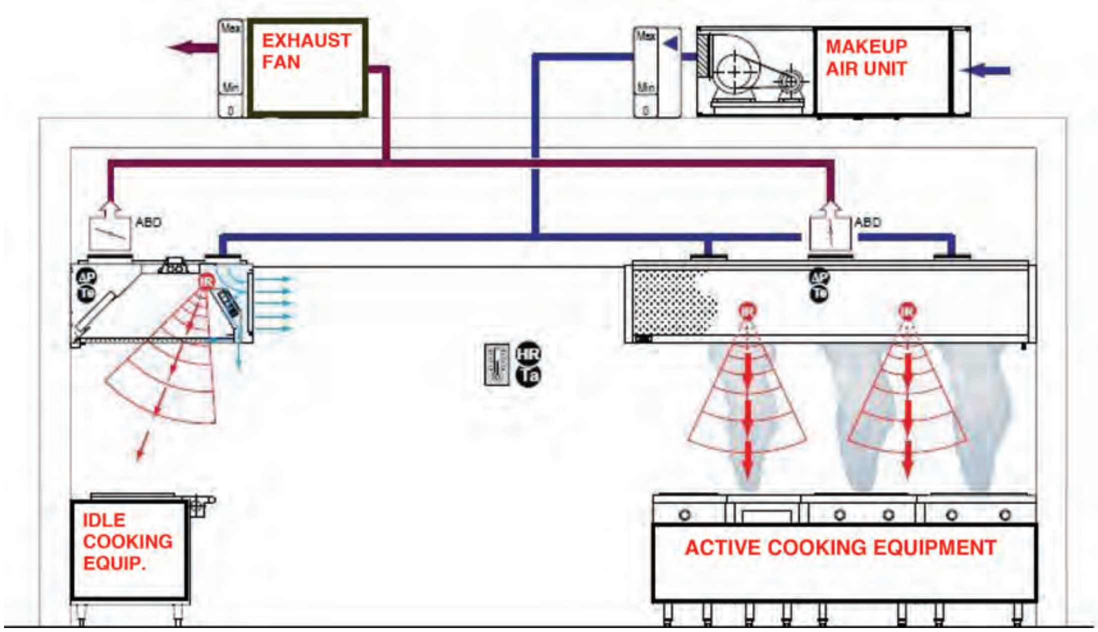

Figure 9. *Schematic DCKV system showing infrared sensor activation control with active and idle cooking equipment. Halton Group.*

Potential energy saving sources:

- Turning down fans under light cooking conditions
- Reducing the amount of tempered makeup air
- Reduction of associated building cooling
- Outdoor air compressor free cooling

CKV controls work together with energy management systems using analog/digital instrumentation to optimize building operations. Controls can regulate several equipment components including, but not limited to:

- Hood exhaust and makeup air fans. The system uses a controller a VFD to adjust the motor speeds of the exhaust hood and makeup air unit fans.
- Ventilation control dampers in the hood and HVAC system.
- HVAC economizer dampers, if any. (Economizers are automatically controlled dampers that can save energy by bringing in outside air during cooling. They do so when the outside air is sufficiently cool and dry that bringing it into the building would reduce HVAC cooling energy.)
- Cooking appliances, for example shutting them down when exhaust duct temperatures get too high using infrared temperature sensing.

Good CKV design practices complemented with technological innovations in the industry can be applied to all project types within the CKV scope. The key CKV design elements to an optimized design must still guide the designer to use those technology improvements. The client will reap the operational and functional benefits of the engineer's optimized CKV design.

Pre-fabricated Exhaust Duct Systems

Cost, safety, and effectiveness are typically the foremost thoughts on a restaurant owner's mind. When it comes to grease exhaust ductwork that connects the hoods to the exhaust fans, field-fabricated steel kitchen exhaust duct does not always satisfy those requirements. The availability of quality welders to fabricate in areas where projects are under construction is steadily decreasing, which simultaneously increases the cost it takes to fabricate quality ductwork. This led to kitchen ventilation companies creating products that would outperform the earlier welded standard.

Prefabricated (factory fabricated) ductwork is the newest innovation in the grease exhaust ductwork world. This ductwork is constructed with stainless steel, with prebuilt clamp connections and pre-installed insulation. The clamps and connections mean that no on-site welding is required, which reduces the cost as well as the chances that a subpar weld affects the life and safety of the system. Since the ductwork is built with an exterior wall with insulation, it can be rated for reduced clearances or no clearance to combustible materials.

Cost Comparison

Cost is a huge factor in any decision or purchase, as it should be, but it is important to factor in all the cost reductions that factory-fabricated ductwork will include when comparing it to field-fabricated ductwork. A simple cost comparison of material costs will not suffice. Instead, we must look at the big picture of costs, including the labor, materials and maintenance costs. Since prefabricated ductwork is made offsite, it is shipped in easily handled sections (per the specific design). These sections weigh much less than a full piece of welded carbon steel grease exhaust ductwork, which saves labor costs. The labor also will not require welding of the seams, since it will be provided with a simple clamp system to hold the ducts together. The maintenance of the prefabricated ductwork is also much quicker and easier. If a section needs to be replaced, it would not take much effort to unclamp the piece and replace it with a new factory-ordered piece.

The safety aspect of prefabricated ductwork is not to be overlooked. Many manufacturers provide a product that is certified with the Underwriter's Laboratories (UL listed). The product also complies with the latest NFPA (National Fire Protection Association) standards. Standard field fabricated ductwork is not held to a UL-listing standard. When owners know that their grease exhaust is proven to handle the heat that is required by the UL safety tests, they have confidence in their equipment. An example of a test is a 30-minute internal fire test at 2,000˚ Fahrenheit, at which the duct should not lose structural integrity.

