Tertiaire sans clim

envirobat Réunion avril 2011

Les bureaux de

l'Ilet du centre

à Saint Pierre

données

Maître d'ouvrage
Jean Michel et Marie Claude Luspot
Architectes
2apmr + APA
LEU Réunion *environnement*
Position : centre ville de Saint pierre
altitude 75 m ngr moyen
Commune de Saint-Pierre (centre-ville)
Année d'achèvement: 2008
66 logements (du T1 au T4)
312 m² de bureaux
SHON 4123 m²
COS: 1

Occupation des bureaux
depuis Février 2008
Occupation des logements
Depuis janvier 2008 et janvier 2009

Photographie Hervé Douris


Terrain de l'opération
ST-PIERRE
Basse Terre
les Bas
N 3
Stade
C. commercial
Gymn.
Lyc.
Chem.
Coll.
Tribunal
Mché
Radier
Hôt. de V.
Casino
Anc. fr a ch.
Gend.
Pris.
Plage
Feu
de l'Épi Jacob
Source du Bassin Bleu
PLAN DE SITUATION


LA REUNION


Rue Joseph Hubert
Limite de propriété
3.00
4.00
Rue François Isautier
4.00
Cloture existante
N
PLAN DE MASSE
0
5
10
15

Conception bioclimatique

L'ilot urbain

Surfaces vertes

Espaces verts
1480 m²

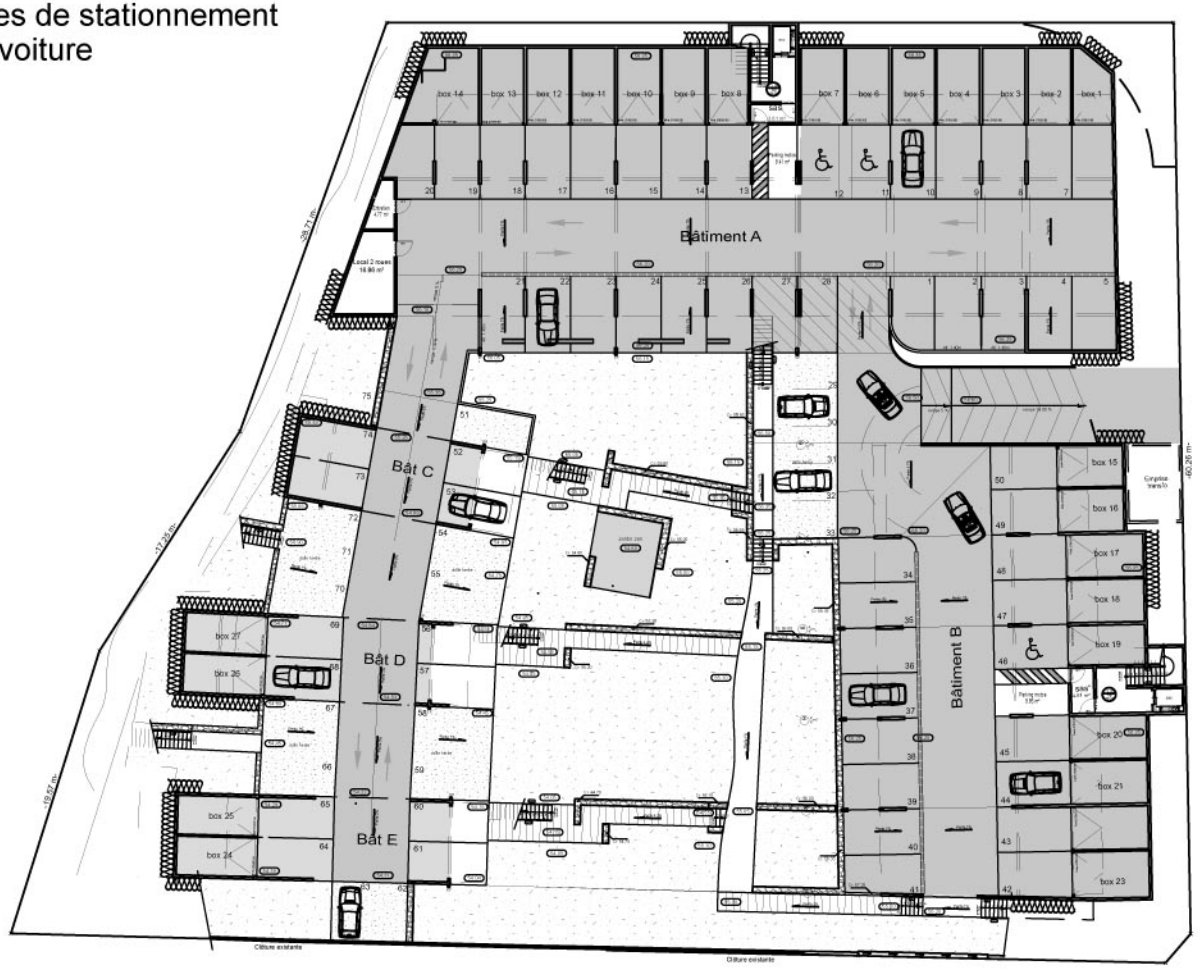
Dalle herbe
260 m²

Toiture végétalisée
60 m²

Surfaces grises

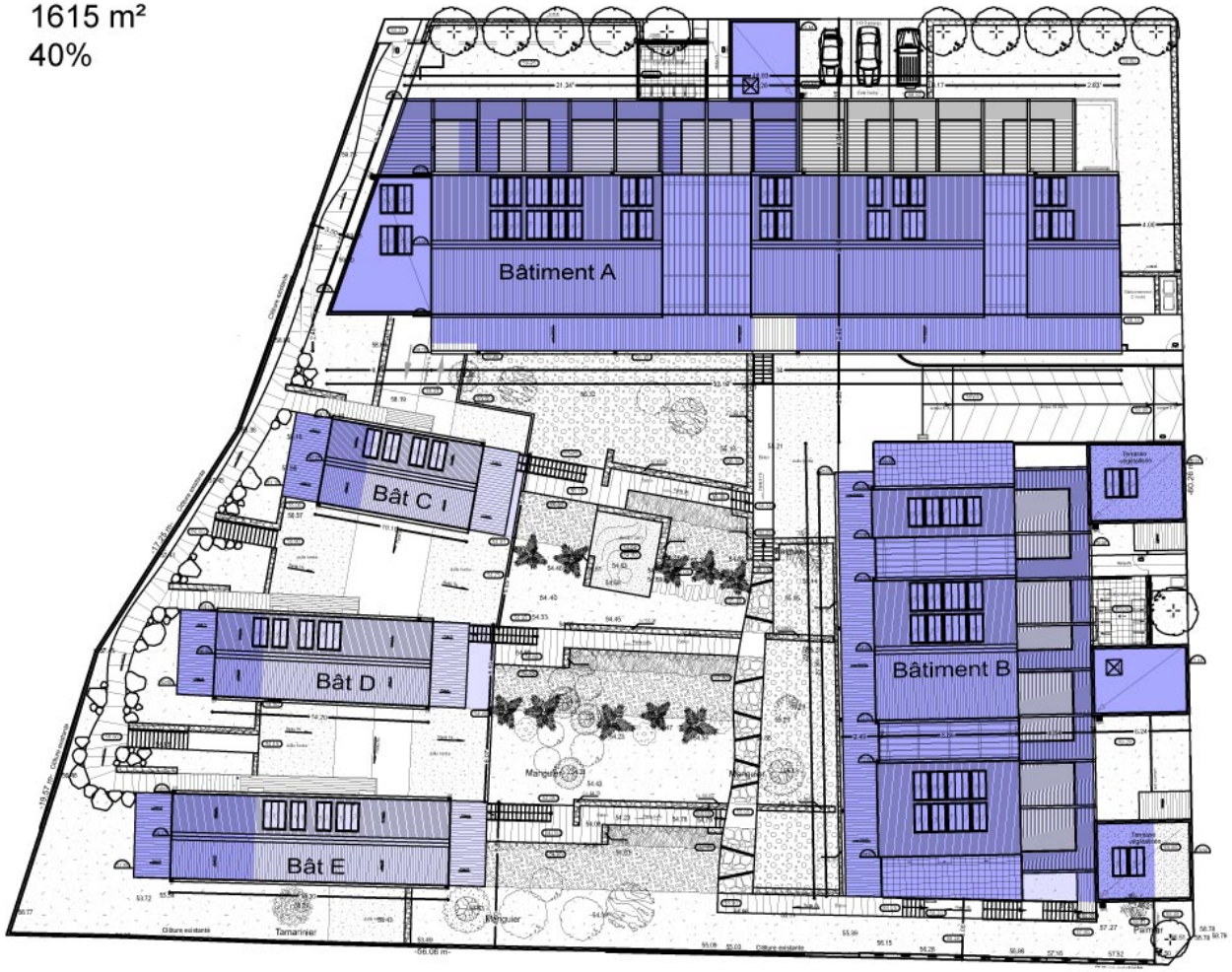
1745.45 m²

99 places de stationnement
17.6m²/voiture



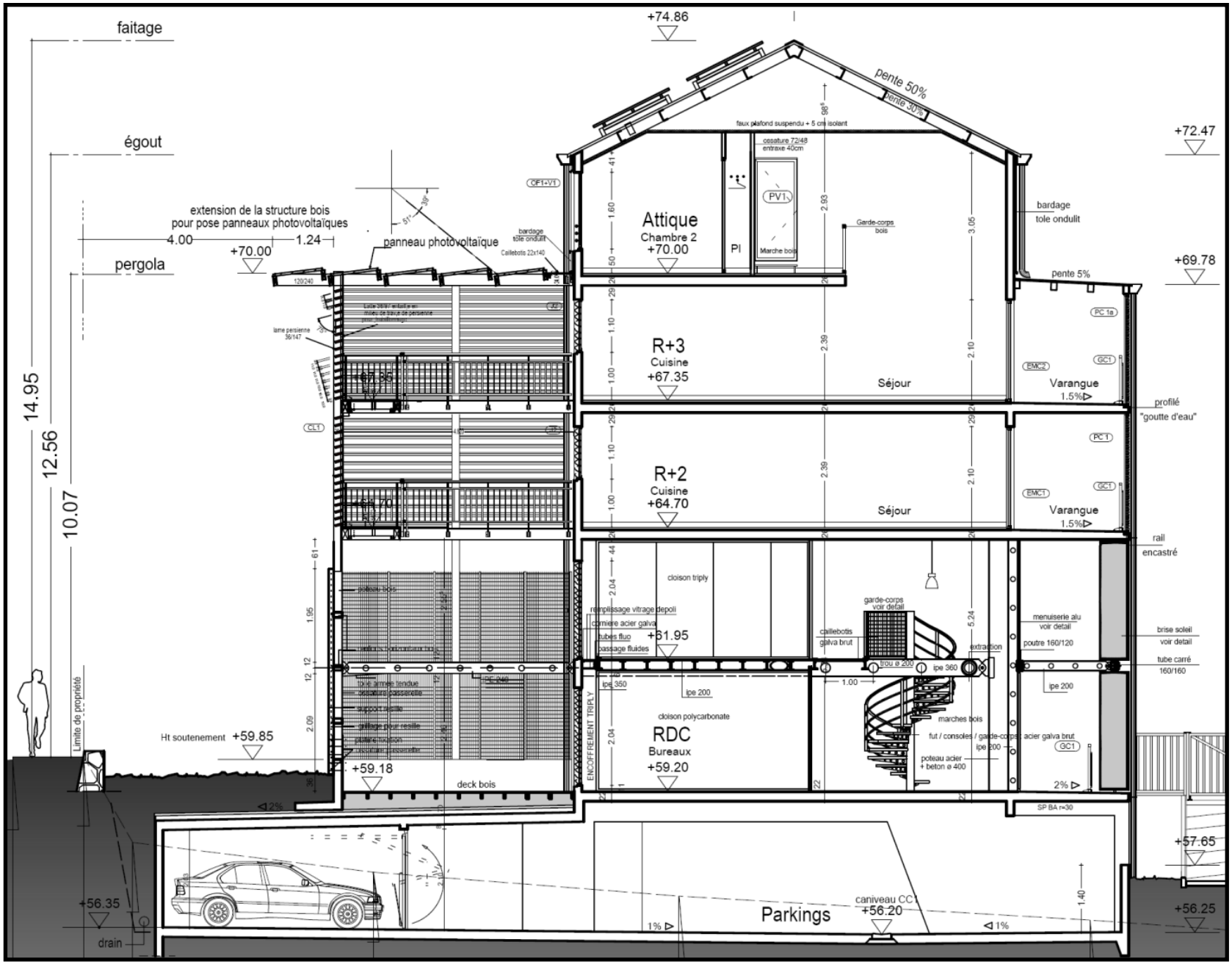
Emprise au sol

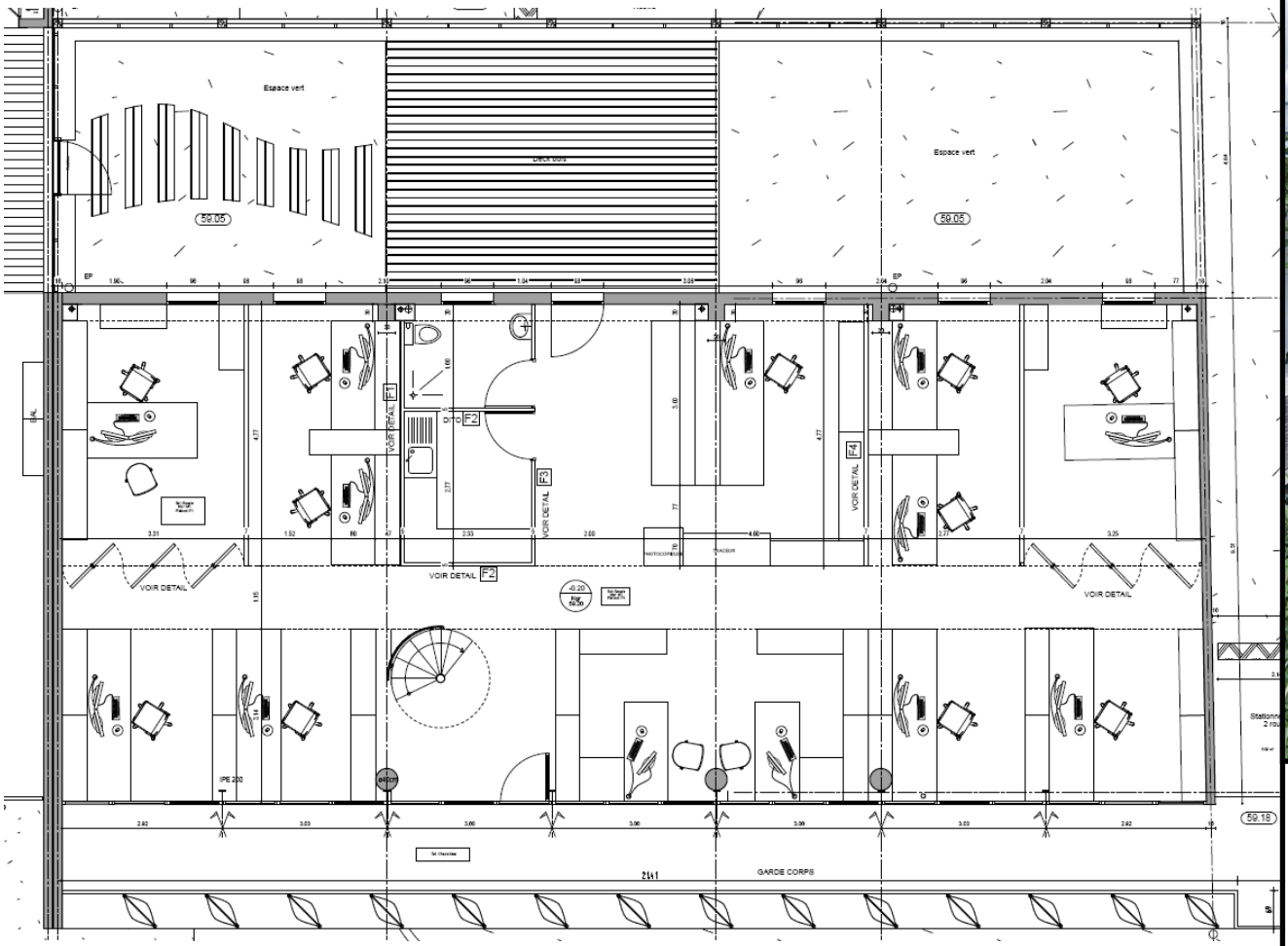
1615 m²
40%

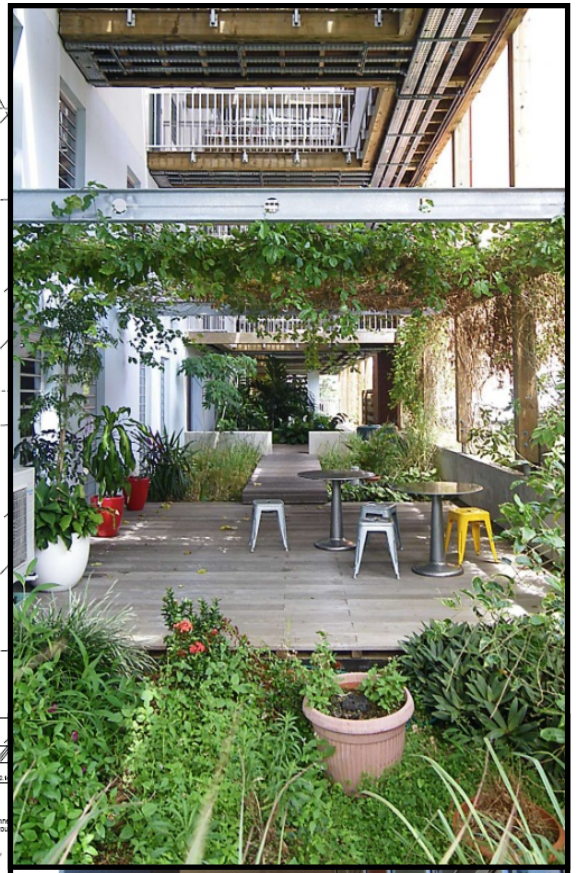


Conception bioclimatique

Les bureaux


faitage
égout
pergola
14.95
12.56
10.07
+74.86
+72.47
+69.78
pente 50%
pente 30%
