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Research Article

NUMERICAL INVESTIGATION TO EXAMINE TWO METHODS OF PASSIVE CONTROL IN URBAN STREET CANYON USING CFD: COMPARISON BETWEEN CROSSING UNDER BUILDING AND SOLID BARRIERS LBW

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ABSTRACT

Different passive control methods are discussed in this paper with the purpose of improved the quality of the air and dispersed the pollution outside the urban canyon road. Numerical investigation model is used in this paper, to examine two methods of passive control within a crossing under building and Low Boundary Wall in center of road for reducing air pollution concentration using Reynolds-averaged Navier–Stokes equations and the k-Epsilon turbulence model as close of the equation system. The results of this investigation show that a low boundary wall located at the central median of the street canyon creates a significant reduction in pedestrian exposure, relative to the same canyon with no wall. The magnitude of the exposure reduction was also found to vary according to the numbers of the crossing under building in the street canyon geometry. The values of the concentration normalized is decreased in the critical region were located in the centerline of the street canyon.

Keywords: Passive Methods, Barriers, Street Canyon, Pollutant Dispersion, Numerical Simulation.

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1. INTRODUCTION

The evaluation of spatial and temporal distribution of different pollutants dispersion and concentrations inside urban street canyons levels have attracted much attention from the scientific community; from the both monitoring and modeling points of view [1-2], mainly due to the increasing of particulate matter concentration. However the atmospheric wind direction perpendicular to the street length axis plays a dominant role to drive particulate matter and to accumulate the pollutants in the street canyon [3-9].

Hence, these pollutants are very important problems in human health [10-12], as well as their impact on the atmospheric air quality [13-14].

In many urban areas of growth populations and industrial activities, the particulate matter resulting from combustion processes, abrasion of brake discs and tires, as well as road dust suspension contribute to a deterioration of air quality [15]. In densely built up areas, air exchange between street level and the atmospheric wind above roof top level is limited. Near ground traffic-released, emissions are not effectively diluted and removed, but remain at street level, resulting in high pollutant concentrations.

A building is an obstacle to wind flow whereas the wind exerts pressure on the various walls of the urban envelope, these pressures push air through openings as passageways under building, without opening air flow under building for example, it can be created overpressures on the windward facade and depressions on the roof and on the leeward facade, in any way the distribution of pressures on the envelope depends on the shape of the building and its details, but also on the environment around the building.

Consequently, continuous increase of the pollutants concentration in the urban street canyon has become necessary to implement wise strategies and solutions for urban street canyon, for providing a clean environment, in this context, the question arises, how can the method of control passive has decrease the concentration of pollutant and their exchange processes in urban street canyon?.

A number of recent researches and studies [16-18], have been recognized and investigated the potential passive control to improve air quality in the urban areas.

Various wind tunnel in both, experiments and numerical investigations have been carried out into the impact of tree planting on the dispersion of traffic emissions on the street canyon; in this way, some researchers studies of the wind flow patterns such as [8], [19-23] and others studies interested about the canyon aspect ratios and the impact of particulate matter on different configurations of built [24-26].

In addition to their influence on the street canyon, others academic works shows that trees and other vegetation that have an act to induce the deposition of particulate matter PM in both, natural and anthropogenic depositions such as desert dust [27] and the vehicle exhaust emissions, thus proceed to reduce the concentration of pollution over the street canyon, from the among these studies, for example [28-30]. Furthermore, these investigations [31-33], have been carried out into the effect of low boundary wall (LBW) on pollutant dispersion.

Similar researches have been carried out into the effect of noise pollution barriers on air pollution dispersion. These have in effect been shown to be dual purpose in the urban environment, providing reduction in noise and air pollution [34-39].

Using low boundary walls, trees, on street parking, hedgerows, noise pollution barriers, passageways under building and other common urban features, studies and investigators revealed that the capability of these methods to increase local dispersion, therefore to reduce air pollution concentrations from traffic in a typical street canyon.

In general terms passive controls can be considered as an act in the air flow patterns over the street canyon, nerveless, with the passive control, the air pollution emissions are redirected away from the edge of the roadway, resulting in very significant reductions in the urban areas.

In this work, a two models with potential passive control have been performed with a three dimensional (3D) numerical CFD code and their major characteristics are discussed, whereas the volume of pollutants emitted from the road surface was simply to provide a generic of pollutant concentrations, in this way, considering a crossings under building and low boundary wall center (LBW) models that implemented in a the symmetrical urban street canyon, the two methods of potential passive control has been compared with *CODASC* from measurement data, on behalf of determining the amount of pollutant concentration, therefore to assure the air quality of the areas building in question.

2. MATERIALS AND METHODS

2.1. NUMERICAL METHOD

In order to investigate physical processes of the dynamic impacts of barriers solid and crossings under building in the urban canyon road, the governing equations of standard *k–ε* model of turbulent flow field is represented by finite volume schemes, while an structured grid was applied, these equations can be written in the following form:

a- The continuity equation:
$$\frac{\delta \overline{u}_i}{\delta x_i} = 0 \tag{1}$$

b- The momentum conservation equation*:*

$$\overline{u}_j \frac{\partial u_1}{\partial x_j} = -\frac{1}{\rho}\frac{\partial \overline{p}}{\partial x_j} + \nu \frac{\partial}{\partial x_j}\left[\frac{\partial \overline{u}_1}{\partial x_j}\right] - \overline{u'_j \frac{\partial u'_1}{\partial x_j}} \tag{2}$$

Where ρ [*kg.m*$^{-3}$] is the density, u [*m/s*] is the velocity and p [*atm*] is the pressure, where subscript i denotes direction. The overbear variables are the Reynolds time-average which represented the velocity components $\overline{u}_t$, the pressure $\overline{p}$ and the kinematic molecular viscosity ν [*m*^{2}.*s*$^{-1}$] of the ambient air and without vehicle emissions of sulfur hexafluoride (SF_6).

c- The equation for the transport of TKE, k: The turbulence kinetic energy k (equation 3) and its rate of dissipation ε (equation 4) are obtained from the following transport equations:

$$\rho \overline{u}_j \frac{\partial k}{\partial x_j} = \tau_{ij}\frac{\partial u_i}{\partial x_j} + \frac{\partial}{\partial x_j}\left[\left(\mu + \frac{\mu_t}{\sigma_k}\right)\frac{\partial k}{\partial x_j}\right] - \rho\varepsilon \tag{3}$$

$$\rho \overline{u}_j \frac{\partial \varepsilon}{\partial x_j} = \frac{\partial}{\partial x_j}\left[\left(\mu + \frac{\mu_t}{\sigma_k}\right)\frac{\partial \varepsilon}{\partial x_j}\right] + C_{1s}\frac{\varepsilon}{k}\tau_{ij}\frac{\partial \overline{u}_t}{\partial x_j} - C_{2s}\rho\frac{\varepsilon^2}{k} \tag{4}$$

d- The turbulent viscosity*:*
$$\mu_t = C_\mu \frac{k^2}{s} \tag{5}$$

Where, u_i and u_j are velocity components in i and j direction, respectively; μ the laminar viscosity [*kg/m.s*]; σ_k and σ_s are the turbulent Prandtl numbers for k and ε respectively; C_i mean the pollutant concentration [*kg.m*$^{-3}$], however the coefficients taken for the model chosen are: C_μ = 00.9, C_{1s} = 1.44, C_{2s} = 1.92, σ_s = 1.2 and σ_k = 1.0.

