

Large Light-wells to revitalise a deep office building in Lausanne

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Abstract. The city of Lausanne is built on fairly steep slopes, with the consequence that some buildings are leaning against what could be described as cliffs and, therefore, have only one glazed facade. The Rue Saint Martin office building has been built during the 1970s. Because of its important depth (~23m from the façade), the spaces located at the back were totally deprived of natural light. During the renovation of this building, the architects wanted to create large openings in the roof and in the floors' slabs in order to provide daylight to the rear spaces. The close collaboration between Estia¹ and Archespace² allowed for the design and implementation of an efficient system that provides a new quality of use for the interior spaces and a new identity for the building.

1. Issues / Aim of the project

The refurbishment of the Rue Saint Martin office building was initiated in 2017. Built on the slopes of the old city of Lausanne, the initial building had only one glazed façade facing south-east (Fig. 1).

Due to the large depth of the building (~23m), the areas located at the back did not have access to daylight. These areas were therefore used as depots and had a low rental value.

In order to revitalize these areas, it was decided to get natural light from the roof and to create large light wells. This paper describes the choices that were made to maximize the performance of these daylighting systems, shows the results obtained and the way in which users have appropriated this equipment.

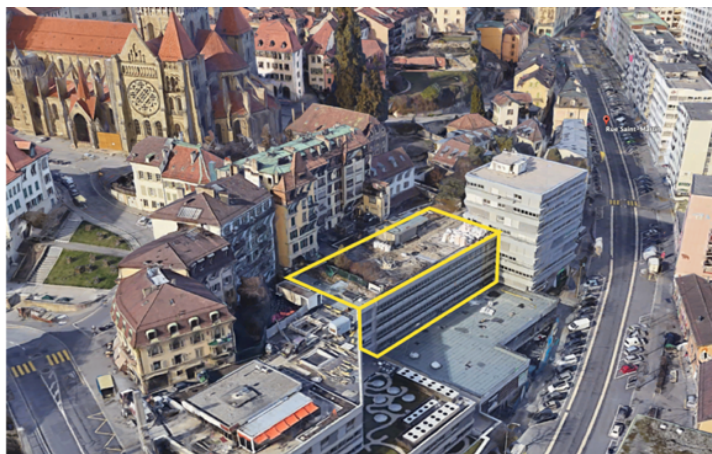


Figure 1: Location of the building at the foot of the old town of Lausanne.

2. Methodology

The first step consisted in defining the possible areas of implantation of the wells in concordance with the vertical circulation areas and the site configuration.

The next steps were devoted to the definition of the geometry and photometry of the different walls of the well.

Finally, the question of artificial lighting was studied in order to activate the wells when natural light is lacking.

