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HKIE Mechanical, Marine, Naval Architecture & Chemical Division

Newsletters

Chairman's message by Ir Barry Lee

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MMNC's Chairman Ir Barry

Half of my chairmanship term for MMNC has gone swiftly and I would like to take this opportunity to put a remark on what the Division has achieved in last six months and the way ahead. With the strong support of our committee members and the members of SYEA and AESG, we have organized more that 80 technical visits, seminars and social gathering events so far which created a record for the Division.

Most of our activities have been well executed with overwhelming response by our members. The nature of the activities also covered a wide spectrum of areas and interests ranging from seminars in public speaking, project management, risk management, motor vehicle technology, technical visit to aircraft maintenance plant, power plant, water treatment plant, sewage treatment plant and marine / chemical Facilities, etc. MMNC also jointly co-organized a 4 days delegation to Shanghai in China with the Gas & Energy Division for visiting a nuclear power plant, shipyard for manufacturing of LNG vessel and Tongji University in October 2008.

We have also successfully hosted two certificate courses in last several months at a high rate of participation by our members. The first course was jointly organized with the Hong Kong Institute of Acoustics covering the area of road traffic noise control and measurement. The second course covered the design, operation and maintenance of sewage treatment technology, special thanks are given to Ir S M Yu of EMSD, HKSAR for his voluntary support as the guest speaker of the course. The third certificate course entitled "Mechanical Ventilation System for Tunnel Infrastructure" would be launched in March 2009.

Other than those above-mentioned technical functions, we have also organized the Dragon Boat Competition and Football Competition as part of the MMNC 30th Anniversary Celebration Program. With the support by IMechE, ASME and HKJB, all these activities were finished with lot of fun and memory. The MMNC Marathon team was also formed to promote the importance of physical training and participation of community activities to our members. The first community activity we attended was the Community Chest Corporate Challenge held on 18 January 2009.

In addition to the above, another important achievement we have accomplished was the formation of the Special Interest Group in the Aircraft maintenance Engineering (AME) within MMNC. This movement would no doubt able to connect our members in the AME to the Division and to promote the AME profession to the engineering society. Another remarkable event forthcoming is the one day Conference on Advanced Technology in Transportation for a better environment to be held on 24 April 2009. Our past MMNC Chairman and past President of HKIE Ir Dr Alex Chan was the Chairman of the Organizing Committee whereas the Department of Mechanical Engineering of the Hong Kong Polytechnic University is the co-organizer of the Conference. Needless to say, the most important event to come in my remaining chairmanship term will be our 30th Anniversary General Meeting and 30th Annual Dinner which is to be held on 7 May 2009.

All in all, I would appeal on behalf of the Division for your support and participation to make all the forthcoming events a success. Last but not least, I would like to take this opportunity to wish you and your family will have a successful and fruitful year in 2009.

Displacement ventilation

In the HVAC industry, there are two types of room air distribution, mixing and displacement. In Hong Kong, designer conventionally uses mixing ventilation for building. However as raised access floors are a standard item in most offices, underfloor air distribution (UFAD) systems are becoming much more popular. UFAD is one of the application examples of displacement ventilation.

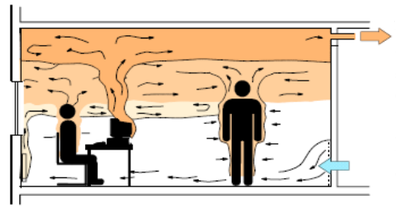

Figure 1 Schematic illustration of displacement ventilation and convective flow pattern driven by heat source (Source: Displacement ventilation in non-industrial premises)

Principle Behind it and its advantages:

The displacement outlets are usually located at or near the floor. Using buoyancy forces generated by heat sources (say for example, human body, electric equipment) in a room to move contaminants and heat from the occupied zone to the return or exhaust grilles above.

The most significant advantage for displacement ventilation compared with mixing ventilation is a better indoor air quality (IAQ). Room air separates into two layers, an upper polluted zone and a lower clean zone (due to the characteristic of air density discrepancy in two zones). In other words, the pollutant concentrations are lower in the occupied space in case of displacement ventilation than in the case of dilution ventilation (providing that air flow rates, pollutant emission rates and room sizes are identical).

