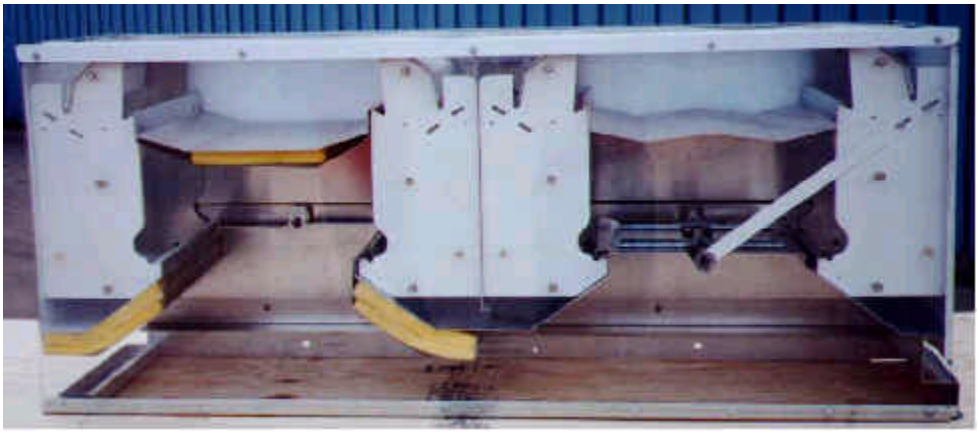
Gravity Ventilation Systems



GRAVITY VENTILATION:

NATURAL DRAFT OR GRAVITY VENTILATION SYSTEMS REPRESENT ONE OF THE OLDEST AND MOST COMMON METHODS OF OBTAINING FRESH AIRFLOW TO AN ENCLOSED SPACE. PHYSICAL EFFECTS SUCH AS THE TEMPERATURE DIFFERENTIAL BETWEEN INSIDE AND OUTSIDE AIR, WIND SPEED, AND THE HEIGHT BETWEEN THE CENTER OF THE AIR INLETS NEAR THE FLOOR AND THE VENTILATOR AT THE ROOF LEVEL ALL CONTRIBUTE TO A NATURAL CONVECTION EFFECT. THE PRIMARY PURPOSE OF A NATURAL FLOW SYSTEM IS TO USE NATURAL FORCES TO INTRODUCE COOL OUTSIDE AIR INTO THE OCCUPANCY LEVEL OF A BUILDING, NORMALLY THE LOWER EIGHT TO TEN FEET, WHILE EXHAUSTING HEATED AND CONTAMINATED AIR FROM THE SAME ENCLOSURE. THIS IS ACCOMPLISHED IN ITS SIMPLEST FORM BY INTRODUCING OUTDOOR AIR INTO THE BUILDING VIA LOUVERS OR FANS, ALLOWING IT TO BE HEATED BY FURNACES, PROCESS EQUIPMENT, OR SIMPLY BY THE OCCUPANCY LEVEL ITSELF, AND AS THE WARMER AIR RISES DUE TO ITS REDUCED SPECIFIC WEIGHT, PROVIDE AN OPENING IN THE ROOF FOR THE HEATED AIR TO PASS THROUGH.

THE WIDEST APPLICATION FOR A NATURAL FLOW OR GRAVITY VENTILATOR OCCURS IN MANUFACTURING AND INDUSTRIAL PROCESSES WHICH GENERATE LARGE AMOUNTS OF HEAT. THE METALS INDUSTRY IS A PRIME EXAMPLE. GRAVITY VENTILATION IS USED EXTENSIVELY IN ALUMINUM REDUCTION, STEEL MAKING OR ROLLING, AND HEAT TREATING OPERATIONS. THE GLASS AND RUBBER INDUSTRY, AS WELL AS FOSSIL FUELED ELECTRIC GENERATING PLANTS, ARE OTHER OPERATIONS WHICH UTILIZE NATURAL FLOW VENTILATION. IN ADDITION NATURAL FLOW SYSTEMS HAVE HAD WIDESPREAD USE IN GENERAL MANUFACTURING PLANTS FOR BOTH PRESSURE RELIEF, GENERAL BUILDING VENTILATION, AND EMERGENCY HEAT AND SMOKE VENTING.