faux plafond suspendu + 5 cm isolant
ossature 72/48
entraxe 40cm
PV1
Attique
Chambre 2
+70.00
PI
Garde-corps
bois
Marche bois
bardage
tole ondulit
pente 5%
extension de la structure bois
pour pose panneaux photovoltaïques
4.00
1.24
+70.00
panneau photovoltaïque
bardage
tole ondulit
Caillebotis 22x140
R+3
Cuisine
+67.35
Séjour
Varangue
1.5%
profilé
"goutte d'eau"
PC 1a
GC1
EMC2
R+2
Cuisine
+64.70
Séjour
Varangue
1.5%
PC 1
GC1
EMC1
rail
encastré
cloison triply
garde-corps
voir detail
remplissage vitrage depoli
cornière acier galva
tubes fluo
passage fluides
+61.95
caillebotis
galva brut
extraction
menuiserie alu
voir detail
poutre 160/120
brise soleil
voir detail
tube carré
160/160
trou ø 200
ipe 360
ipe 350
ipe 200
ipe 200
cloison polycarbonate
RDC
Bureaux
+59.20
marches bois
fut / consoles / garde-corps acier galva brut
ipe 200
poteau acier
+ beton ø 400
GC1
2%
ENCOFFREMENT TRIPLY
Ht soutenement
+59.85
+59.18
deck bois
2%
SP BA r=30
+57.65
+56.35
drain
Parkings
caniveau CC1
+56.20
1%
1%
+56.25
Limite de propriété





Plan d'aménagement du RDC et double peaux

Au nord la pergola urbaine desservant les logements

Au sud les pares soleil et la coursive pour les incidences solaires d'été en soirée

Bureaux: diminution des charges internes (informatique)

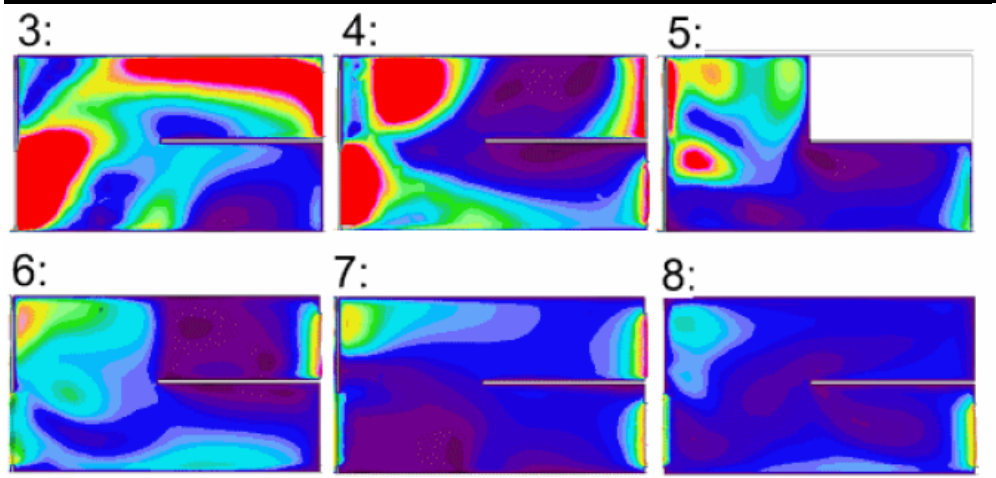
Postes de travail: écran + clavier + souris

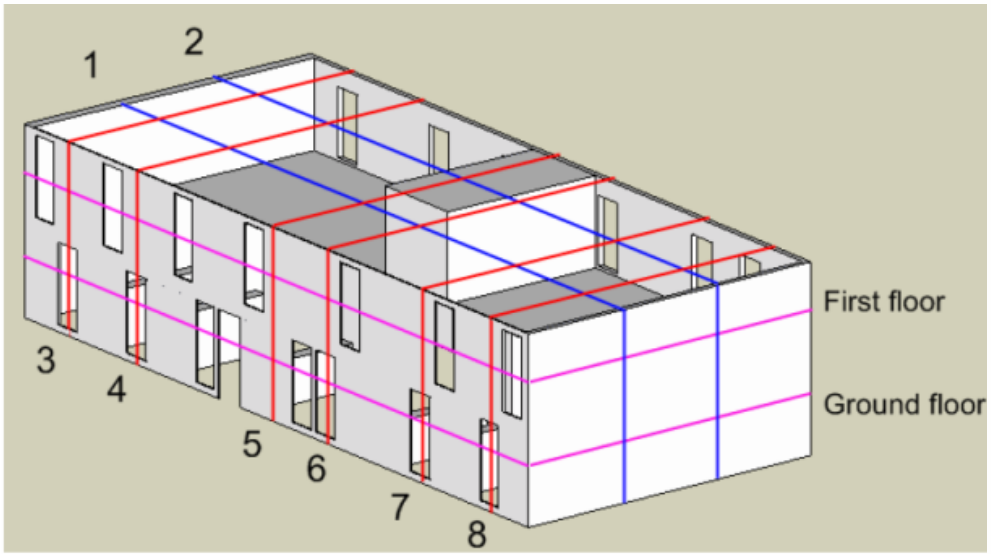
Unités centrales: regroupées dans local informatique sécurisé et climatisé