2.1.2. Dispersion modeling

Using ANSYS-CFX code, the diffusion of passive tracer is solved by computing the diffusive mass flux J in turbulent flows, which it is expressed as the following:

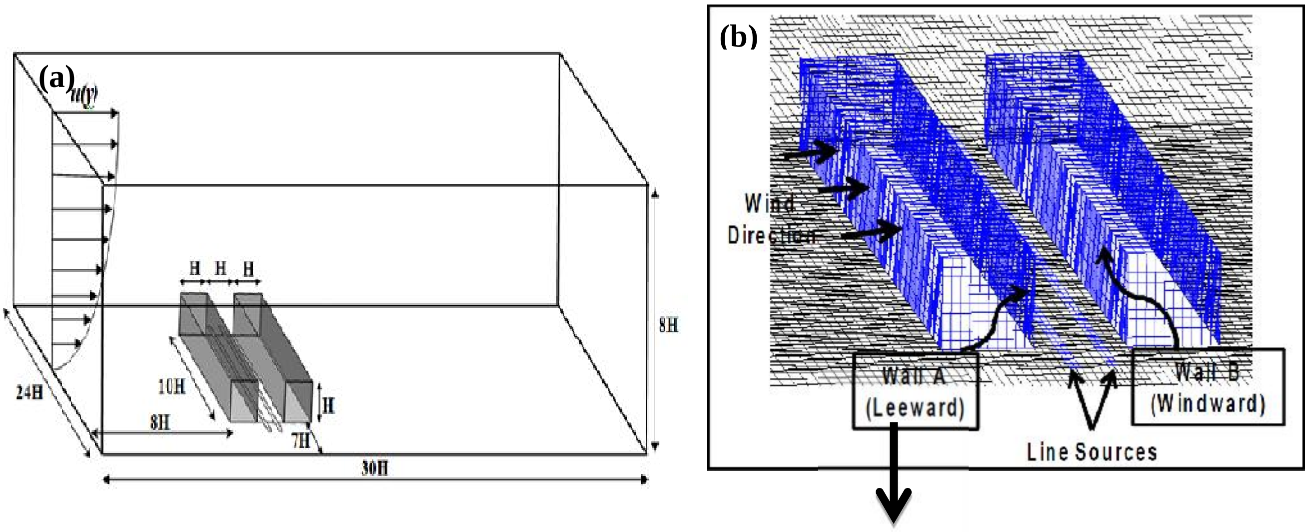
$$J = -\left(°D + \frac{«_t}{sc_t} \right) \nabla M_t \tag{6}$$

Where D is the molecular coefficient, $«_t$ is the dynamic eddy viscosity, his value obtained from the Eq. (5), while ∇M_t is the mass fraction passive scalar of pollutant and $sc_t = \frac{«_t}{°D_t}$ is the turbulent Schmidt number.

2.1.3. Model domain and grids

a- Street canyon base model

The geometrical configuration studied, is similar to that studied experimentally. In this study, base model with no boundary wall and no crossing under building; however Fig.1, shows the computational domain in 3D, whereas, L and H are the length and height of the building, W the width of specifying the street canyon. The heights of upstream and downstream of the building and the width of the canyon floor W are equivalents to H (H =18m); these dimensions are applied in all cases. The height to width ratio was 1.0; the length of the domain of street canyon is 30H; however the sub-domain of street canyon is located at 7H from lateral extension of symmetry wall and 8H from the inlet plane. 19H, is the distance between the downstream building and outflow.



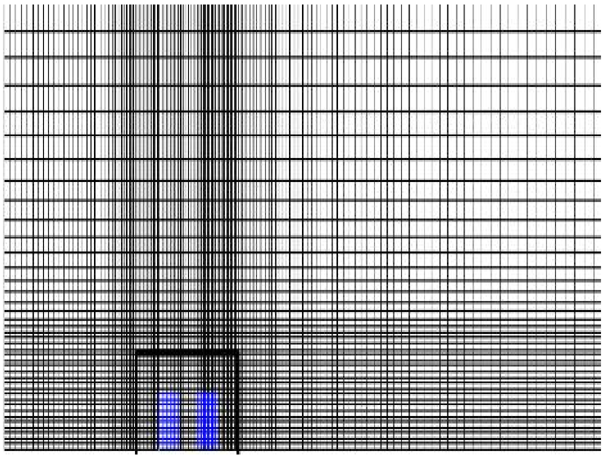


Fig.1. Computational domain and boundary conditions Computational grid of the domain

The grid characteristics of the computational domain concerning each model are meshed, using hexahedral element; the mesh was carried out using different grid sizes. The minimum size of 0.07 m was selected for each model; a surface grid mesh was selected for the canyon floor with a uniform volumetric mesh, for the walls A and B was meshed with hexahedral element of 0.07 m on crossing under the building and barrier solid meshed with 0.05 m size elements; the interest region was finer than other region to ensure a good resolution which was used for line source and for building. A mesh with a total cell count of 8 million is selected.

b- Street canyon with central boundary wall

According to the base model that mentioned in Fig.1, the three-dimensional model with LBW, located in the centre of the canyon at height of 0.5 m and strategically located to increase dispersion and potentially reduce pollutant concentrations at street level; with vehicular emissions represented as double line source across the road surface. Fig.2 illustrates a cross section view of three-dimensional of street canyon with LBW center configuration.

