FIG. 5.0 Rolex Learning Centre at EPFL, Lausanne SANAA 2004-2010 (Photo: Ariel Huber)

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5 Rolex Learning Centre at EPFL, Lausanne

SANAA - Kazuyo Sejima and Ryue Nishizawa

2004-2010

The Rolex Learning Centre has been overly announced, published and praised as 'landscape' as architecture. Completed in 2010, it is the largest scale international building of Japanese Architects Kazuyo Sejima and Ryue Nishizawa (SANAA), and it quickly becomes clear the designer's explicit aim was to solve a complex programmatic and spatial request with an artificial landscape.

The commitment of the building to the creation of landscape explains the choice of the project for this study (5.1.). The context of the project in the EPFL campus of Lausanne and its insertion in the lake Geneva landscape deserve some explanation as well as the specific need for it and how that was answered by the design (5.2.). The impression from the field-trip will be described in the next section (5.3.). The challenging form led to a relatively long planning and building process in which quite unusual techniques and structural design were used for concrete reinforcements, formwork and even pouring at high local building standards (5.4.). My 4 layer analysis can be executed in a pure and complete manner (5.5.). The specific analytical method used for Rolex Learning Centre is a visual space analysis of this project with a 3D isovist software tool, a method I will introduce in the respective section (5.6).

My exploration of the landscape architectural attitudes will also stress the important role of these spatial aspects among landscape architectural approaches (5.7.). My critique will engage the total picture to understand this creation of landscape as architecture and its extension of our conceptual understanding of landscape strategies (5.8.).

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5.1 Choice of the Learning Centre

Four main reasons made me choose this project to be analysed with landscape methods.

- Firstly, at the Learning Centre the predominant architectural shape is an undulating slab that forms the roof and main inner space and is designed intentionally to represent and function like a landscape. Strangely this spatial functioning is not discussed before in this conceptual context in existing literature on landscape and architecture, including the more recent ones (Allen McQuade p.408-433, see more in chapter 5.2).

- Secondly, this project has been repeatedly called a landscape by the architects themselves (Nishizawa 2010). It is an example - like Jussieu - of propagation of the landscape concept as a theory by designers themselves - which can be studied here on a realised building to test my hypothesis. That landscape metaphor that extends to both the form and the design process will illuminate many facets of the critical analysis.

- Thirdly, the building of this particular landscape has evolved into a technical advance of structural systems. In this sense it is a show-case, a case showing applicability of novel structural and formwork design techniques that a landscape concept requires in a building. The tectonics part of architecture - the actual building process of the designed landscape - is unique and valid as its own investigation (chapter 5.4.)

- Lastly, it is a built primer in its consequent elaboration of landscape design strategies in architecture in such an explicit manner. The great impression this space provides makes one wonder how Jussieu would have dazzled people two decades before, if it had been realised. In a way the EPFL building may be a source for explaining an experience that Jussieu never was able to provide.

The Learning Centre is significant to understand landscape strategies in architecture because the architects explicitly introduce landscape concepts and refine their spatial composition and building technique. Similar to Jussieu, the architects activate landscape as public space, but they position themselves less explicitly in a dialectical opposition to the existing campus. They do not develop a whole collage but rather reduce the landscape issue to a condensed gesture. Treating the one form of the undulating slab with a whole set of landscape formal operations, they develop a multitude of landscape expressions in a continuous flow rather than in a sequenced collage. The Lausanne case is more experimental, it neither propagates its own dogmas nor denies others. It deals with public space in a more pragmatic or even hedonistic way. The intellectual curiosity of the designers on the spatial effects of their own composition strongly recalls park designs that often need to be worked on ‘in the field’. Its refinement and poetic reduction become a key to the question of applicability of landscape concepts in architecture.

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5.2 Context of EPFL

The Ecole Polytechnique Federale Lausanne (EPFL) is Switzerland's French speaking national polytechnic university founded in 1969. Its German speaking counterpart, the ETH Zurich was founded in 1855 after the model of the national French grandes écoles in Paris. Only a few higher education institutions in Switzerland are national since education was traditionally divided federally until the 1848 federal constitution.

Like many Universities, the EPFL campus moved to the periphery of the city after the rapid expansion of cities and growth of student numbers in the late 20th century - four km east in Ecublens. According to a Masterplan of 1971 by Architect Jakob Zweifel (1921-2010) the polytechnic was extended step by step from 1972 to 1982 (Schlappner 1996, Zschokke & Hanak 2003). The site is placed along a provincial route between a railroad track to the north and a country road to the south that cuts the site off from the lake. Zweifel's plan orders functional elements with a clear separation of traffic levels on the ground and a system of elevated plazas above. The strong volumetric presence is based on prominent north-south bars that visually connect the site from the green hinterland in the north to the lake and mountain view in the south. As opposed to the closed orthogonal bars of the contemporary Jussieu campus inside Paris (chapter 4.2), the Lausanne campus opens up to the landscape in the wider surroundings. In the 1970s, the polytechnic construction was initially comprised of a modular steel facade system reflecting structuralist manners, but later adopted a more Post-Modern influence with colonnades along a new north-south passage. Next to EPFL, the University of Lausanne is placed; financed by the canton of Vaud and not the federation.

