HIGH INDUCTION
SWIRL AIR DIFFUSER
DAL 358

Presented to :

Hydro-Québec

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A comparative analysis was carried out with two types of square ceiling diffusers G352 and G452 used in the majority of the offices and institutional buildings in Quebec. Other diffusers of the same family come with a uniform plate in top. The induction generated by these diffusers is even weaker.

G352

G452

The analysis was carried out starting from the initial conditions defined as follows:

INITIAL CONDITIONS

Dimensions of local (LxWxH) : 13x13x10 cubic feet (4mx4mx3m)
Breast height : y = 6 feet (1.80 m)
Pulsated air temperature (non isothermal) : To = 12 °C
Ambient air temperature : Tamb = 22 °C
Initial temperature difference : $\Delta T = -10°C$ 0
Pulsated Air velocity : Vo = 50 fpm (0.25 m/s)

DATA AQUISITION

To record the values of the variation in temperature ΔT_{xy} reached by our diffuser DAL358, we used the data compiled by the EMCOAIR software set up by our team.

Concerning the traditional diffusers G352 and G452, we got their curves of operation directly from their manufacturers. Values of the temperature variation ΔT_{xy} were taken for the DN400 with the optimal flow rate indicated in Table 2.

Table 2 : optimal flow rate

	$V\ cfm$	(m_3 / h)
DN400	80(136) - 150(255)	

For low values of flow rate, the acoustic power of the traditional diffusers is not given. For the three curves, it is considered that 10 dB are absorbed by the room.

An analytical analysis was carried out to determine the ratio of proportionality between the variation in temperature with breast height and the induction ratio using the flows.

RESULTS AND DISCUSSION

Results obtained of the variation in maximum temperature ΔT_{xy} of ambient air with breast height according to the flow rate V for various nominal dimensions DN of the diffusers are illustrated in figure 6.

Figures 7 represent the behavior of the induction ratio according to the flows rate obtained by the relation Induction ratio given by *ASHRAE Fundamentals*.