Space Limitations

The drawback to factory-fabricated ductwork is the space required. Since the ductwork is cylindrical it often requires more height above the ceiling. Existing spaces may not have space to spare above the ceilings to accommodate a full size round duct with included insulation. As with any innovation though, manufacturers are always looking to improve their products. Oval grease exhaust ducts have recently been introduced to the market, which give all the same benefits of round grease exhaust ducts, with the added benefit of reduced height.

The consensus for the cost of prefabricated grease exhaust ductwork is that it may cost a little more than field-fabricated ductwork, but the owner reaps the other benefits of ease of installation, increased safety, and better quality. Deciding on which option is best for the situation is not always as black and white as it sounds, so it is best to discuss all the options with engineers.

Plumbing and Fire Protection Options and Design Considerations

One of the largest concerns with hood exhaust systems is the deposit of creosote and grease inside kitchen exhaust hoods, ducts and fans from cooking. These deposits make the systems of ductwork susceptible to fire. Many of codes for kitchen exhaust systems are dedicated to practices that prevent fire in the duct systems from damaging the building. Hoods are required to have suppression systems that react to cooking fires and to prevent fire from entering the duct system.

Not only do these deposits represent a large fire risk, they also are a maintenance problem. Duct systems are required to be cleaned regularly, as are hoods, and fans. There are systems that assist in reducing the maintenance of exhaust hoods, ducts and fans:

Hood-Wash System

Some hood manufactures offer a hot-water wash system that is integrated into the hood. The system can be programmed or can be manually controlled to operate once cooking is completed. Washing the plenum while the hood is hot reduces cleaning frequency of the grease duct and hood, and also reduces grease fires in the ductwork.

When considering this option, address these design requirements:

- The required water temperature
- Required backflow prevention
- Required gallons per minute and the duration of drainage cycle
- Water pressure requirements
- Required controls

Grease Removal systems

Some hood manufactures provide a grease removal system that uses a cold-water mist that automatically cools the exhaust gasses as they leave the hood. This aids in the removal of grease vapors, which are the largest contributor of grease in ductwork. This will also reduce grease in the ductwork and thus reduce duct cleaning frequencies and grease fires in the ductwork.

When considering this option, address these design requirements:

- Required water temperature
- Backflow prevention requirements
- Gallons per minute required and the duration of the cycle
- Drainage requirements
- Water pressure requirements
- Controls

Combined System

A combined system would incorporate the hot-water wash and the cold-water mist grease removal system. This would combine the advantage of the cold-water mist when the hood is in use, and the hot-water wash at the end of the day.

Fire Suppression Systems

When choosing a fire suppression system there are a few methods. The most common method is a wet chemical system like Ansul and Amerex. An alternate method is the water-based sprinkler system that incorporates the wet fire protection. Design considerations for the sprinkler system would be gallons-per-minute rate and pressure requirements. Lastly there is an option that uses the water wash and cold-water mist as a supplement to the suppression system. Design considerations for this option would be to coordinate control sequence.

There are many components to the kitchen ventilation design and selection. After selecting the design, the owner needs to maintain the system and provide a safe environment for employees. Plumbing and fire protection options will enhance the operation, and safety for the workers and should always be considered when designing the kitchen ventilation system.

CONCLUSIONS

In the ever-changing CKV industry there is no one-size-fits-all solution to CKV projects. Whether it involves ventilation design, plumbing and fire protection or prefabricated duct systems, the design consultant must be aware of the client's needs and site constraints to allow the building and kitchen equipment to function properly and optimally in a cost-effective manner. Good CKV engineering design practices must come first and use the industry's latest technological advances where applicable to each project. With commercial kitchen ventilation, Dialectic knows it is better to evaluate each client's needs and find the solution that best fits those needs.

References

13 Coins Case Study: Airflow and Energy Savings with the Halton MARVEL System. Halton Group (2013)

Energy Management Systems (EMS) and Demand-controlled Kitchen Ventilation (DCKV) Energy Savings in Restaurants. Pacific Gas and Electric Company (2014)

Energy Standard for Buildings Except Low-Rise Residential Buildings. ANSI/ASHRAE/IES Standard 90.1-2016

HVAC Fundamentals and Applications, Exhaust Air Quality. ASHRAE Paper 10326_1 Seminar 7 (2013)

Improving Commercial Kitchen Ventilation Systems: Integrating Kitchen Exhaust Systems with Building HVAC (Design Guide 3) – Southern California Edison. Architectural Energy Corporation and Fisher Nickel Inc. (2002)

Improving Commercial Kitchen Ventilation Systems: Optimizing Makeup Air (Design Guide 2) – Southern California Edison. Architectural Energy Corporation and Fisher Nickel Inc. (2002)

Improving Commercial Kitchen Ventilation Systems: Selecting and Sizing Exhaust Hoods (Design Guide 1) – Southern California Edison. Architectural Energy Corporation and Fisher Nickel Inc. (2002)

New Rules for Kitchen Exhaust. ASHRAE Journal. (November 2002)

Standard for Fire Ventilation Control and Fire Protection of Commercial Cooking Operations. NFPA 96 (2017)

Dialectic
ENGINEERING

310 W. 20th St., Ste. 200, Kansas City, MO 64108 816-997-9601 DialecticEng.com