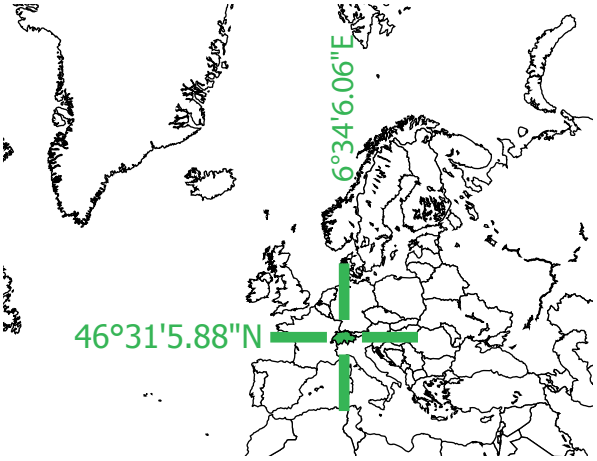

FIG. 5.2.1 Global Position Lausanne, Switzerland

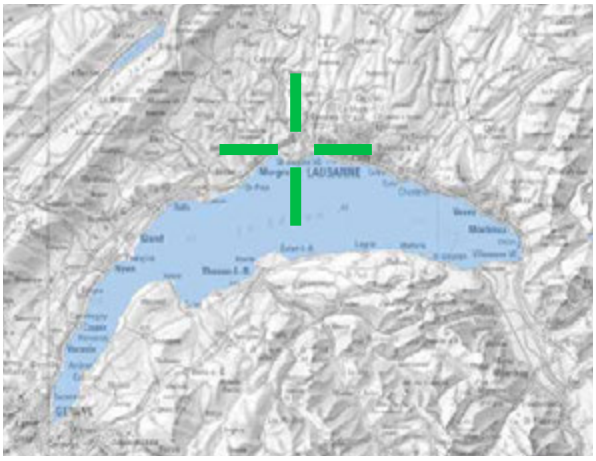

FIG. 5.2.2 EPFL in Lausanne Region Scale: 1.250'000

A problem occurring from its peripheral situation is that the campus lacks life, especially in the late working hours of many students and scientists. To bring more urban life to the campus, a congress centre, library hotel, and lodgings were to be added according to an internal planning procedure of EPFL in 2003 (see also Aymonin 2007). In 2004, the EPFL launched an exclusive competition which eventually settled on 12 architects, many outside of Switzerland, chosen from a pool of 182 applicants from 23 countries (ETH Rat 2004 p. 20). Besides the winning team of SANAA, other teams that were invited included Abalos & Herreros, du Besset-Lyon, Diller Scofidio & Renfro, Zaha Hadid, Herzog & de Meuron, Xaveer De Geyter, Jean Nouvel, Mecanoo, OMA, Valerio Olgiati and Livio Vacchini (Bisbrouck 2006).

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FIG. 5.2.3 The EPFL Campus at Lake Geneva (EPFL Photo: Alain Herzog)

Note that five of these architect teams had been competing 12 years earlier on the Jussieu competition (Du Besset-Lyon, Nouvel, HdM , OMA and De Geyter, who had worked at OMA on the winning scheme for Jussieu, see chapter 4.2.).

With the given site in the competition, EPFL formulated an ambitious set of programmatic requirements that would usher in the future of learning. The programmatic aspect was loaded with much more than functional requirements: the building 'must be significant', needed to 'impose itself in the environment like a signal in the landscape', was to 'become a hive of activity' and 'magnify the school, adding to the reputation of its academic curricula, emphasising the school's radiance at national and international levels' (program quoted from Bisbrouck 2006). Many results of the competition took that quite literally and developed different types of imposing sculptural volumes in crystalline- (Hadid, de Geyter), tilted- (DS+R, HdM), or arch-shapes (OMA).

The EPFL Learning Centre's main task is to bridge the gap that disconnects the EPFL and its neighbour, Univeristé de Lausanne UNIL, from the city. It should reestablish connections between students and the city and bridge between the academic world and society. Put in traditional terms, the program predominantly consists of a library, restaurants, a conference centre, meeting and exhibition spaces, and work places for scientists but none of these look nearly how one would expect from their title. The English term 'Learning Centre' would describe a new building type for a digitised library integrated into university teaching. Since Lausanne, it would become an accepted term even in the French Republic's administration (Jouguellet 2009). EPFL's search for new building types is connected to the digital revolution (as anticipated also at the Jussieu project, see chapter 4.7.). The shifts in media had a huge impact on the daily life of research and education.

