CHAPTER VIII

CONCLUSIONS AND RECOMMENDATION

8.1 CONCLUSIONS

CFD technique has been applied to predict the phenomenon of the air flow past the parallel inclined flat plates in a square duct. According to the analysis of the experimental and numerical results , these can be distinguished for two influences that directly affect to the development length as belows

(a) The figure and alignment of the obstacles.

(b) Reynolds number of the air flow.

In case of the figure of the obstacles , its characteristic of the present study is the number of flat plates which obstruct the flows or namely the various types of the damper. According to subsection 7.1.1 , it is remarked that at the same Reynolds number and same inclination , the 3-blade damper requires the length for fully developed flow to be less than the other dampers due to the velocity profiles behind the flat plates distorted or almost be alike the undisturbed flow (at the small inclination). While 2-blade damper produces the more distorted-velocity profiles due to enlargement of the breadth and decreasing of the number of blades from 3 to 2. Hence , the allowed pathways of the separated flows are decreased too. Such behavior can directly facilitate the generation of the reversed flow regions so the development length of this initial condition is longer but still less than the case of 1-blade damper that the downstream velocity profiles are extremely

distorted due to maximal increase in size of the breadth (equals to D_h of the duct) and also the number of blades is decreased to be only one. Thus , there are only two allowed pathways for the separated flows. That are the gaps nearby the top- and bottom-wall of the duct. These both gaps are quite far from each other if compare with the adjacent gaps of 2- or 3-blade damper. Consequently , the longest distance for fully developed flow is surely required for 1-blade damper.

In case of the alignment of the obstacles , its characteristic of the present study is the inclination of flat plates against the flow direction or namely the various degree angles of attack. According to subsection 7.1.2 , it is remarked that at the same Reynolds number and same type of the damper , when the flat plate is small inclined as 10 degree angle , the separation distance is so short , thus the adjacent separated flows can reattach each other easier than the larger inclination as 30 degree angle due to the separation distance is elongated. Consequently , the smaller degree angle of attack requires the shorter distance for fully developed flow and such phenomena can be obviously observed when the inclination of the flat plate becomes 50 degree angle because the adjacent separated flows are the farthest from each other if compare with 10 or 30 degree angle,accordingly ,this development length is longer than the other inclinations.

In case of Reynolds number of the air flow , according to subsection 7.2.1 , it is remarked that at the same type of the damper and same inclination , the air flow with lower Re as 2.6×10^5 requires the distance for fully developed

flow less than the higher Re cases because the momentum along flow direction of the separated flows carry the lower value then such flow is effortless to reattach and redevelop the velocity profiles for fully developed flow. When Re is increased as 5.1×10^5 , the reattachment of the adjacent separated flows takes the longer distance due to higher value of the momentum , therefore , the development length must be surely disturbed and then resulting to be extended too. At the highest Re of the present study as 1.0×10^6 , although the flow is highly turbulent that let the exceeding fluctuations or even the mixing of the air but such behavior can not prominent over increasing of the longitudinal momentum , hence , the adjacent separated flows still require the long development length and naturally be the longest distance for whole Reynolds numbers in the range of the study.

Furthermore , in a unified conclusion , for the dynamics similarity case or same Reynolds number , it is remarked that nothing of the exact determinative for the flow without any obstacle requires the distance for fully developed flow to be shorter or longer than the case of the flow which is obstructed within the duct , but it absolutely depends on those obstacles can facilitate the recovering of the separated boundary-layers and then develop to the unchanged velocity profiles with the rate as be faster or slower.

Consequently , the influence of whether (a) , or (b) , or both simultaneously , surely affects to the distance for fully developed flow in the duct.

8.2 RECOMMENDATION

According to this present study , in order to reduce or eliminate installation effect for the engineering application , the recommended location to install a flow meter , at least , should be about 40 diameters of the duct behind the damper. However , such effect can be avoided by selection of the appropriate damper. The multi-blade damper style is recommended for this purpose due to expedite the developing to be fully developed flow , thus the accuracy of a flow meter is improved. As the increasing of blades causes the increasing of investments , therefore , the economical stand points also should be considered.