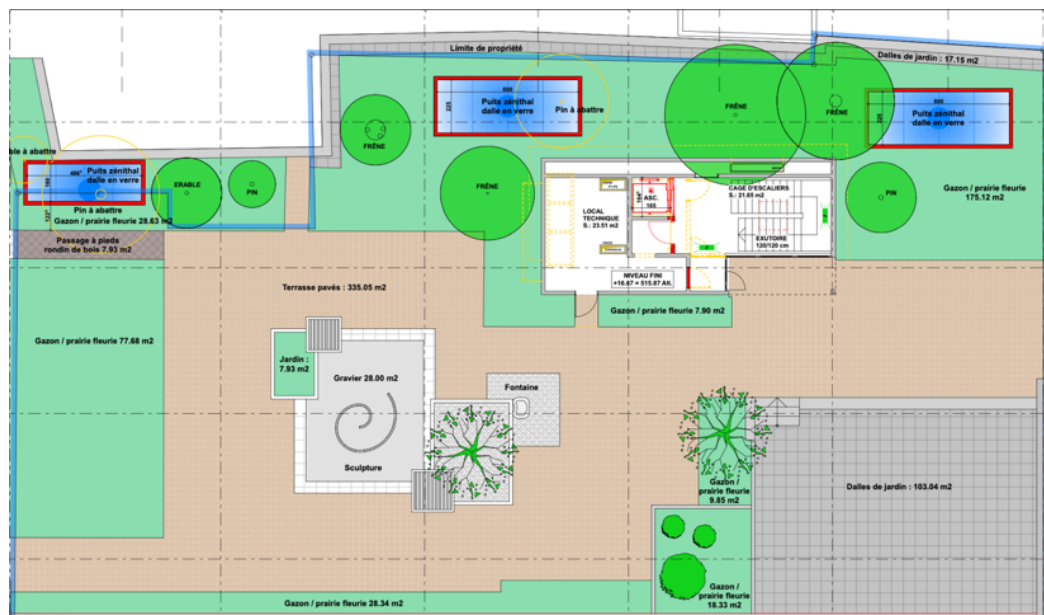
3. Light-wells location

Due to the configuration of the building, 3 wells were planned. These are distributed across the width of the building to better spread the light over the areas located at the back (cf. blue areas in Fig 2).

It was decided that the skylights would serve the upper 4 levels of the building (cf. Fig 3). This correspond to the floors dedicated to administrative offices.

The possibility of using the same duct for both daylighting and natural ventilation, which would have been interesting to activate the free cooling potential, was ruled out for the following reasons:

- Fire protection: airflow through the light duct poses a compartmentalization problem (a separate duct for each level) that would result in significant absorption of light rays.
- Acoustics: Airborne sound transmission through "open" light ducts might be problematic.
- Maintenance: Air circulation in the light ducts would result in dusting of the walls and a potential reduction of the reflection factor.



4. Light-wells definition

4.1. Geometry

The basic principle was to maximize the size of the canopies in order to increase the incident light flux at the top of the wells. Then, we adapted the width of the shaft to the slope of the cliff against which the building is leaning (Fig 3 **Erreur ! Source du renvoi introuvable.**).

As a result, the maximum width at the top of the wells is 3.00m, while the minimum width is 1.70m at the bottom. The total depth of the shaft, from the top canopy to the floor of the first floor is 13.20m. The fact that the back wall is slightly inclined upwards allows it to appear clearer as the angle of vision of the sky is more favorable.

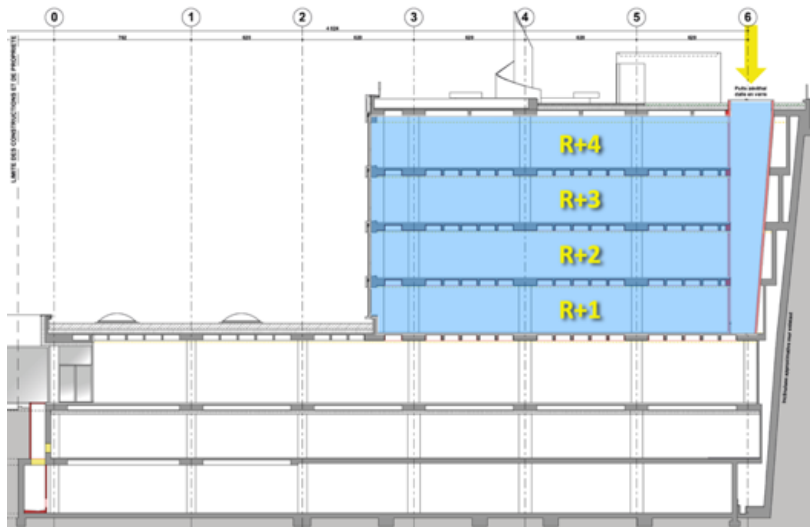


Figure 3: Schematic section of the implementation of the light wells.

4.2. Photometry

- Back-wall: This wall is very important because it is in direct correspondence with the eyes of the occupants of the building. It must appear very clear to create a luminous call towards the back of the premises. This wall has been covered with matte white panels with a ~ 0.90 reflection coefficient.
- Sidewalls: These walls receive a lot of light as their viewing angle to the sky is relatively large. They have been treated in the same way as the back wall.
- Front-Wall: These walls are made of large glass panels to distribute light to each floor. For the opaque parts, which correspond to the thickness of the floor slabs and which are not visible to the occupants, it was recommended to cover them with a light color slightly tinted with yellow. The objective was to warm up the light tint in order to avoid that it appears too pale at the beginning and end of the day.