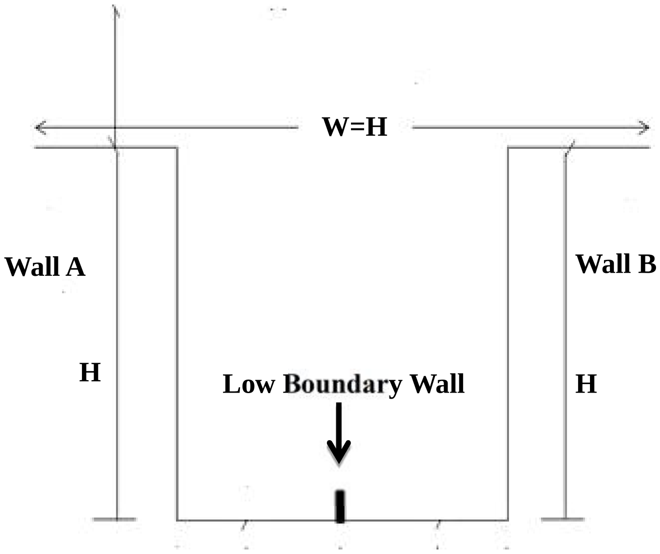


Fig.2 Schematic of sketch of geometry of LBW model

c- Street canyon with passageways under building

Fig.3 shows an example of Canopy model with crossings under the building. The dimension of each crossing is about 18 m in length and 4 m in the height.

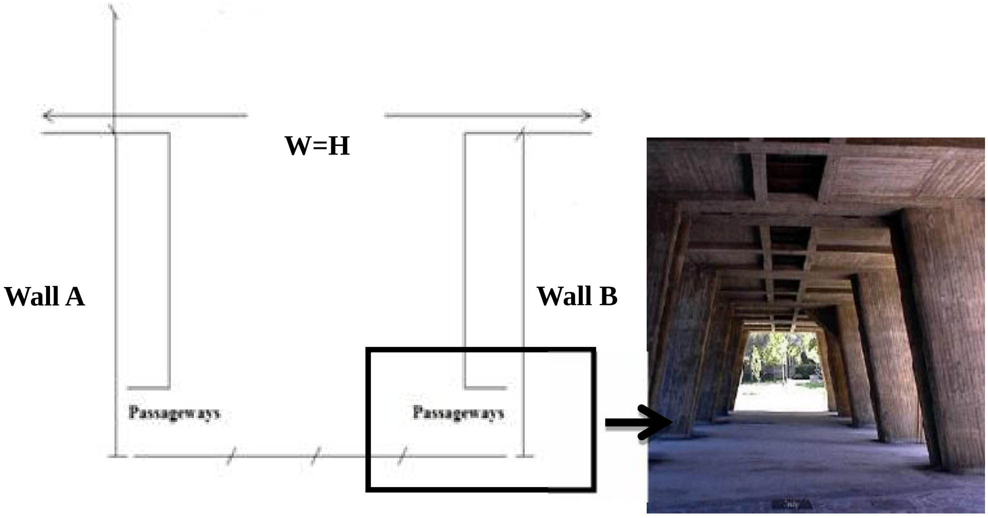


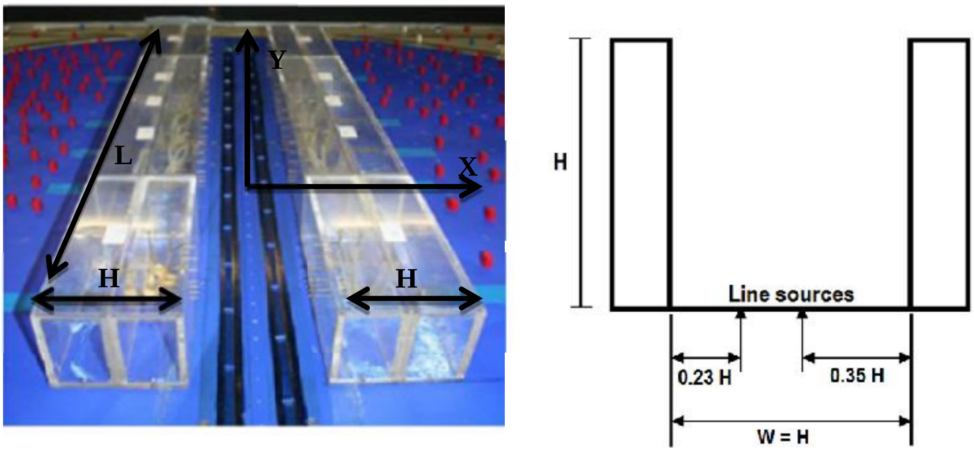
Fig.3. Schematic of sketch of geometry of passageways (crossing) under building

2.2. MODELING APPROACH

2.2.1. Experimental Setup and model validation

The Laboratory of Building and Environment Aerodynamics (*Karlsruhe Institute of Technology*) has been set up to provide detailed information about pollutant concentration in the atmospheric boundary layer, mainly in street canyons, knowing as *CODASC* (COncentration DAta of Street Canyon). Fig.4 shows a configuration of street canyon in wind tunnel and the position of their line source in the road.

The horizontal homogeneity of the turbulent boundary layer is achieved under “empty” computational domain conditions. The term “horizontal homogeneity” refers to the absence of streamwise gradients in the vertical profiles of wind velocity and turbulence quantities, however the inlet profiles are maintained with downstream distance as discussed in [40]. The surface roughness is expressed in terms of a sand grain roughness, while K_s instead of the aerodynamic roughness of z_0 as well as in the most meteorological codes. [15] set K_s equal to the aerodynamic roughness length z_0 which founded to be $z_0 = 0.0033$ m in the wind tunnel experiment. They agreed that setting $K_s = z_0$ was not correct in a strong sense, but justified the choice from the results obtained.



(a)

(b)

Fig.4. (a) Configuration of street canyon in Wind tunnel experiment, (b) Dimension of street canyon used in the experiment by the Laboratory of Building and Environment Aerodynamics (www.codasc.des)

According to the power law formulas (Equations 7 and 8) were reproduced in the experiment test [28-29], [41] the boundary layer of database, concerning level measurements of pollutants concentrations and flow fields were obtained from street canyon are the velocity *u(y)*, profile exponent (α = 0.30) and turbulence intensity I_u, profile exponent (α_I = 0.36).

$$\frac{u(y)}{u(y_{ref})}=\left(\frac{y}{y_{ref}}\right)^{\alpha} \qquad (7)$$

$$\frac{I_u(y)}{I_u(y_{ref})}=\left(\frac{y}{y_{ref}}\right)^{-\alpha_I} \qquad (8)$$

The line sources exceed the width of building by approximately 10% on each side; for taking into account the traffic exhausts released on sidewise street intersections [29]. The tracer gas were carried out in this study was sulfur hexafluoride (SF_6) to simulate the vehicle emissions in this context the emission rate Q was maintained at 10 g.s^{-1}, while C^+ signify the pollutant concentrations of the gas were measured at the canyon walls and normalized according to the Equation (9):

$$C^+=\frac{CHu_H}{Q/l} \qquad (9)$$

With C being measured concentration, u_H flow velocity at height H in the undisturbed approaching flow and Q/l tracer gas source strength per unit length; l is the length of the line source.