Apart from indoor air quality, energy efficiency is another issue concerns by the society. As the buoyancy force is totally provided by convective heat source, this approach successfully uses natural convection forces to reduce fan energy.

Why it is not common it Hong Kong? Any limitations on this air distribution system?

There are a few limitations on displacement ventilation designer required to tackle. Certain amount of wall area and floor area are required for air supply unit. Supporting from architect and client in Hong Kong is crucial, as every single feet of area cost developer money.

Displacement ventilation systems are of limited use in spaces with high heat loads because of the low cooling capacity available, so they are often teamed with a secondary system of chilled ceilings. Where there is a high latent load causing high humidity, the possibility of condensation occurring on cold surfaces. These factors hinder to application of displacement ventilation in Hong Kong.

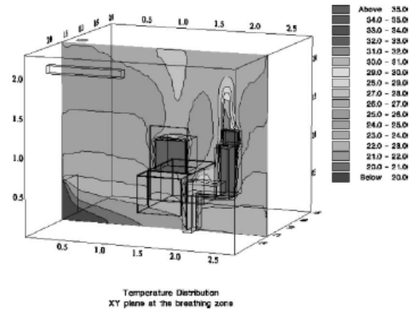

Figure 2 Temperature Prediction for displacement ventilation using Computational Fluid Dynamics (Source: A study of the air quality in the breathing zone in a room with displacement ventilation, Building and Environment 36 (2001) 809–820)

Difficulty of designing displacement ventilation

The convective flow of displacement ventilation, unlike total mixing of dilute ventilation, is dictated by many factors, including heat source, partition, as well as furniture location. Wide variety of flow patterns affects the thermal comfort and IAQ greatly. The current design regulations and standards are based on average values which do not provide information concerning the fields for air temperature, air velocity, and contaminant concentration. Computational fluid dynamics therefore become more common in assisting the design of displacement ventilation.

Indoor Environment Quality

Given that on average a person in Hong Kong spends over 90% of their time indoors, the quality of the indoor environment has a significant impact on the quality of life. Buildings should provide a safe and healthy indoor environment. Indoor environment quality (IEQ), defined in terms of thermal comfort conditions, indoor air quality (IAQ), lighting and acoustical properties, has a significant impact on the comfort, health and well-being of building occupants. Poor IEQ in commercial and institutional buildings can impact on productivity and may impose health risks to users. The design, management, operation and maintenance of buildings should seek to provide for adequate IEQ, but with optimum use of energy and other resources.

Parameter	Unit	8-hour average [a]	
		Excellent Class	Good Class
Room Temperature	°C	20 to <25.5 [b]	< 25.5 [b]
Relative Humidity	%	40 to <70 [c]	< 70
Air movement	m/s	< 0.2	< 0.3
Carbon Dioxide (CO_2)	ppmv	< 800 [d]	< 1,000 [e]
Carbon Monoxide (CO)	$\mu g/m^3$	< 2,000 [f]	< 10,000 [g]
	ppmv	< 1.7	< 8.7
Respirable Suspended Particulates (PM_{10})	$\mu g/m^3$	< 20 [f]	< 180 [h]
Nitrogen Dioxide (NO_2)	$\mu g/m^3$	< 40 [g]	< 150 [h]
	ppbv	< 21	< 80
Ozone (O_3)	$\mu g/m^3$	< 50 [f]	< 120 [g]
	ppbv	< 25	< 61

Achieving good IEQ in buildings will depend on the adequacy of the design of the building and the building services installations to meet user requirement, and the extent to which operation and maintenance practices has maintained building performance. The specified thermal comfort conditions can be achieved where systems can cater for part-load operation, IAQ is best dealt with through the control of pollutants at source. Lighting quality is not simply a matter of lighting level, but also needs to consider quality, such as glare, distribution, daylight and views, etc. The acoustics properties of space impact on audibility, and unwanted noise can impact on comfort.