5. Simulations

5.1. Daylighting

For daylight purposes, the simulations were made with Daylight Visualizer [1] on the basis of a 3D model (Sketchup file). Daylight Factor values were then calculated for each floor in order to determine the influence of the light wells.

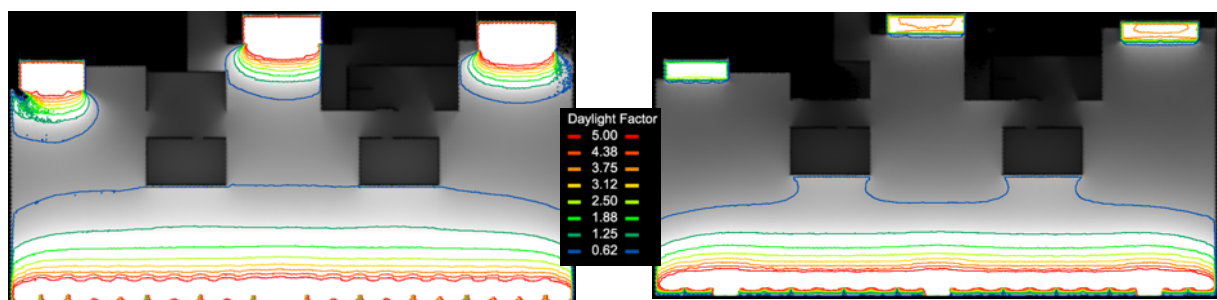


Figure 2: Daylight factor values on the 4th floor with (left) and on the 1st floor (Right) (Daylight Visualizer simulation).

On the left-hand side of Figure 4 we can see that, on the 4th floor, the area of influence of each of the skylights is equivalent to about twice the area of the skylight itself. This confirms that the contribution of the light is relevant and that it causes a radical change in the lighting environment of this floor.

For the lower floors, the contributions decrease gradually, and on level 1 the area of influence does not exceed the surface of the skylight itself (right-hand side of Fig. 4). In this case, the light inputs do

not have an impact on the quantitative level, but the light appeal at the back of the building is still present and contributes to connecting this area with the outdoor (cf. Fig. 8).

Figure 5 shows the luminance and illuminance values on the back wall of the skylight as well as the daylight factor value at each floor slab level. As an indication, the DF value of 7.5% calculated at the bottom of the shaft, allows to obtain a value of 500 lux during more than 80% of the time between 8am and 6pm (DIAL+ simulation [2], Lausanne climate data).