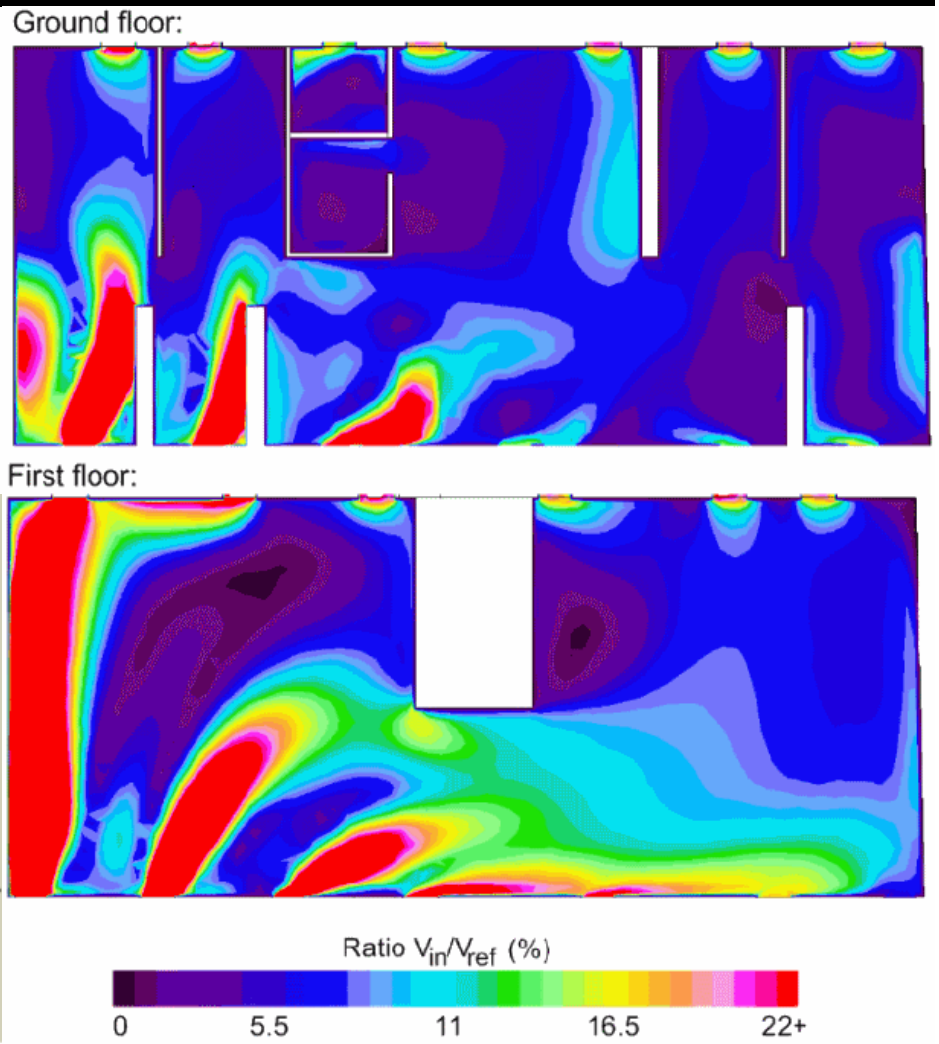
simulations numériques du confort thermique

CFD sur les écoulements d'air en ventilation naturelle

Une étude de thèse en mécanique des fluides par Xavier Gillard







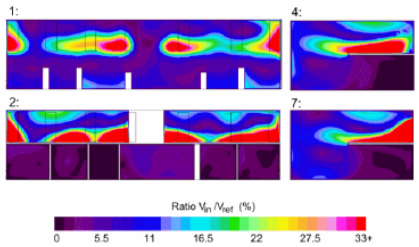


Figure 3: Results for the night thermal breezes simulation on cross sections

3.2 Thermal Simulation over a Complete Year

Once calibrated, the numerical model was used to perform a simulation over an entire year. The results — mean operative temperature and relative humidity in the offices during working hours — were then plotted on a psychrometric diagram. Three zones were defined to assess thermal comfort: one corresponds to still air, the second corresponds to airflow of 0.5m/s (corresponding to strong trad winds, see above), the last one, corresponds to airflows of 1 m/s, which can only be achieved by the use of ceiling fans.

The conclusion is that thermal comfort can be achieved with natural ventilation airflows between May and October; in March, April and November, the use of ceiling fans is often required; from December to February, it is mandatory almost all the time.

3.3 The Drawback Effect of Natural Ventilation

Five scenarios were then defined and modelled, in order to understand the building's behavior in more details: natural night cooling, mechanical night cooling, closed offices (with and without night cooling), absence of shading devices.

The first conclusion drawn from these analyses is that, despite the high air change rates involved by natural ventilation, the operative temperature is maintained below the external air temperature almost all the year long. The importance of this conclusion does not lie in the fact that difference of temperature is positive (it is indeed on the order of 0.2° C), but rather in the fact that it is not negative. The fact that natural ventilation can hardly lead to air temperatures lower than the external one constitutes already a high disadvantage, if the radiant temperature tended to rise the effective temperature, the results would be even worse.

3.4 Note on Night Cooling

The second conclusion, more important, is that night cooling, not yet implemented but considered as an option for improving the existing, thermal conditions would results in a low impact on the operative temperature during the working hours.

First, the CFD and thermal simulations, as well as measurements, proved that night ventilation would not be homogeneous in the whole offices.

Assuming an efficient night ventilation, and closing the offices openings does not help 4. The heat exchanges by ventilation, or through the non insulated walls, glazing elements and floor, would rise the air temperature to a point such that the effect of the diminution of the radiant temperature are negligible.

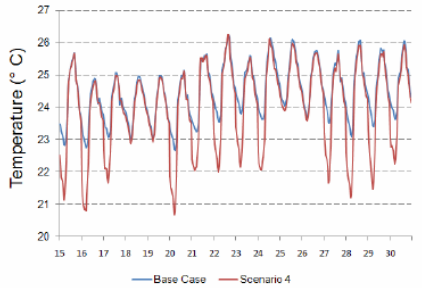


Figure 4: Comparison of the base case average operative temperature to that of the fourth scenario (closed offices during the day, efficient ventilation a night), for the moderate period.

4 Conclusion

The dynamic thermal simulations presented above are expected to be of good quality. Extensive access to the building's characteristics was allowed, sensitivity analyses were performed for the uncertain assumptions and a comparison to measurements was carried out.

CFD simulations, on the other hand, should be considered with more caution. For resource limitation considerations, the model was indeed drastically simplified, and only three scenarios were investigated. However, they are assumed to provide an acceptable description of the internal airflows, as well as a good indication on the highest achievable velocity magnitude.