2.2.2. Simulation Setup and boundary condition

Two methods of passive control are selected, to get the estimations of effects range of these methods onto the air quality in symmetrical urban roads. For this purpose a barrier solid (LBW) and crossings under the building were introduced in ICEM-CFX code (Fig.2 and Fig 3). The source of the vehicle emission can be taken as double line sources located between the footpath and the barrier in the numerical modeling cases, however the source boundary conditions for emission of the passive scalar was set as "mass flow inlet", wherever a mass inlet flow rate was specified as the specifying the inlet mass velocity U_{in}, normal in the inlet area A:

$$^{\circ}U_{in}A=\frac{dm}{dt} \qquad (10)$$

Where ° is the density and $\frac{dm}{dt}$ is the differential mass per time that introduced to the computational domain, while the passive scalar mass flow rate of 10 g.s^{-1} was set for each case studied.

A logarithmic law takes into account, to show the vertical wind velocity profile of inflow under a neutral stability condition and according to the Eq (7), the inlet wind speed was assumed as a given equation:

$$u(y) = 4.7\left(\frac{y}{0.12}\right)^{0.3} \tag{11}$$

Where $u(y_{ref})$=4.7 m. s^{-1}, is the velocity at y, a higher above the ground, whereas the equations concerning k and £ are givens as:

$$k = \frac{u_*^2}{\sqrt{C_«}}\left(1-\frac{y}{¢}\right) \tag{12}$$

$$£ = \frac{u_*^3}{Ky}\left(1-\frac{y}{¢}\right) \tag{13}$$

K = 0.4, represent Von-Karman coefficient, u_*=0.54 m.s^{-2}, is the friction velocity and the depth of the boundary layer is ¢ =0.5 m.

The No-slipping boundaries are set for the solid boundaries, knowing as wall function boundaries used on the closest grids to the wall. The calculations were performed using the second order accurate upwind schemes; the well-known SIMPLEC algorithm which discussed by [42]; used for pressure-velocity coupling while the convergences for scaled residuals criteria were set at 10^{-6}.

3. RESULTS AND DISCUSSION

3.1. Validation of base model results with measurements data from CODASC

Mean normalised concentration (C^+) profiles at the canyons leeward (Wall A) and windward (Wall B) wells of the refrence model was validated with wind tunnel measurements; the validation shows in Fig. 5; therefore the results are very close to those obtained by the measurement of *CODASC*, this confirmed by the increasing of pollutant concentrations at the leeward, however, its decreased at the windward in the both, reference model and data from the experiment. At ground level, the flow is directed opposite to the atmospheric wind direction (from wall B towards the leeward wall A) and after, the canyon vortex and helical recirculation moves upward and are partially entrained into the atmospheric cross-flow above roof level [28].Two fundamental vortex structures can be identified. These are the canyon vortex in the middle part of the canyon (length) and the corner eddies at the two ends of the street canyon. The corners eddies transport air from the outside environment directly into the street canyon, were provide additional ventilation and lead to lower traffic pollutant concentrations at the street canyon ends.

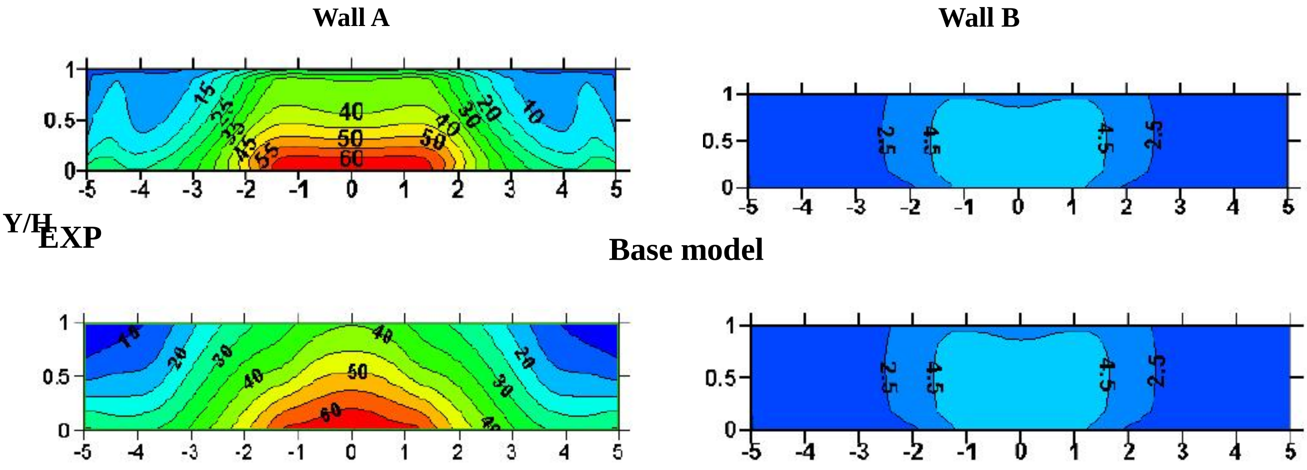


Fig.5. Normalized pollutant concentrations C^+ at walls (wall A and B) in the street canyon for wind tunnel data and numerical simulation (base model).