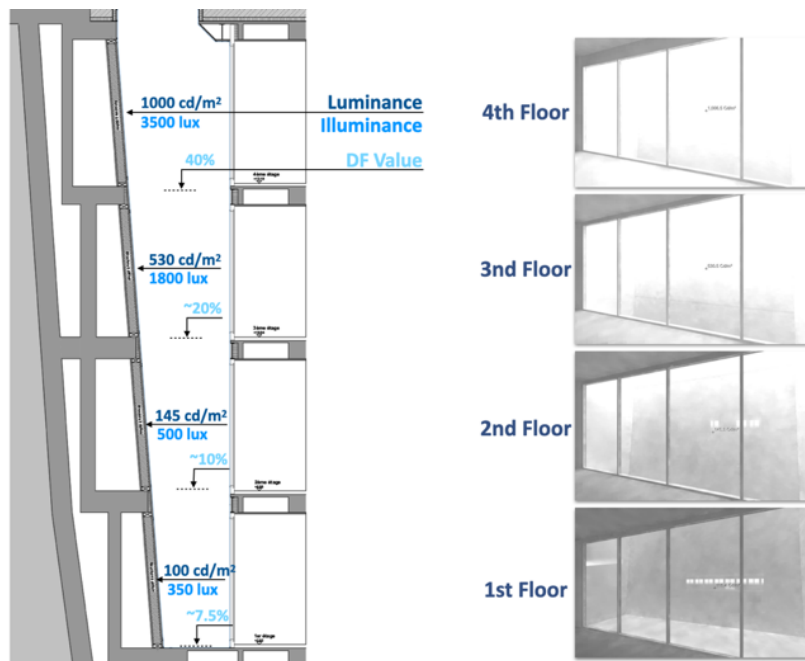


Figure 5: Luminance, illuminance and daylight factor values inside the central light well. Daylight Visualizer simulations)

5.2. Electric lighting,

The objective was to dimension the installation in order to be able to reproduce the luminous effect generated at the top of the well, during overcast conditions (in the absence of sun). The idea was to be able to maintain the effect of light call even when the climatic conditions do not allow daylight to go down deep into the wells (winter, beginning and end of the day).

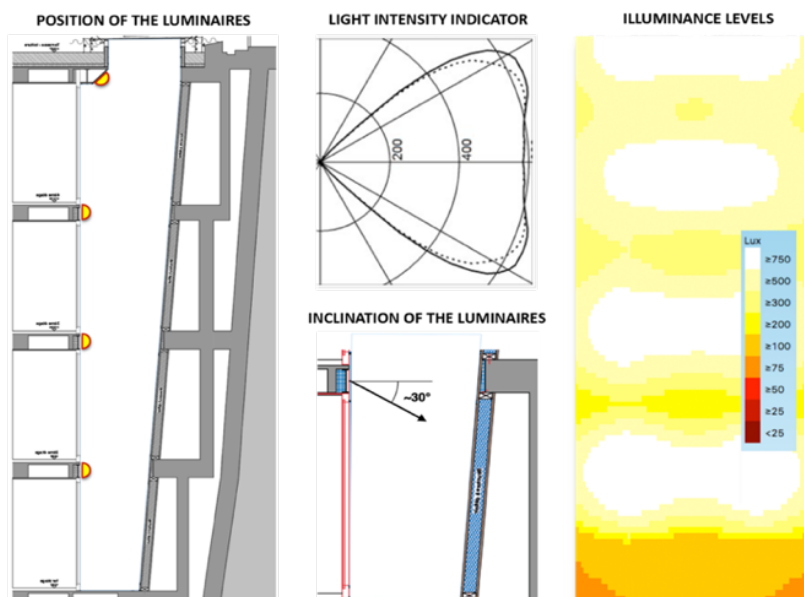


Figure 6: Schematic description of the electric lighting installation

Simulations performed with Daylight Visualizer showed that on an overcast day, the luminance of the back wall of the well is close to 150 cd/m^2 , which corresponds to an illumination level of about 500 lux. It was therefore decided to install luminaires on the heads of the slabs of each of the intermediate floors as shown in Figure 6. To ensure a good homogeneity of the lighting, we chose line LEDs luminaires.

Finally, we tilted the fixtures slightly downward to give the emitted light a downward direction.

We ran simulations with the DIAL+ software [2] to calculate the illuminance values on the backwall of the well. This led us to select the luminaire type (cf. light intensity indicator on Fig. 6) and to determine the total installed power (the luminous efficacy of the luminaire is 136 lm/W).

6. Results

Figure 7 shows different views of the well itself (from outdoor and inside the light duct).