BEFORE DECIDING TO USE A GRAVITY OR NATURAL FLOW SYSTEM SEVERAL CRITERIA SHOULD BE EVALUATED TO INSURE A SUCCESSFUL APPLICATION. FIRST, THE VERTICAL DISTANCE BETWEEN THE EXHAUST AIR ROOF OPENING AND THE CENTER LINE OF THE INTAKE AIR OPENINGS, OR STACK HEIGHT, SHOULD BE MORE THAN TEN FEET. SECOND, THE INTAKE AIR OPENINGS SHOULD BE LOCATED AS CLOSE TO THE OPERATING FLOOR LEVEL AS POSSIBLE. THIRD, THE FREE AREA OF THE AVAILABLE INTAKE OPENINGS SHOULD BE GREATER THAN THE ROOF VENTILATOR THROAT AREA; NORMALLY A RATIO OF 1.5 TO 1 WILL BE THE OPTIMUM. KEEPING THE EXHAUST OPENING AT THE TOP OF THE BUILDING AS THE POINT OF MAXIMUM RESTRICTION, HELPS TO INSURE THAT A POSITIVE PRESSURE WILL BE CREATED IN THE UPPER PORTION OF THE BUILDING. FOURTH, THE HEAT RELEASED IN THE BUILDING SHOULD BE SUFFICIENT TO PROVIDE A MOVING FORCE TO MAINTAIN THE DESIRED CHANGE RATE. FINALLY, INLET OPENINGS SHOULD BE DISTRIBUTED UNIFORMLY ABOUT THE BUILDING, AND CARE SHOULD BE TAKEN THAT THEY ARE NOT OBSTRUCTED BY EXTERIOR BUILDINGS OR TOPOGRAPHY OR INTERIOR PARTITIONS OR EQUIPMENT.

THE FIRST STEP IN THE DESIGN OF A NATURAL FLOW OR GRAVITY VENTILATION SYSTEM IS THE

SAME AS FOR ANY OTHER SYSTEM - DECIDING HOW MUCH VENTILATION IS REQUIRED OR HOW MUCH AIR IS TO BE EXHAUSTED. THE AIR CHANGE METHOD AND THE HEAT REMOVAL METHOD ARE THE TWO BASIC METHODS FOR ESTABLISHING THE VENTILATION REQUIRED. THE AIR CHANGE METHOD DEPENDS UPON INDUSTRY EXPERIENCE FOR VARIOUS CATEGORIES OF OPERATIONS, AND ALTHOUGH THIS METHOD IS NOT AS PRECISE AS THE HEAT REMOVAL METHOD IT IS SUITABLE FOR MOST GENERAL VENTILATION APPLICATIONS AS WELL AS BUDGETARY STUDIES. THE AIR CHANGE METHOD IS EXPRESSED IN THE FORMULA BELOW:

$$\text{VENTILATION REQUIRED IN CFM} = \frac{\text{VOLUME OF BUILDING INCU.FT.}}{\text{TIME FOR AIR CHANGE IN MIN}}$$

AFTER DETERMINING THE VENTILATION REQUIRED THE NEXT STEP IS TO DETERMINE THE PROPER TEMPERATURE DIFFERENTIAL BETWEEN THE OUTSIDE INLET AIR AND THE EXHAUSTED AIR AT THE ROOF OPENING. THE TEMPERATURE DIFFERENTIAL MUST BE SO SELECTED THAT THE HEATED AIR PLENUM DOES NOT REACH INTO THE OCCUPANCY LEVEL OF THE BUILDING. DESIGN CRITERIA OR WORKING CONDITIONS MAY FORCE AN ENGINEER TO ESTABLISH A MAXIMUM ALLOWABLE TEMPERATURE AT THE ROOF LEVEL THUS ESTABLISHING THE TEMPERATURES AT THE OCCUPANCY LEVEL. EXPERIENCE HAS PROVED THAT IF THE HEAT SOURCE AND INTAKE AREA IS AT LEAST 1 1/2 TIMES THE EXHAUST AREA, THE FOLLOWING FORMULA APPLIES:

$$\text{TEMPERATURE DIFFERENTIAL (F)} = \text{STACK HEIGHT (FT)} \times 0.6$$

THE RESULTS OBTAINED ABOVE MAY BE ROUNDED TO THE NEAREST FIVE DEGREES WHEN SELECTING CAPACITY DATA FROM CATALOGS OF REPUTABLE MANUFACTURERS OF VENTILATION EQUIPMENT. WITH THE STACK HEIGHT AND TEMPERATURE DIFFERENTIAL KNOWN IT IS A SIMPLE MATTER TO ENTER THE MANUFACTURERS PERFORMANCE TABLES TO DETERMINE THE NUMBER AND SIZE OF THE VENTILATORS REQUIRED TO ACHIEVE THE CALCULATED VENTILATION RATE.