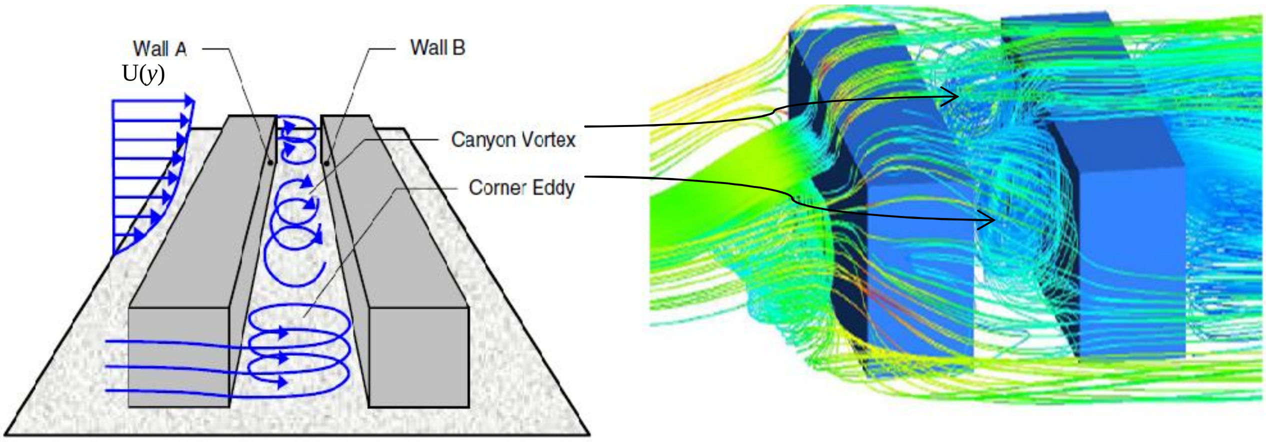


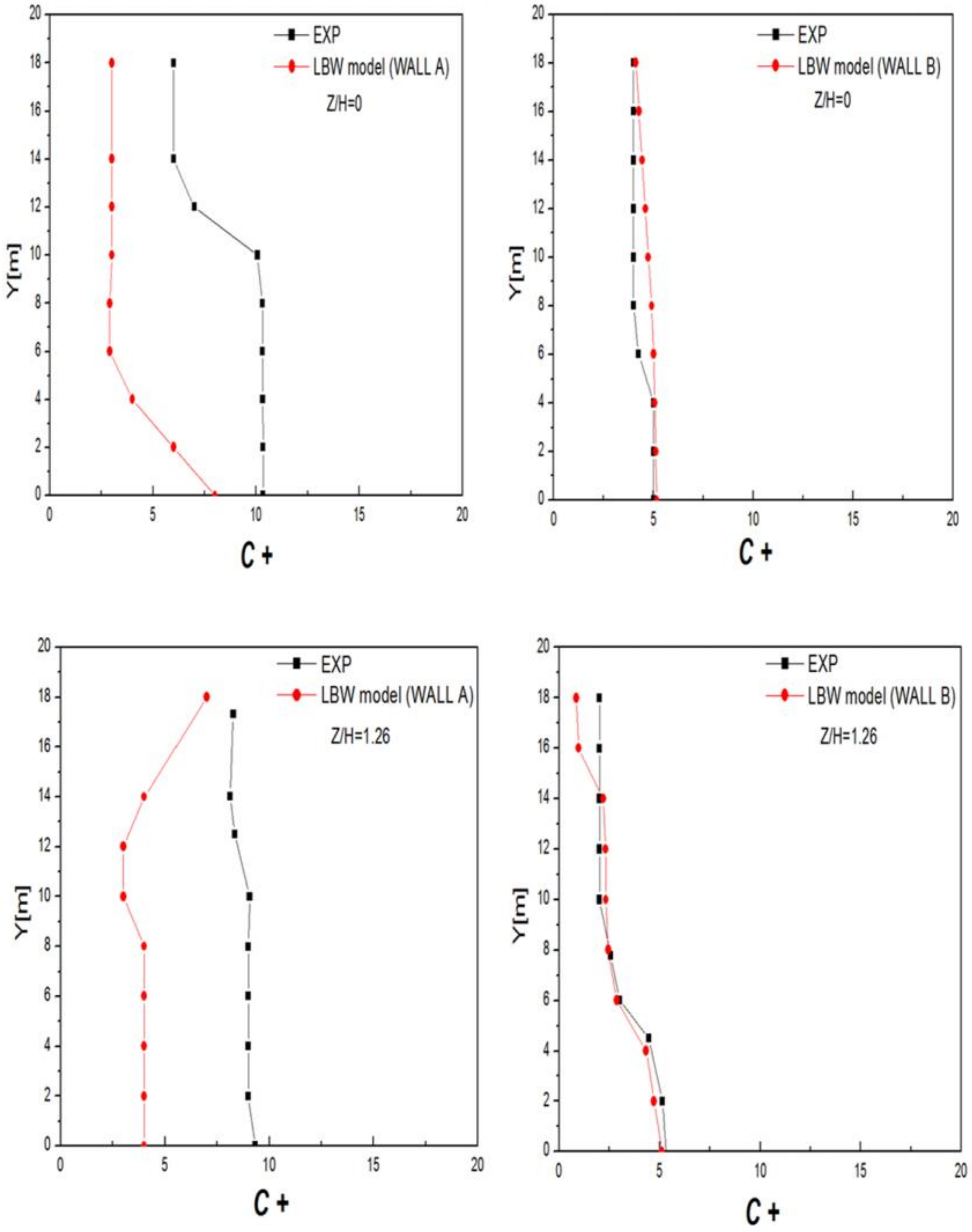
Fig. 6 Flow field and fundamental vortex structures in the street canyon (base model) with aspect ratios of *H/W* = 1

3.2. Comparaison of numerical results of Low Boundary Wall model and CODASC data

The influence of low boundary wall at the air quality, in the urban street canyon has been attracting attention by many research; among them, [32]; they established that an adding of low boundary wall (LBW) in the middle of the road improved the air quality of vicinity of the building and surrounding spaces like breathing for childs and adults.

The numericall results concerning the concentration C^+ that are obtained with ICEM-CFD are shown in Fig.7, from the last fig it can be done the diminishing of pollutant concentration at the wall A, when we compared to leeward wall measurments data, however the same thing happens for windward side, this may explain that the more intense movement of the flow appeared near the upwind region, associated to the vertical velocity when it increased over the roof canyon and it decreased down at the ground surface.

Furthermore, the Fig. 7, represents the quantitative analysis of the concentration profiles at three different vertical positions along both walls A and B, hence the evolution of patterns mean concentration profiles on the walls A and B, related to different altitude, while the centre line is the critical region. From the numerical results that have been compared by the measurement data, it can be found that a high pollutant concentration appeared on the leeward walls, this is due to the wind intensity circulation close to the building; the maximum concentration levels at the leeward side are in the range of $C^+ = 7$ for LBW model; this value has decreased up to the level $H = 8m$ approximately and stabilized out of this height to the value of $C^+ = 3$; however, in the experiment data, the maximum concentrations levels are in the range of $C^+ = 11$; this value is constant up to the height of $10m$ and start decreasing out of that height; in the vicinity of the center line $(Z / H = 0)$ at the windward side, the maximum concentration levels are in the range of $C^+ = 5$.