Put together, the results of these two types of simulations, together with a measurement campaign allowed to draw different conclusions on the building's behavior:

— thermal comfort within the offices is achievable all the year long, either by natural ventilation (from May to October), or with the help of the ceiling fans; — a night cooling strategy, either natural or mechanical, would have little effect on the daytime thermal comfort.

References

[1] Projet PERENE - PERformances ENErgétiques des bâtiments à la Réunion - rapport final. Technical report, INSET, 2004.

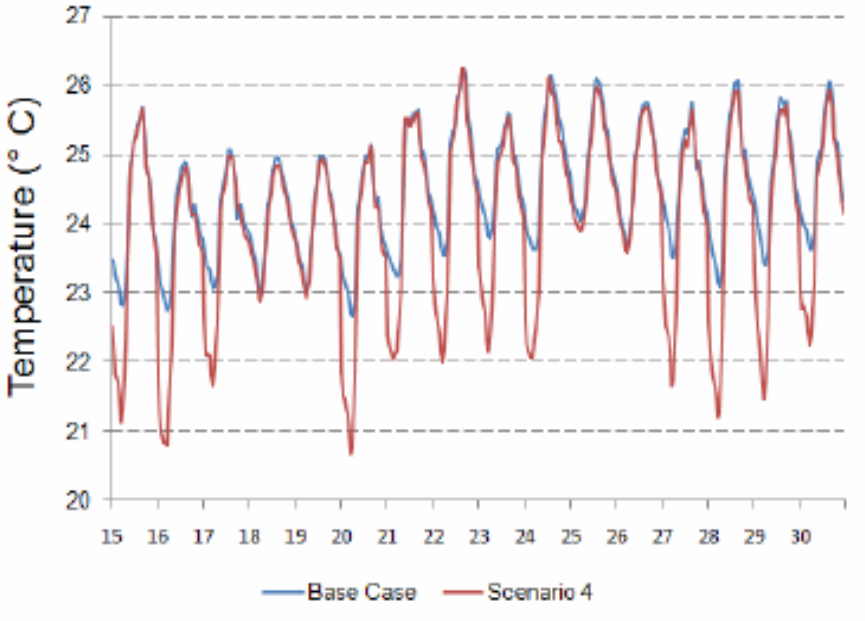


Figure 4: Comparison of the base case average operative temperature to that of the fourth scenario (closed offices during the day, efficient ventilation a night), for the moderate period.

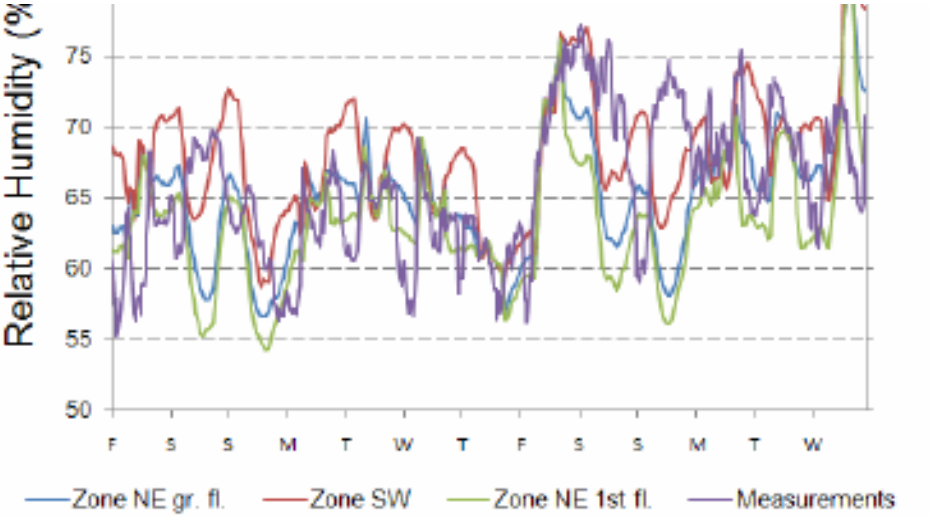


Figure 2: Comparison of humidity results to measurements for the thermal model calibration.