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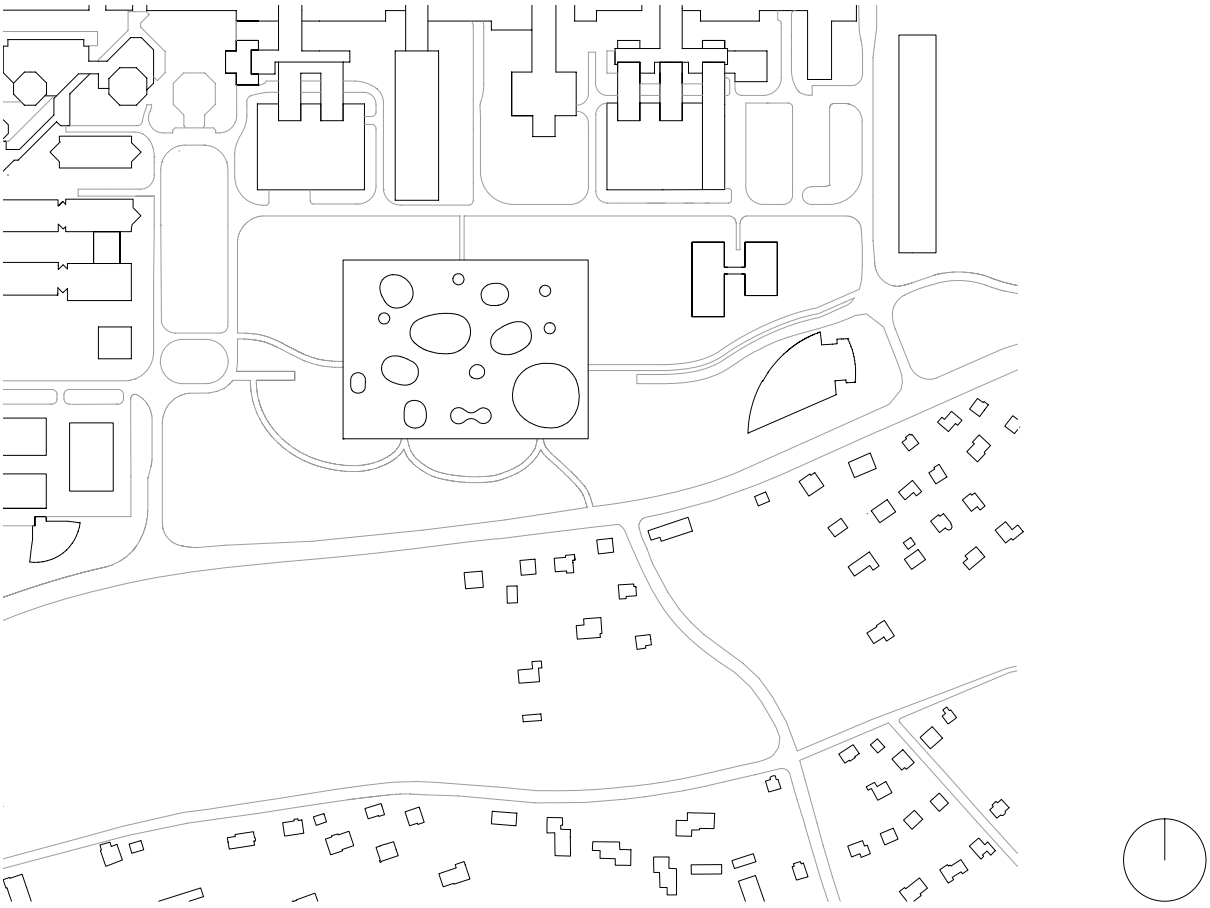

FIG. 5.2.4 Site Plan of Rolex Learning Centre 1:5'000

As a physical built context, much of the university dematerialises into virtual databases and on-line exchange of thoughts. Nevertheless, university buildings still refer to a typology of the Greek philosopher's school.

5.3 Impression from the Field-Trip and Design

According to architect Ryue Nishizawa, the EPFL Learning Center in Lausanne at Lake Geneva is 'a dramatic space, that words can hardly describe' (Nishizawa 2005 p.11).

Even to start our description upon entry is difficult with this building, although the Learning Center is clearly limited by a vast rectangular shape. One does not enter the rectangle at the edges but through the center. Once inside, nothing guides the visitor in conventional ways except for the signs on its curved glass walls. Those walls inside are exterior walls around clearings in the middle of the building. As nothing is forcing the visitor on a certain path, the report of a walk-through would still be very subjective. One cannot avoid describing this building only by its space. No intellectual framework other than the pure creation of space for people is the working ethos of SANAA – as they have made evident here.