Analytically, Indoor Air Quality (IAQ) is defined by a list of the constituents, in both solid and gaseous states in air. Subjectively, IAQ is the human perceived response to nasal irritants in the air. SHARAE defines 'Acceptable Indoor Air Quality' as "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do no express dissatisfaction."

A key factor in determining appropriate standards for IAQ is the duration of exposure. Exposure to indoor pollutants for a matter of minutes (e.g. car parks), hours (e.g. entertainment establishments), or over a working day (e.g. offices, classrooms, etc.) will be different for most parameters depending on dose and response. For example, limits of the exposure considered acceptable for the general public, include the young and inform, are different from exposures considered acceptable for the sedentary workplace, and certainly the industrial workplace. Table on the left shows the concentration of different IAQ pollutants under 'Excellent Class' and 'Good Class' respectively.

An individual assessment must be carried out in order to find out whether the building is under good environmental performance or not.

Sources: ASHRAE Standard 62, ASHRAE, 2001, Hong Kong Building Environmental Assessment

Prepared by K.K.CHOW

Sports and Engineering – Car Racing

A great event in Macau – 55th Grand Prix, was done in mid of November. The Guia Circuit is a street circuit of 6.2 km with an exhilarating combination of long, fast straights and sharply twisting corners. It is recognised as one of the most demanding circuits in the world.

Street circuit is more challenging since the track is relatively narrow. The car may hit the wall once a mistake is made. The racing speed is very high and the G-force could be 50 to 100 times of the force of gravity during a crash. Therefore, safety is the prime concern. Various types of soft walls like tyres or plastic foam are erected to absorb the impact energy of a car at a high speed crash. Once accident happens, a flag will be displayed to indicate the status of a race and to communicate instructions to competitors as the following:

Flag	Description
	Local Caution or Full-Course Caution (if displayed with "Safety Car" sign)
	Debris/Oil/Slippery Course
	Stop race
	Restart race

Table 1 Some uses of flags in FIA sanctioned championships

Besides, racing car provides protection for driver. A roll cage is built inside the cab of a car to protect the driver from being injured in an accident. Furthermore, the window opening on the car is covered by a mesh made from nylon webbing to keep the driver's arms from flailing out of the car during a crash especially in event of roll-over. Of course, the driver has to wear safety gear (driver suit) and helmet to prevent from burning and debris puncturing respectively.

Figure 1 Racing Car

Quicker response of the car can be achieved by weight reduction. To further make the car run faster, tuned power-train and fuel supply systems are fitted. In the meantime, the higher braking force and handling are required. The air streams above and underneath carbody induce venturi effect. By adding spoiler and air dam, air pressure difference between the streams can be utilized to increase the downward force acting on the car and so do the tyre to ground grip ($f = \mu N$). Furthermore, underfloor pan is used for enclosing the parts underside of a car to reduce drag due to underbody roughness.

Cornering technique is one of the decisive factors to win a race. "Slow-in and Fast-out" is a golden rule in controlling speed in curves while "Out-in-Out" instructs how to steer a car as shown in figure 2. The former requires decelerating when entering into a curve and picking up the speed after the apex of the curve. In the case of entering bends without reducing speed, the car is forced to slow down before finishing corners to lose speed and stability. In the worst cases, the car might spin or run off the course. It also gets the car moving too late to pick up speed. As a result, "Slow-in and Fast-out" is the fastest way to take corners. The latter is a way of turning curves from the outside line of a course into the inside line to which the car will come closest to the apexes and finishing the corner back to the outside line, thus making the longest possible turning radius. By utilizing the full width of the course, the car will make an easier turn than the actual curve. This will allow the car to run through the turns faster.

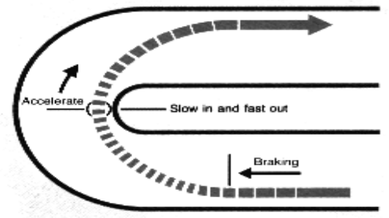

Figure 2 Cornering Technique

As engineers, we not only appreciate skills of the competitors but also engineering knowledge and advanced technologies applied to the racing car. Indeed, the racing car could not be born without engineers' detailed calculations, analysis, and painstaking effort. Therefore, the course is an arena for engineers as well.

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