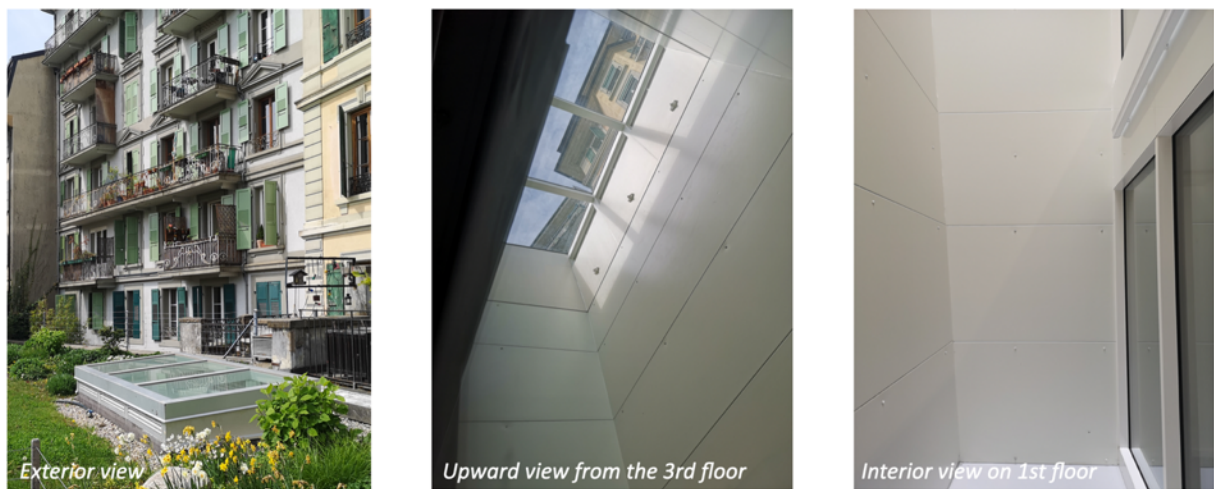


Figure 7: Pictures of the light well (April 28th ~11 AM intermediate sky).

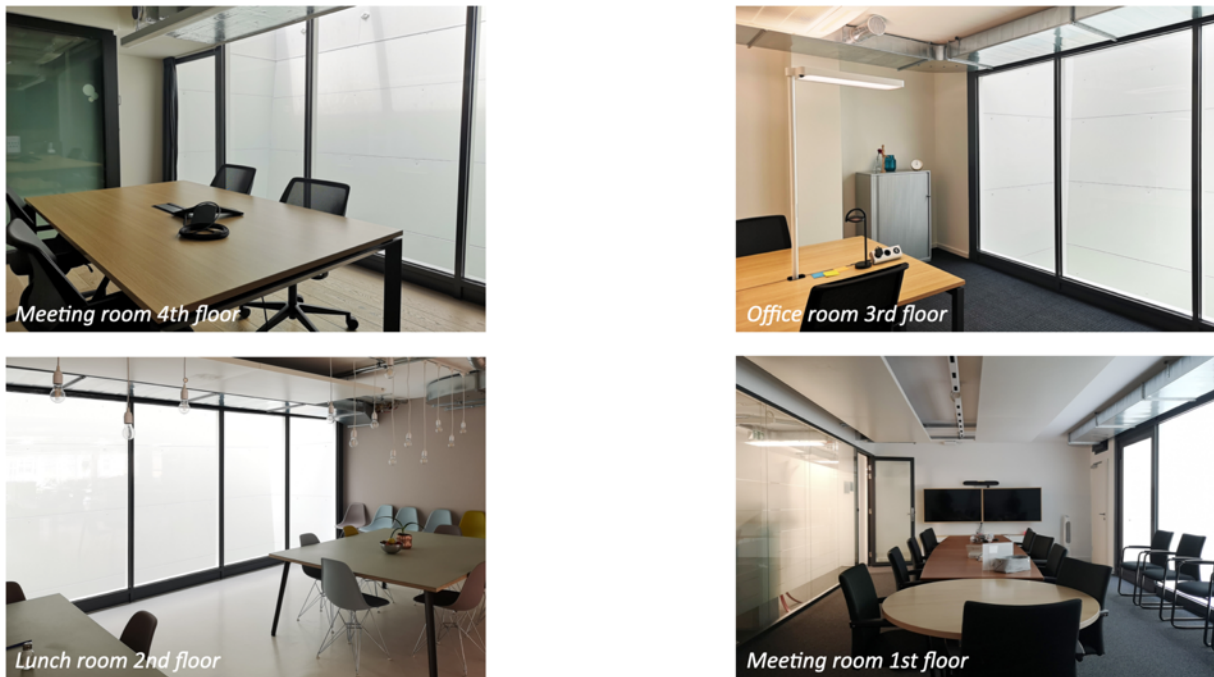


Figure 8: Pictures of some representative rooms facing the lightwell on the different floors

The building has now been occupied for several months. The different floors have been arranged by the occupants according to their own needs. Among the spaces facing the skylights are meeting rooms, temporary offices, common spaces (lunchroom, open meeting rooms, etc.).