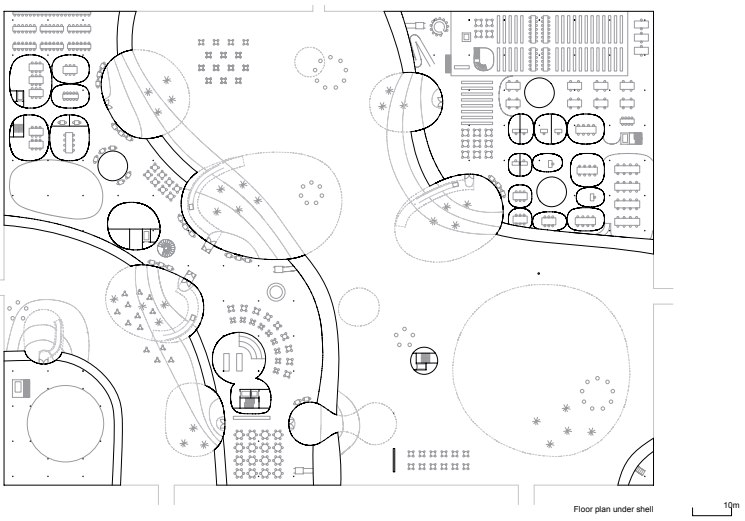

FIG. 5.3.1 Learning Centre Floorplan under shell 1:1'000 (SANAA 2010)

The Learning Centre consists of only one single large public floor above ground. This giant continuous space can be described as an abstracted landscape. More precisely, standing in the building feels like being inside an architect's model of a landscape. The undulating slab of that single floor does not always touch the equally large basement floor. It lifts up from the ground at different zones, providing entries for slipping in at every edge of the basic rectangular form. Inside the rectangle, a series of holes not only provide masses of light to the inner space but also act as axis points around which the entry paths are woven through the holes between the ground and the undulating slab. The building wraps around the approaching visitor. When I enter the inner landscape I feel like falling into it from outer space; walking on the modest gray carpet is at first strange, like walking on the moon.

The continuous plane is not indifferent. It adapts to programs with seating here and a platform there. Ramps in the shape of serpentine roads and rack railways for wheelchairs are abstract quotes of the alpine world, moments that the hilly city of Lausanne and the nearby Alps are quite well known for. The strength of the architectural language lies in the connections it makes through only a few elements. The holes are one essential part in communicating the space that divides and connects at once. The spatial dynamic of uphill and downhill inner spaces and the views with bits of natural landscape framed by this artificial world connect the visitor with his surroundings. I can not help but compare the building to the mountainous scenery outside. More than a walled garden, this is reminiscent of the English landscape garden using effects and scenery found in nature to trigger that thrilling and edgy experience of the sublime landscape. While the separation between building and nature is made very clear by materials, they are intensely connected by the spatial composition.

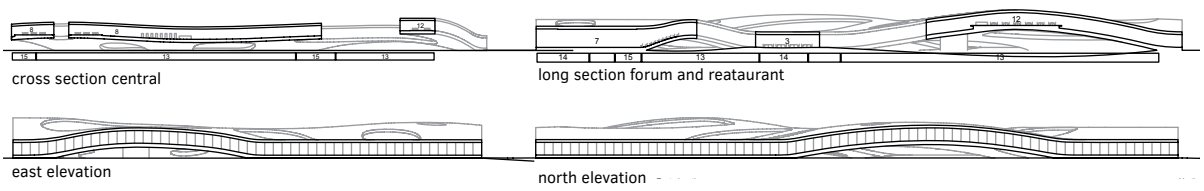

FIG. 5.3.3 Learning Centre sections and elevations 1:1'000 (SANAA 2010)

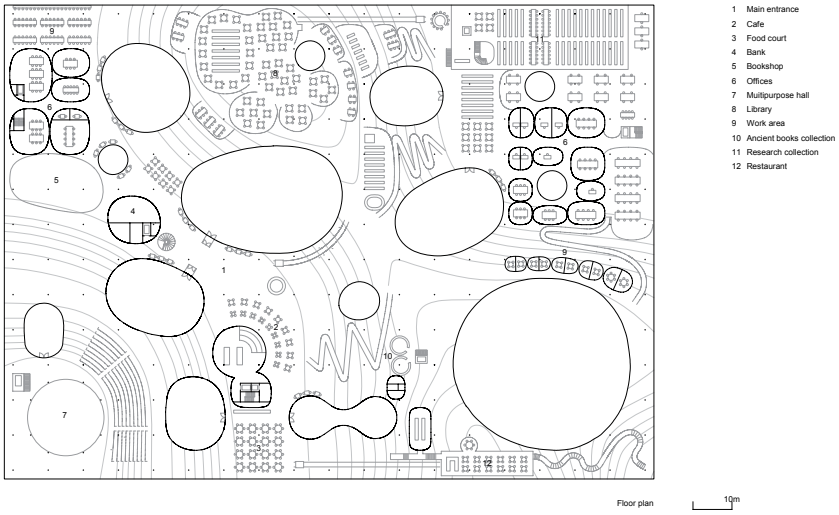

FIG. 5.3.2 Learning Centre Floorplan 1:1'000 (SANAA 2010)

In their work for the Learning Centre architects Kazuyo Sejima and Ryue Nishizawa experiment with modern architecture as a composition of space, program, and nature, reflecting on the human condition. They implement transparent connections between inner and outer space. SANAA's modernism is not about formal language but about trying to break apart conventions and bring space and composition into direct relation with the human experience. SANAA keep expanding their formal repertoire; this building is the furthest they have gone in experimenting with free formed shapes, but because the goal of creating space is never out of sight, they master this craft carefully. A parallel to the Baroque architectural tradition of creating space by modelling light, voids, enclosures, and vaults can be found here – like the modern, the Baroque is only referenced in its spatial qualities, free of ornate decoration.