EXP
LBW model (WALL A)
Z/H=0
Y[m]
C +
EXP
LBW model (WALL B)
Z/H=0
Y[m]
C +
EXP
LBW model (WALL A)
Z/H=1.26
Y[m]
C +
EXP
LBW model (WALL B)
Z/H=1.26
Y[m]
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2
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5
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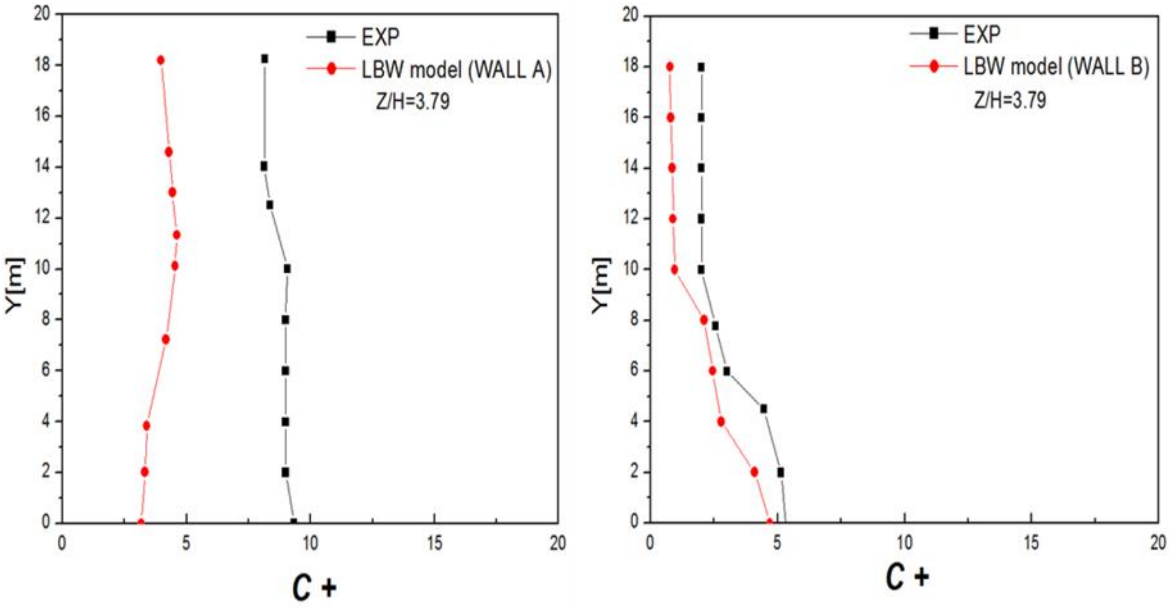


Fig.7. Mean concentration profiles on Wall A (leeward) and Wall B (windward), a comparison of LBW model with data experiment

When the LBW model is applied and away from the critical region when Z/H takes the values of 1.26 and 3.79, the maximum concentrations are in the range of $C^{+}=4$; this value is constant up to the height of $10m$ and start increasing out of that height ranged from $C^{+}=7$, opposed to the experiment data the value of the mean concentation was constant along of the altitude, it's in the range of $C^{+}=4.5$.

Fig.8 shows the contour of normalized concentration data onto the Walls A and B. The comparison of the *CODASC* data to different numerical results of the LBW model, large amounts of pollutant concentration can be founded onto the canyon walls from the experiment, however, at the leeward wall, the normalized traffic pollutant concentration has been decreased once the LBW model be practical in the street canyon, whereas the pollutant charge resulting from traffic released emissions is considerably lower at wall B than wall A. Consequently, the implementation of passive control as low boundary wall provide reduction in pollutant concentration therefore it can improve air quality in the urban street canyon.

3.3 Comparaison between crossings under the building model and CODASC data

The numerical results obtained from the simulation concerning the mean concentration profiles on the leeward and windward walls for testing the model of crossings under building are presented in the Fig. 8, whereas the simulations about crossing and several crossings under building has been evaluated by those taken from the measurement data without including the crossing model (without control passif), where different altitude are tested as the critical position $(Z/H=0)$, and extreme altitude $Z/H=1.26$ and 3.79.

From the Fig. 8, it can be observed that the pollutant concentrations occurred at the both walls A and B has been decreased in the vicinity of the centerline $(Z/H=0)$, the highest pollutant concentrations occur at pedestrian level in the central region of the leeward wall A; when the building is constructed with several crossings under building, however a smaller amount of pollutant concentrations has been marked at the position $Z/H=1.26$ and $Z/H=3.79$

From the mean concentration plot, it can be observed that the maximum concentration $(C^+=2.3)$ established at the leeward side, concerning passageways under building models; whereas, at the height of $12m$ close to the roof of building, quantitatively, the mean concentrations are in the order of 5.6 about the sevral crossings under building model, the same as results are obtained at the extreme region $Z/H=3.79$. The Concentrations decreases towards the ends of street are evidently at the both canyon walls; the results shows a better agreement to the model with several passageways under building than the *CODASC* data; it can be observed from the results mentioned in the Fig.8 that the concentrations peaks in the model with crossings under building are in the range of $C^+=7$ at the leeward side of the ends of the street; other than, the maximum mean concentrations results of the emitted gas from the experiment data are in the range of $C^+=9$ at the windward side.