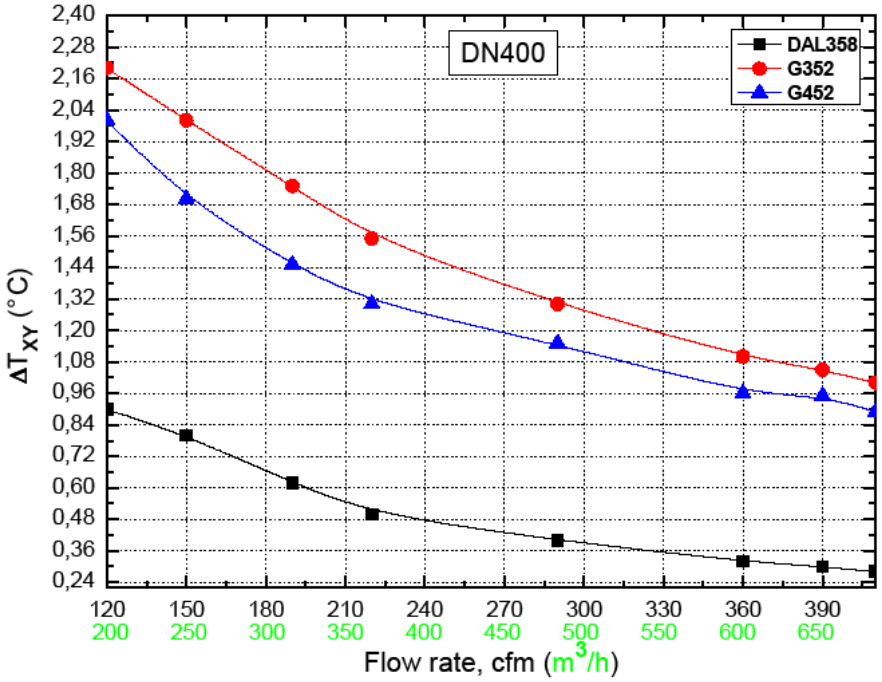


Figure 6 : Temperature variation ΔTxy

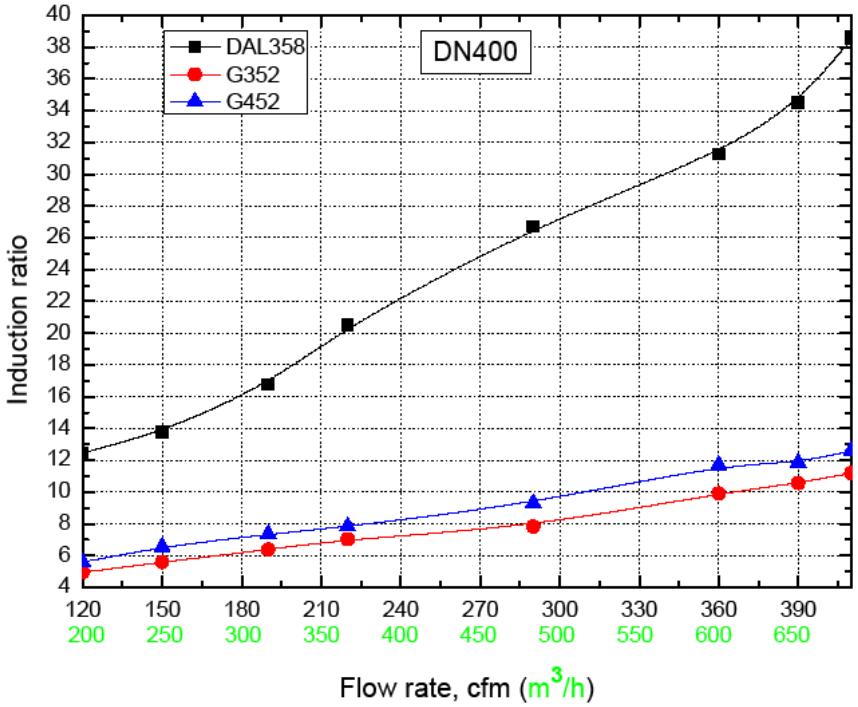


Figure 7 : Induction ratio

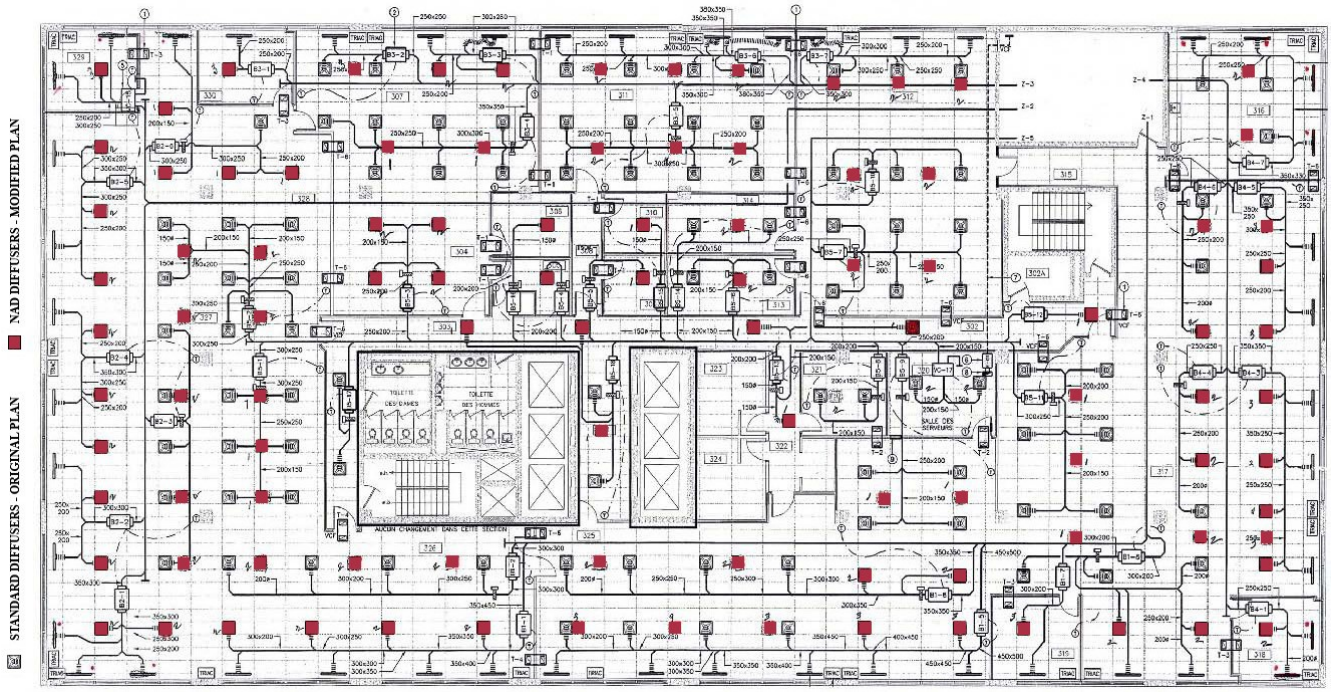
Very important results are shown on these figures. Firstly, we notice that when the flow rate increases the variation of ΔT_{xy} decreases. However, even if this variation decreases it remains important for the two standard diffusers compared to the temperature variation obtained by the **DAL358**.

On figure 6, the maximum value of the temperature variation reached by diffuser **DAL358** is 0.9°C compared to 2 °C reached by the standard diffuser G452 for a flow rate of 120 cfm. That represents more than double. For a flow rate of 410 cfm, the minimal variation of temperature reached by our diffuser is 3 times less than that reached by the two standard diffusers.

Figure 6 shows that minimum variation in temperature ΔT_{xy} reached by the standard diffusers corresponds to the maximum reached by the **DAL358.** This ratio is about 3 times. This means that in a room with an open space equipped with 6 standard diffusers requires only 3 **DAL358** diffusers to satisfy the conditions of comfort because of the high flow rate which the **DAL 358** can support. An example illustrated in appendix A shows a real case scenario of an open space room equipped with our diffusers. This realization allows for a reduction of ± 50% of the diffusers required.

Very small variations in temperature reached by the **DAL358** creates a better mixture of the air (homogenized) because of the high induction ratio as illustrated in figure 7. Figure 7 shows that the temperature variation Δt_{xy} is inversely proportional to the induction rate. This variation decreases when the induction ratio increases. In figure 7, the DN400 with a flow rate of 120 cfm ($200 m_3 h$) has an induction ratio of 2.25 times more than the standard diffusers. This ratio is more important when the air flow rate increases. It reaches a ratio of 3times at a flow rate of 400 cfm ($700 m_3 h$).

APPENDIX A



A full version can be obtained here:
http://www.eco-en-ergy.com/imagesEC/DAL358report.pdf