In the architects' design process, a simple problem triggered a leap in the design. They quickly realised that they did not want to stack levels – one continuous floor should connect all the different uses in the flow. Connections between spaces were more important than their division. But the simple wish to have a view from the restaurant to the lake would mean that it had to be upstairs unless you skip the stairs and use the whole building to get there instead. So while wrangling with placing shifts and splits and limited views between adjacent spaces of different heights, the architects started to lift that one continuous floor plan locally. The discovery of the horizon as a space divider convinced the designers and made them develop all the public spaces into one single continuous undulating plane – a landscape making architectural space.

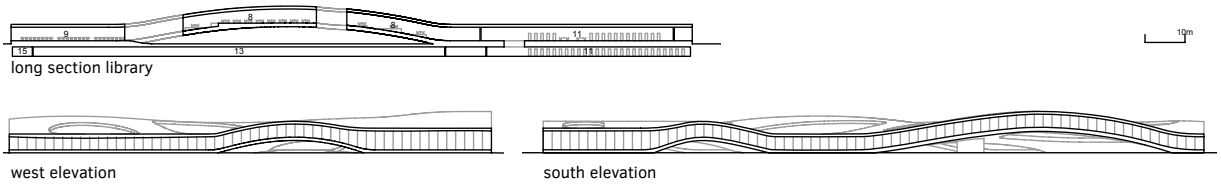

FIG. 5.3.4 Learning Centre sections and elevations 1:1'000 (SANAA 2010)

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FIG. 5.4.1 Learning Centre from East, at opening 2010 (Photo: Ariel Huber)

5.4 Building the Rolex Learning Center

As an explicit built landscape this project also reveals some particular technical challenges to building it. The undulating concrete slab was a particular challenge in its structural design, requiring even thicker insulation on the cold underside. One principal misunderstanding between the architects and engineers was the shell form of this building, which is not effectively a shell structure. A reinforced concrete shell can be impressively slim with a ratio span/thickness of 250 to 500, meaning that 20 cm slabs can carry across 50m if they are designed and calculated in their structurally ideal shape (Santini 2008). The great works of Felix Candela for example would follow a design process of formal optimisation. In the case of the Learning Centre, the shape had to be determined by spatial, visual, and functional aspects, making it impossible to find such a structurally ideal form (Santini 2008). The engineering firms Bollinger Grohman Frankfurt and Walther Mory Maier Basle were to translate the idea formulated by SANAA of light and slender shell-like slabs into a build-able solution.

An additional handicap was that usable surfaces in buildings (floors) allow much less deformation than surfaces on roofs or on bridges. The airy white plastic sheet of the architects' competition model turned into massive concrete ceilings. This is not about surface shaping but gros oeuvres, big works – the whole slab is 40-80cm thick with up to 470kg of reinforcement steel per cubic meter of concrete. This is almost 5 times more steel than the Salginatobel bridge built in 1930 and

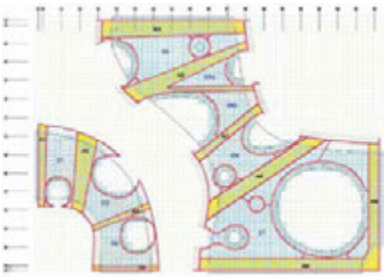


FIG. 5.4.2 yellow 11 arches with reinforcemnet in red formwork in blue (Grohmann 2008)

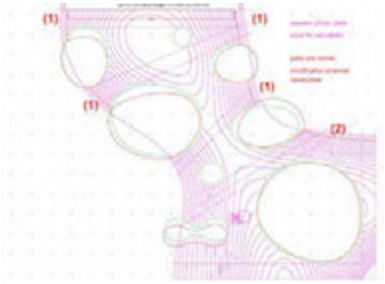


FIG. 5.4.3 modification changing openinges from green to red (Grohmann 2008)

FIG. 5.4.4 construction of the slab for larger hill in 2008 (Grohmann 2008)

designed by the concrete pioneer Robert Maillard (1872-1940). With a span of 94m, the bridge would use 103kg per cubic meter of concrete (Micelli 2009). At the north side the Learning Centre spans 80m and the arch is only 4.85m high. This is half as steep as bridge engineers would see as a feasible minimum. The structure here has to bear 78000 kN or 8000 tons of weight, 200 loaded double trucks hanging on a few meter wide zone. The solution proposed took a whole year of pure structural design study not counting the extra demands for steel layout and formwork design (Gromann 2008). The engineers proposal is a hybrid system of 11 arches hidden inside the two shells, four in the smaller and nine in the larger hill. These arches do not span between two rocks like Maillard's bridge, but lay on top of a parking garage and a curved wall that needed to be passed under by cars on many levels. To fix the landings, all of the massive concrete landing zones are connected with horizontal cables at ground level in the roof of the underground parking garage. These connections also criss-cross between arches in a kind of a zigzag system.