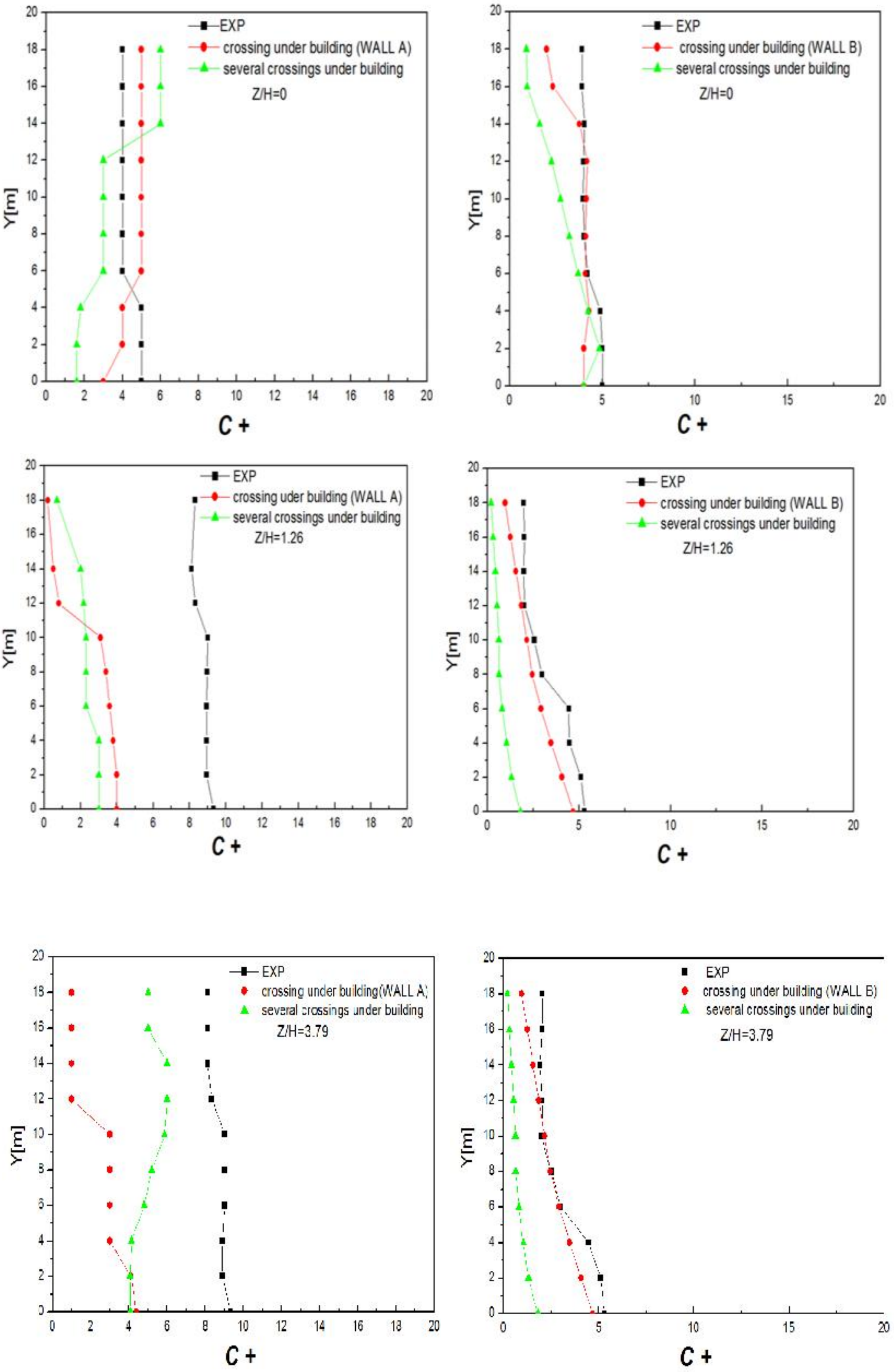
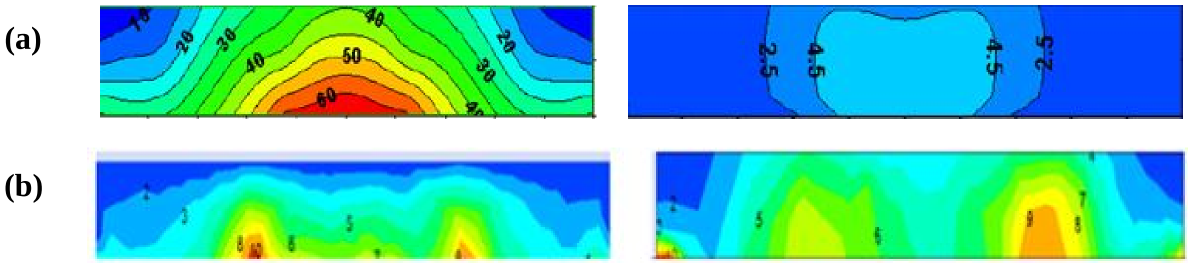


Fig.8. Mean concentration profiles on Wall A (leeward) and Wall B (windward) to compare the different numerical results with single crossing and several crossings under building with data experiment

3.4. Pedestrian comfort inside the street canyon with control passive

Figure 09 shows contour plots of pedestrian comfort at a height of 1.76 m inside the street canyon for the different street canyon cases considered in this study. Cette hauteur peut généralement être considérée comme la hauteur de une personne. the wind speed inside the street canyon near the windward of building increases; was remarkable in the street canyon with crossing under building which explains the ventilation by the gaps. corner streams in fact are also generated by a pressure short-circuiting effect, i.e. around the corners of the building; the corner streams at the passage corners contribute to and merge into the passage jet. At the middle of the windward, can be found as a danger zone in the base case for pedestrians; this is due to the reason that the significant down flow of air at the windward face from the front stagnation point that subsequently enters into the canyon from the ground level. This is due to the reason that the significant downflow of air at the windward face from the front stagnation point that subsequently enters into the canyon from the ground level. That very pronounced increase of wind speed in the canyon is limited to the near ground level and decreases with increase in height in the y-direction. Fig. 09 shows a typical dispersion profile for the central low boundary wall. The impact of this boundary wall configuration provides the reduction in pedestrian exposure; an anti-clockwise major vortex is developed in the street canyon. The presence of the central boundary wall, acting as a baffle, shifts the center of the vortex to the windward side and a second minor vortex is created in the region near Leeward. The pedestrian on the windward side would also experience a drop in pollutant exposure as air flowing down the windward buildings must travel faster due to the center of the vortex shifting towards the windward side. This increased air velocity on the windward side travelling downwards results in a more rapid dispersion of air pollution emissions away from the pedestrian on the windward side.



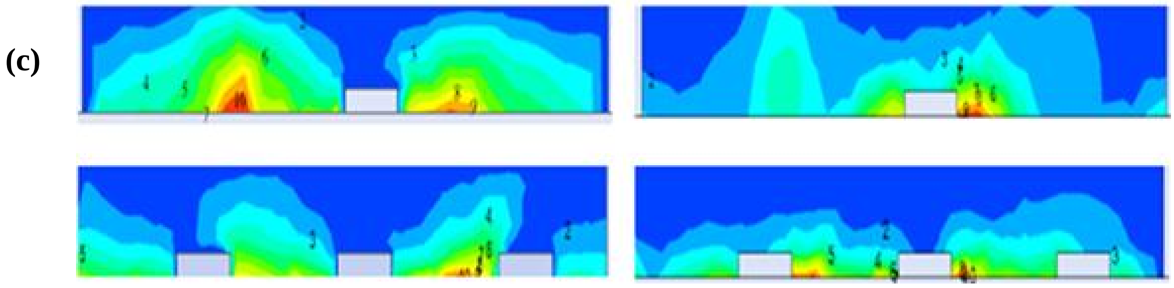


Fig.9. Contour of normalized concentration C^+ on Wall A (leeward) and Wall B (windward) comparing (a) the base model to the different numerical results with (b) the numerical results of LBW (c) crossing under building and to several passageways under building

The contour of normalized concentration obtaning by the simulation of several passageways under building models of wall A and B has been given in the Fig.09. The results presented in last figure are confirmed by normalized vertical velocity V^+; however the distributions of vertical velocity at the middle plane of the canyon $(Y/H=0)$ are obtainable in Fig 10.