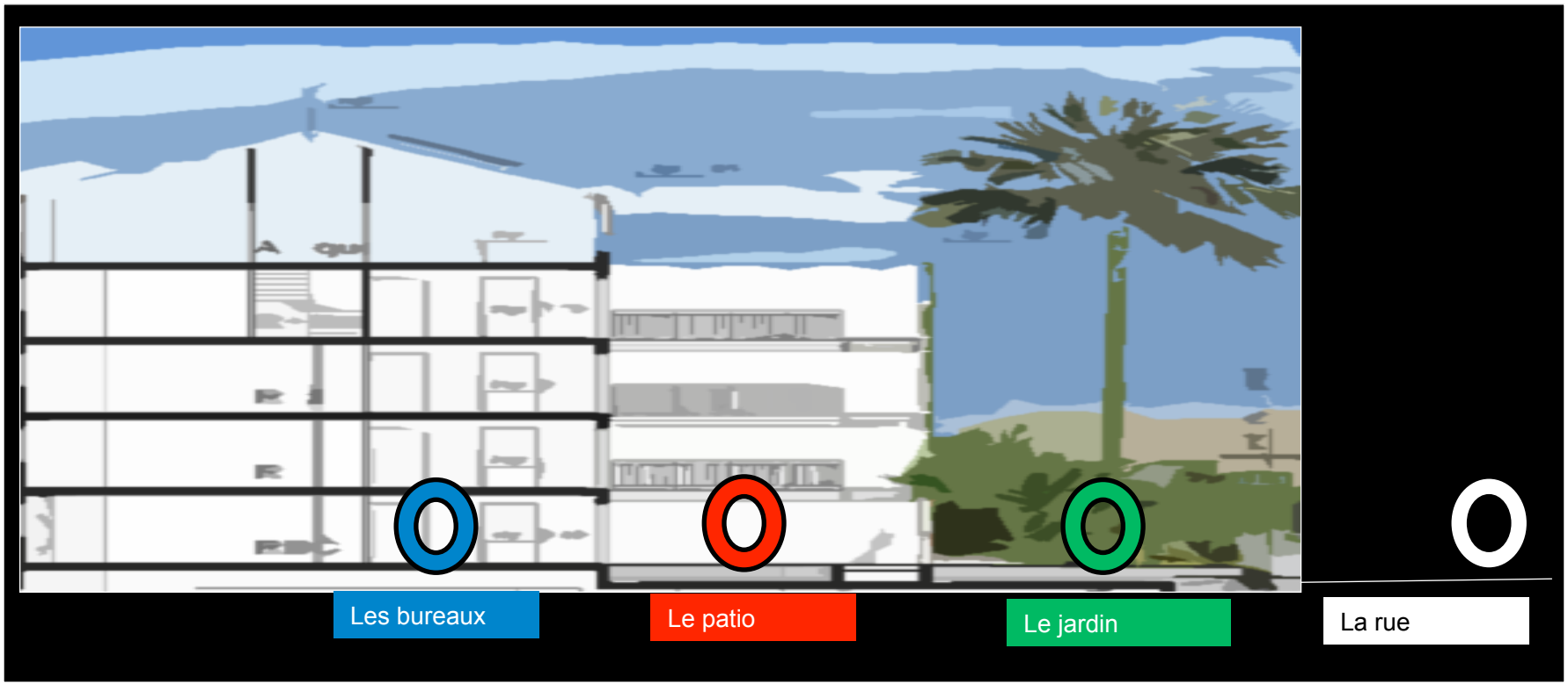
Retours d’expérience

Occupation des bureaux depuis Février 2008

ETUDE DU CONFORT THERMIQUE

<u>Période:</u> Eté austral, du 25 Février au 25 Mars 2011

Enregistreurs de donnée de température et d'humidité relative

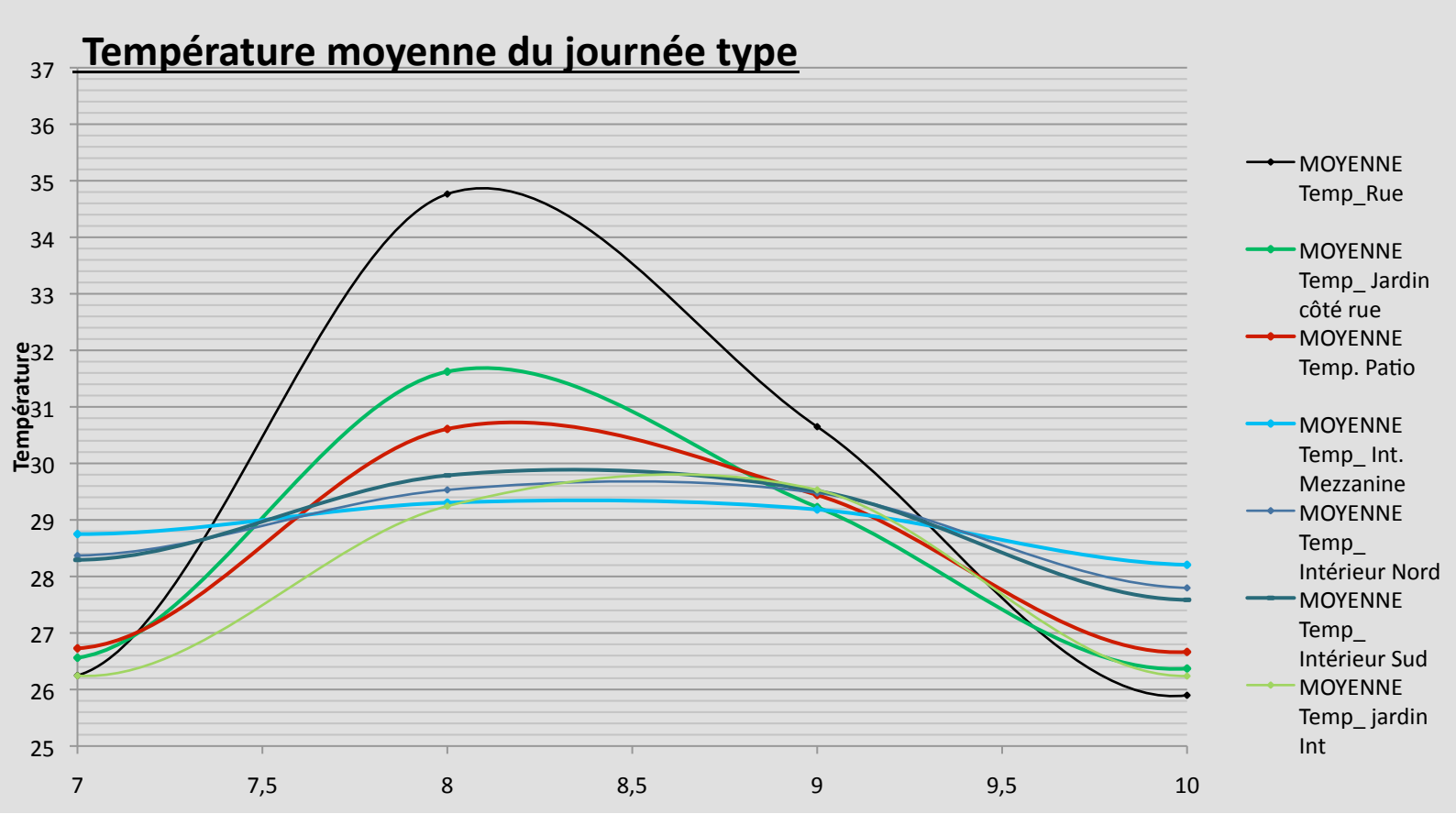


RESULTATS:

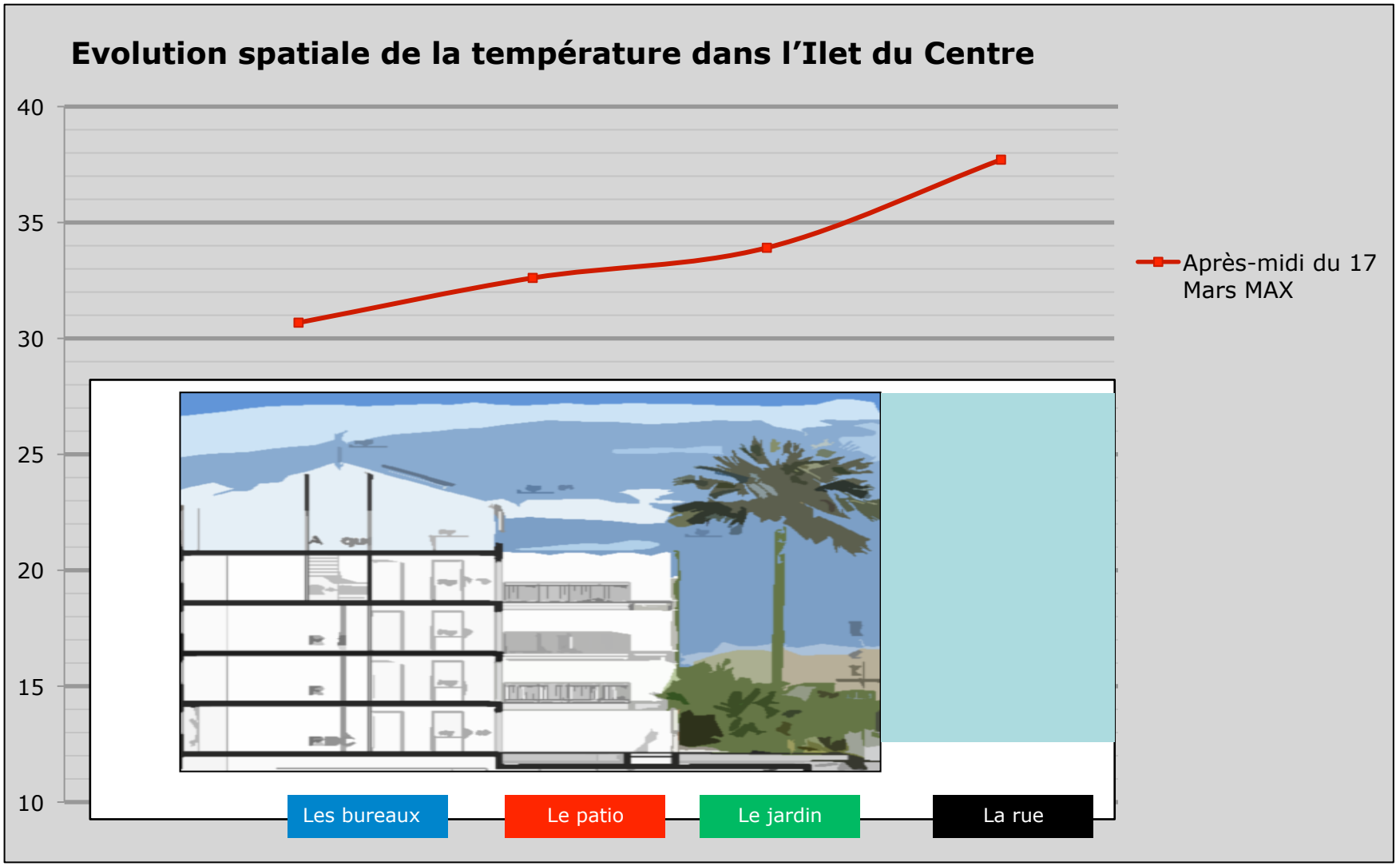
<u>Etude globale (1 mois) en période d'été</u>

Pendant les horaires de bureau, *de 8h00 à 18h00*

- Température moyenne dans la rue 32,86°C
- Température moyenne dans les bureaux 29,29°C



Evolution spatiale de la température dans l'Ilet du Centre




MICHEL
FABIEN
DANA

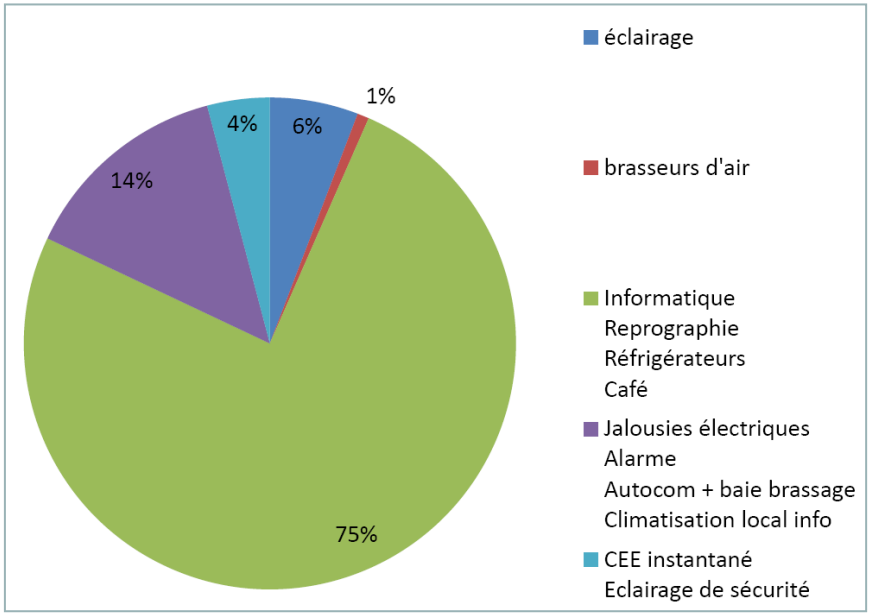
Bureaux: consommation énergétique

Surface totale: 310 m² utiles

Parc informatique: 20 ordinateurs personnels, 1 serveur, 2 onduleurs centralisés

Consommation électrique totale: **63 kWh/m²/an** (tous usages, mesures entre le 1er mars 09 et 1er mars 10)

Répartition des consommations:



Consommation électrique hors informatique-repro-cuisine: **15 kWh/m²/an**

Bureaux: consommation énergétique

	Bâtiment bureaux standard (Réunion)	**PERENE 2009**	**Ilet du Centre**
kWh/m2/an*	**135**	**93**	**15**
Surface climatisée	70 %	70 %	3 %

•Consommation électrique en énergie finale hors process ; surfaces utiles

•**Les 3% de clim sont utilisés pour le process et non les conforts des usagers**

Optimisations possibles:

- Améliorer l'éclairage naturel
- Serveur informatique central
- Comptabilité énergétique


Merci de votre attention