Several modifications had do be made to the shape in a negotiation process between architects and engineers. In this process, the architects insisted on certain heights and emphasised visual relations especially from the elevated inner spaces - they wanted views across the roof which should remain parallel to the floor. They also rejected resolving the lower level structure with columns, forcing impressive free spans comparable to larger sports halls. The modifications are steeper bows, avoidance of concave bumps, approaching symmetric parabolas along the eleven bowlines and moving the openings to have wide enough stress zones with the cables. To minimise risks in this new way of building, construction started with the smaller and steeper hill and addressed the large one after. The negotiated shape had to then be put in place with 1331 different pieces of formwork that had been designed by a specialised company (Scheurer 2010 p.200-203). In a three day non-stop operation in July 2008, 4300 m3 of concrete were to be poured including more than 20 truckloads per hour with 250 workers involved (Mallet 2008).

Additionally, the high ambition of the client to reach the Swiss energy label "Minergie®" that is based on a minimum of energy to be consumed per m2 required extra efforts. The ratio envelope surface to heated floor surface is very important to reach this standard and was far from optimal here. The study of natural ventilation and heat changes as another example would require thirteen consecutive simulation models to determine the distribution of openings in the facades (Jaboyedoff 2009 p.24).

A mixed structure of wood and steel was used for the roof to reduce heat deformation, weight, and cost of the structure. In the flat areas, the primary structure (IPE400) is filled with steel beams (IPE300), but in the curved areas on to the 9m square column grid are filled with a total of 986 laminated wood secondary beams, or five per field. (Grimault 2008 p.18).

FIG. 5.4.5 Into the large opening (Photo: Ariel Huber)

FIG. 5.4.6 Rasing between clearings (Photo: Ariel Huber)

After the competition win, the realisation phase of the project was relatively long (with almost six years in total from competition to opening) and encountered some challenging technical and financial hurdles, with a total delay of two years to the initial planning. Initially praised for its modesty by the parliament's financial commission, it eventually turned into an expensive object of technological prestige. The cost of the original proposal at 40M CHF in the competition stage jumped to 90M CHF with SANAA's preliminary project design in 2005, and finally to 110M CHF (70M EUR), of which 50M–52M were privately funded by various companies including watchmaking company 'Rolex' that purchased the name (cost according to archicentral.com 2009, ETH Rat 2004 p.20, ETH Rat 2008 p19, EPFL Media Dossier 2010, Aebischer NZZ am Sonntag 2010).

5.5 The 4 Layers of the Landscape Architectural Composition

5.5.1 Ground Form

The topography of the EPFL Campus is relatively flat by Swiss standards, especially compared to the city of Lausanne 4km to the east. In a 1sq-km area or roughly 500m distance to the Learning Centre the terrain varies in height by a maximum of only 2m - probably a motive to choose this area for the quickly expanding campus in the 1970s.

The ground form relates to the landscape of this site of the Learning Centre is a southern extension of the campus towards Lake Geneva at 400m above sea level or 28m above the lake. The site is strongly dominated by the surrounding landscape. To the south, the whole panorama is occupied by Lake Geneva, which is only 500m away. 13km across the Lake on the French side are the Baths of Evian. Behind the French shore and toward the east end of the lake, an impressive panorama of the Alps arises. The highest mountain in Europe, the Mont Blanc, at 4810m above sea level in France, is only 80km away to the south (at 163 degrees). On the opposite side of the Alps is the the Jura chain with Mont Jorat (975m above sea level) 10km to the northeast of the site.

FIG. 5.5.1.1 Through large opening to SE corner (Photo: Ariel Huber)

FIG. 5.5.1.2 Towards road and lake (Photo: Ariel Huber)

The flatness of the site of EPFL campus is in contrast with to the steep mountain scenery but also to the topography of the city of Lausanne itself. There, the centre is at 475m above sea level, or 100m higher on the lake side neighbourhood of Ouchy. Urban transportation in Lausanne therefore makes use of mountain railways (see on funiculars section 5.6.3.).

The predominant reaction of architecture in the 1971 EPFL masterplan by Architect Jakob Zweifel (1921 - 2010) to the landscape is to open the corridors between the long stretched buildings towards the alpine panorama (see Schlappner 1996, Zschokke & Hanak 2003). They are either north-south oriented in the area north of the building site or east-west oriented on the western wing. They are three or four stories high (15-20m), which still gives them a rather modest earthbound proportion. Most of the buildings are connected by a system of elevated walkways one level above the streets. I interpret the Zweifel Masterplan as a relatively successful example of a reaction to the landscape context in comparison to the Jussieu campus of Albert (see 4.2.). The Rolex Learning Centre is still different from the predominant Zweifel masterplan in its reaction to the site - but SANAA's intervention is less agitated than OMA's and leaves space for the existing buildings of the campus and their existing visual relations across the site.