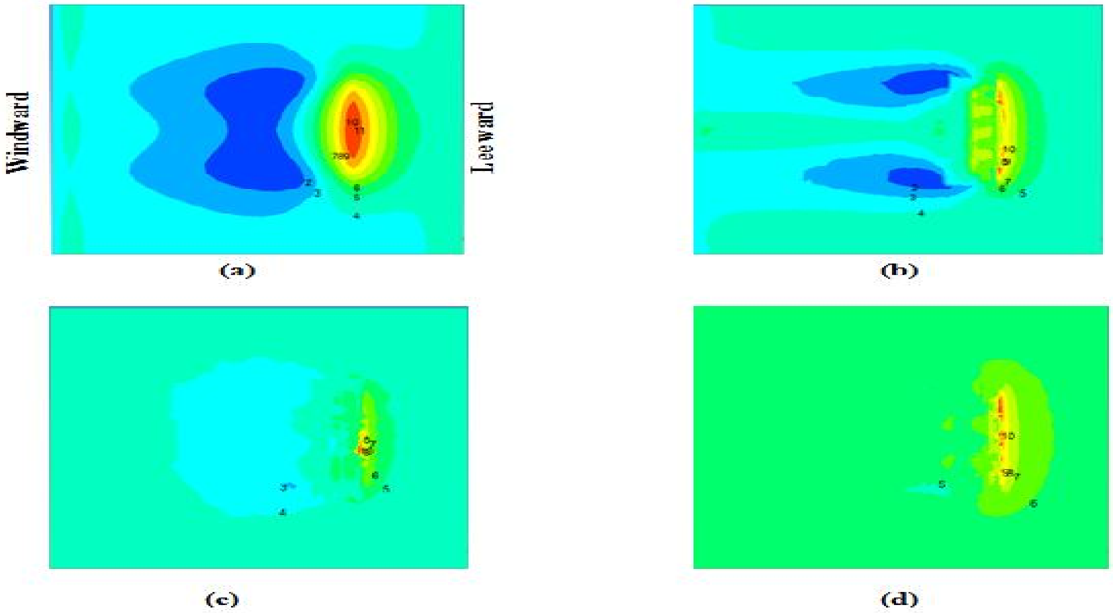
From the Fig.09, the flow fields in middle canyon is dominated by a vortex and not by corner eddies; however, on the outside of the canyon, a superposition of two vortexes structures occurs, forcing the laterally incoming air to move in a helix-type motion into the canyon center, it appears onto the wall A of the wind experiment. Other than the introduced the model of passageways under building provide a falling of pollutant concentrations onto the leeward wall, where the lateral air flow exchanged between the ends and the center of the street canyon, even as the model of passageways under building provoke a natural ventilation around the street canyon, therefore it to permit to cleared the pollutant away from the area buildings.

Fig. 10 account the dynamic effects of pollution concentrations at different altitude. The primitive vortex situated at the right of the top corner of the canyon derived by the shear layer is moving in clockwise direction while the secondary vortex to be found at the right bottom corner of the canyon is progressed in anti-clockwise direction, dominated by the primitive vortex.

The numerical results shows that, another small tertiary vortex moving in anti-clockwise direction be in command of the primative and secandary vortexs, however the obtained results agree with those of measurments data, when the street canyon subjugated by a single vortex rotated in the same wind direction.

The progress of the secandry vortex near the leeward wall has been noticeable when the LBW centre is used, consequently the pollutant concentration amount has been reduced in leeward wall, therefore the traffic emission was dispersed far from the street canyon.

A great variations of vertical velocity distributions has been distinguished between a model with a single crossing and a model with more than crossings under the building, these varitions are due to number of passageways that made under building, in this manner, whenever the number of passageways will be huge, of course all depends the norms of constructions, whenever the distributions of air flow in different sides, will be agreeable for decrease the concentration of pollutant in the street canyon.



(a) (b)

(c) (d)

Fig.10. Normalized vertical Velocity V^+ at mid plane of the canyon at centerline $Y/H = 0$ (a) CODASC data, (b) model with LBW center, (c) model with crossing under building, (d) model with several crossings under building

4. CONCLUSIONS

The interaction of atmospheric boundary layer with the implementations of crossings under building and LBW, particularly in the urban street canyon, is commonly investigated.

A three dimensional (3D) numerical ANSYS-CFX code, rendering it ideal for examining the aerodynamic effects of pollution concentrations, while the employed of Reynolds-averaged Navier–Stokes equations and the enhancement by k-ε turbulence model provides numerical predictions of qualitative agreement to experimental observations.

As a result, it is reasonable to assure that under dynamic wind field and traffic flow, the presence of crossings under the building and LBW alters the distribution of the airflow structure inside the street canyon, forming a major vortex affect the pollutant distributions inside and outside the street canyon.

the diminishing of pollutant concentration at the leewards and windward sides, caused by the intense movement of the flow appeared near the upwind region, associated to the vertical velocity when it increased over the roof canyon and it decreased down at the ground surface.

A good correlation was found between the model simulation concerning the normalized concentration where different altitudes are tested and measurement data from CODASC. Large amounts of pollutant concentration can be found onto the canyon walls from the experiment, however, the normalized traffic pollutant concentration has been decreasing at the leeward wall, once the LBW model and crossings under building have been practicing in the street canyon, from the results the peak of mean concentrations on the leeward and windward walls are jointly affected by wind speed, LBW, crossings under building band vehicle flow.

A great variations of vertical velocity distributions has been distinguished between a model with a single crossing and a model with more than crossing under the building, these variations concerning the wind speed are due to number of passageways where the major vortex expanded inside the street canyon, in this manner when the air is at the compressing stage, the presence of passageways under building and LBW increases the pollutant concentrations at the bottom center, but reduces the pollutant concentrations at the windward and leeward.

The model of passageways under building provoke a natural ventilation around the street canyon while the LBW centre is used to create a vortex near the leewards, allows the change of wind speed which would induce a mass exchange between the internal and external air. Such exchange could improve the pollutant diffusion inside the street canyon, therefore the realization of the both models inside the urban street canyon permit to disperse the traffic emission pollutant away from the area buildings.

Consequently, the implementation of passive control as low boundary wall and passageways under building reduction the pollutant concentration, therefore it can improve air quality in the urban street canyon.

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