WHEN BUILDING HEAT RELEASE IS GENERAL AND SPREAD OVER A WIDE AREA, VENTILATORS SHOULD ALSO BE DISPERSED AS WIDELY AS IS PRACTICAL. IF THE BUILDING IS FLAT-ROOFED, A NUMBER OF SMALL UNITS SHOULD BE SPACED OVER THE ROOF. ON PEAKED BUILDINGS, VENTILATORS SHOULD BE CONTINUOUS AND VENTILATOR LENGTH SHOULD APPROACH THAT OF THE PEAK. EFFECTIVE VENTILATOR THROAT WIDTH CAN BE ADJUSTED TO SUIT THE VENTILATION REQUIREMENTS.

WHEN THE BUILDING HAS A HOT SPOT, A LARGE VENTILATOR SHOULD BE PLACED OVER IT. IN

LOW BUILDINGS - ESPECIALLY THOSE WITH FLAT ROOFS - IT IS SOMETIMES PRACTICAL TO INSTALL BAFFLES AROUND THE HOT SPOT. THE BAFFLES PREVENT CONTAMINATED AIR FROM SPREADING INTO OTHER AREAS. THE ENCLOSED AREA CAN THEN BE TREATED AS A SEPARATE BUILDING, WITH ITS VENTILATION REQUIREMENTS HANDLED SEPARATELY. A DISPERSAL OF SMALL VENTILATORS CAN BE USED FOR GENERAL VENTILATION REQUIREMENTS IN OTHER AREAS OF THE BUILDING.

SINCE A PEAKED ROOF WILL DIRECT THE CONTAMINATED AIR TO THE PEAK, BAFFLING IS USUALLY NOT NECESSARY. IT IS NECESSARY, HOWEVER, TO FIGURE THE HOT SPOT VENTILATION REQUIREMENTS SEPARATELY FROM THOSE FOR THE REST OF THE BUILDING. A LARGE EFFECTIVE VENTILATOR THROAT WIDTH MUST BE USED OVER THE HOT SPOT AREA. LET SMALLER VENTILATORS HANDLE GENERAL VENTILATION REQUIREMENTS IN THE REST OF THE BUILDING. CALCULATED TEMPERATURE DIFFERENTIAL SHOULD BE THE SAME FOR BOTH GENERAL VENTILATOR REQUIREMENTS AND VENTILATION OF A HOT SPOT - BASED ON EQUAL STACK HEIGHTS.

WHERE SPECIAL BUILDING CHARACTERISTICS OR HIGH AND CONCENTRATED HEAT SOURCES EXIST, THE HEAT REMOVAL METHOD OF CALCULATION SHOULD BE UTILIZED. THE WESTERN CANWELL STAFF OR THE REPRESENTATIVE IN YOUR AREA ARE PREPARED TO ASSIST YOU IN SIZING AND SELECTING THE PROPER VENTILATOR DESIGN FOR YOUR PARTICULAR APPLICATION. WE HAVE OVER SEVENTY YEARS OF EXPERIENCE AVAILABLE TO ANSWER YOUR QUESTIONS. PLEASE CONSULT THE SWEETS SHOWCASE FOR A REPRESENTATIVE LIST OF GRAVITY PROJECTS, OR CONSULT THE FACTORY DIRECT FOR A LIST OF CUSTOMER REFERENCES.

REFERRALS:

OUR COMPANY IS LISTED WITH "SWEETS GENERAL BUILDING AND RENOVATION GUIDE" CATALOG #07720/WES - BUYLINE 9502. INFORMATION CAN ALSO BE VIEWED ON SWEETSOURCE CD ROM AND AT SWEETS WEB SITE, http:\\www.sweets.com.

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