To understand the ground form I follow a description of the architects (SANAA guided tour 2010). On the wide plane of the site, two hills are laid out. The hills fulfil the simple requirement for overview onto the campus in the rear and, more importantly, a view across nearby obstacles to the lake and alpine panorama behind it. As the two hills are not massive, but a curved concrete slab, they can form entries to sneak in below. This cut is provided by a rectangular shape, precisely northeast and southwest oriented like the templum of a roman city. The rectangular system used at Learning Centre is at EPFL already an outside given of the Zweifel masterplan. The development of the site relationships is like a reversed urbanisation: looking at the development of a city like Florence, we see a structure first abstracted from the landscape by establishing the templum. In Roman times, this was defined as an outer border of the rational orderly world inside from the natural wilderness outside. Growing across that border, Florence will later be integrated into the topographical realities of the Arno valley, developing a growing aesthetic integration with that landscape (Steenbergen and Reh 1990 p45, 2003 p47). At the Rolex Learning Center, that process of antique and medieval urban development is reversed. The given of the cardo and decumanus by a rigid masterplan of 1971 is stopped in the 2004 design by a templum as a border with rational order outside and artificial wilderness inside. That shape itself subordinates the building to the existing order. The orderly world remains outside, while the inner landscape is reconnecting spatially and metaphorically to a wider surrounding space beyond the campus towards the surrounding nature and city.

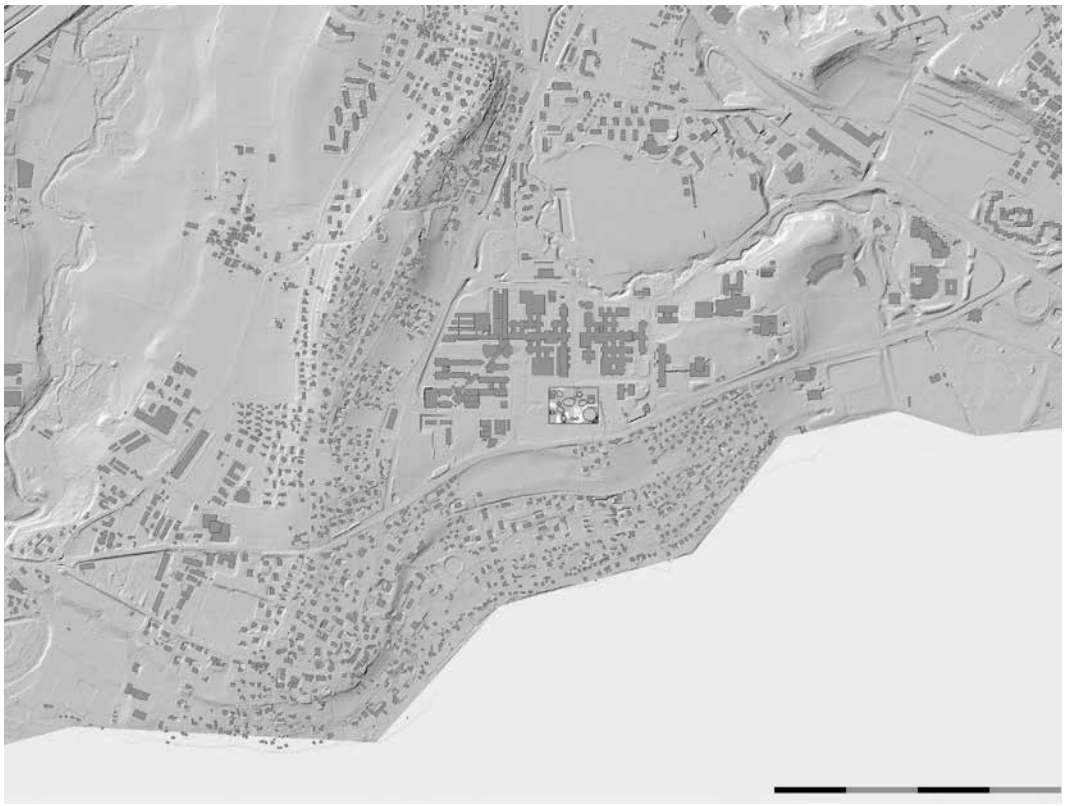


FIG. 5.5.1.3 Relief of the site of EPFL in Ecublens with buildings 1:10'000 (source www.geoplanet.vd.ch rendered by the author)

The rectangular shape is the outcome of different alternatives, including flower-like complex amorphous shapes (architect's sketch during interview no.2, A2.4.). The rectangle takes the main direction of the site, but it sits right across the main axis towards the metro on the north entry and also across several other paths that cross the site. Lifting up the slab, the passage under the building is free even at times the University remains closed. The widely opened and undulating space inside connects visually to the outside with a series of spatial inventions that I will discuss under spatial form.