Figures 8 shows photographs of the skylights in use. The photos were taken on April 28 in the late morning with an intermediate sky (partially hazy sun) and the electric lighting system was off.

Although the amount of light offered decreases with distance from the roof, the effect of light appeal remains striking even at 1st floor. This effect rebalances the interior space and reactivates the rear area of the building.

Figure 9 shows the wells in winter, at the end of the day when the lighting system is on. The photos were taken on January 24 between 4 and 5 pm. The effect produced is quite comparable to that of the day. The uniformity of the light distributed on the back walls gives the impression that the day continues and that the wells still provide access to the light of the sky.

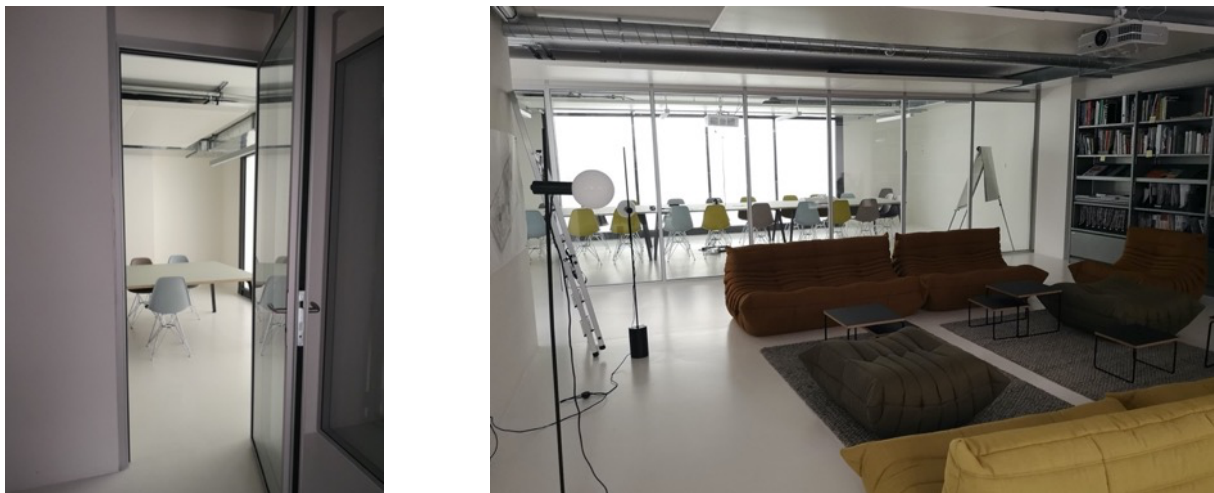


Figure 9: Pictures of the lightwell in the evening when the electric lighting is On: Left: View of a small meeting room from the corridor / Right: view from call effect from one of the meeting room overlooking one of the wells.

7. Conclusions

Beyond their intrinsic performance, the creation of the skylights in the Saint-Martin project has truly breathed new life into this building. The entire rear area, which was considered a secondary zone, has regained its use value. The way in which the new occupants have appropriated the areas and arranged the spaces confirms that these devices make it possible to increase the value of the entire surface of each of the floors.

The collaboration between Estia and Archespace, and the choices that were made throughout the design and implementation of the project, have contributed to the enhancement of the existing building and are part of a more global approach to revitalize the city center of Lausanne.

References

- [1] <https://commercial.velux.com/inspiration/daylight-visualizer>, last visited: 05-07-2021
- [2] <https://www.dialplus.ch/home>, last visited: 05-07-2021