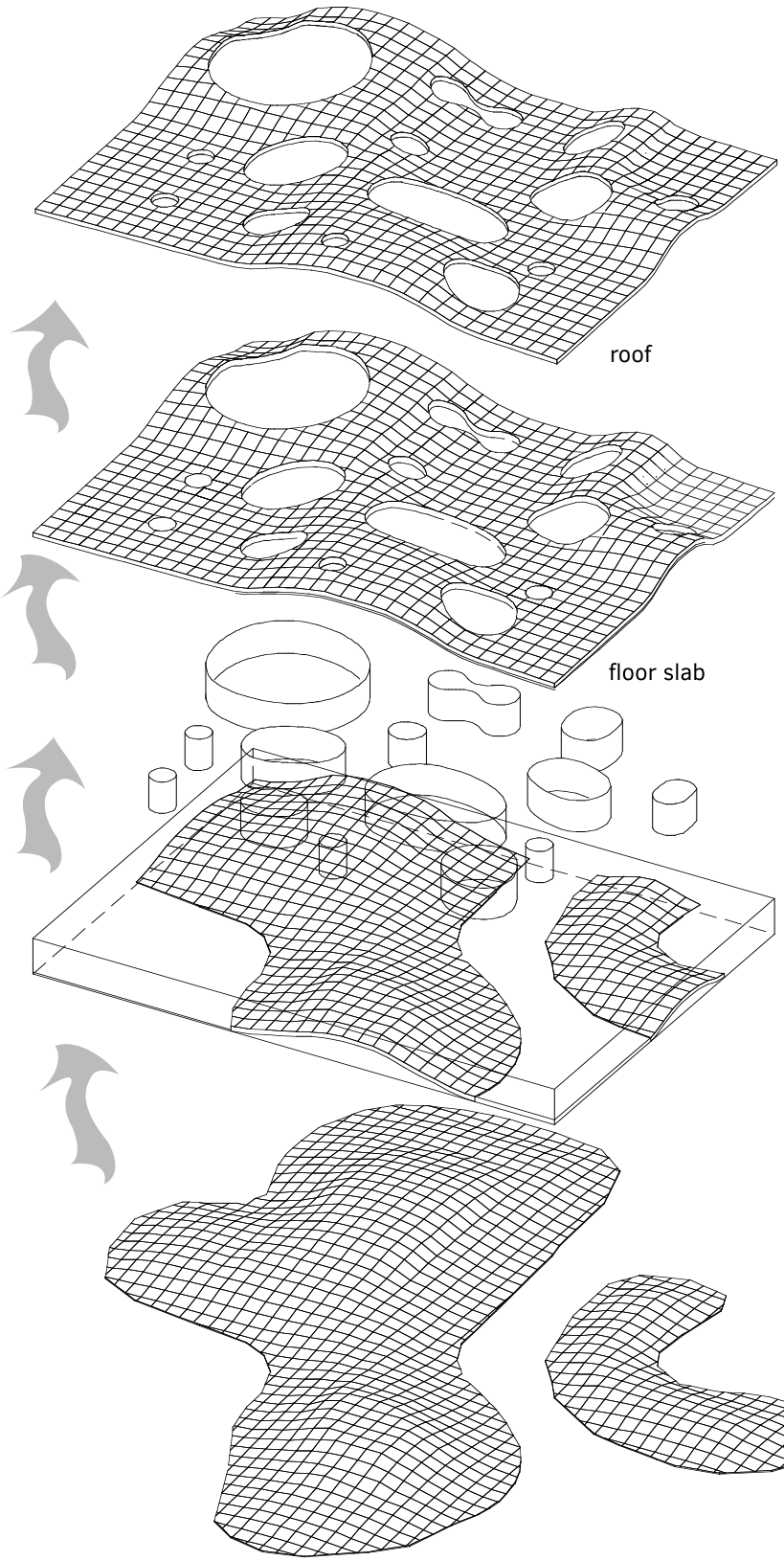
To continue the discussion of the design in its ground form, two other important manipulations must be regarded. First to mind are the elliptical holes which are fourteen in total. According to their distribution on the hills (the edge of the hills or next to them), the spatial quality of each hole has different consequences. Three of them are in flat areas merely to provide light as hidden gardens or inner courtyards. Three other holes are fully elevated, providing light to both the upper undulating slab and the space below the shell as well as some visual relationships, which I will also discuss as spatial form (in 5.5.2.). The remaining eight holes that sit on the edge are touching the ground with one side elevated. They cut through from one topological surface to the other. These holes connect the space of the flat ground under the shell with the undulating continuous slab on top of the shell. The holes are the main openings for access, even if they are in an unusual place; rarely will one find a built surface in which one would have to look above for the main entry. In the image form I will discuss how the lower space can be seen as a grotto (see 5.5.3.). Still, the holes here are part of a more general manipulation of the ground form within the reversed relation of the inner topography and the outer orderly and flat world. The primary function is bringing in light, as the building expanse would be much too large if otherwise uninterrupted. Building regulations under other Swiss codes (like for example the Zürich PBG) would not allow buildings for work or living deeper than 24m, in order to provide sufficient light for inhabitants. But the side effect is a paradoxical relation of spaces, an interweaving of two topologically different planes and a

FIG. 5.5.1.4 Relief of Lausanne with buildings 1:10'000 (source www.geoplanet.vd.ch rendered by the author)

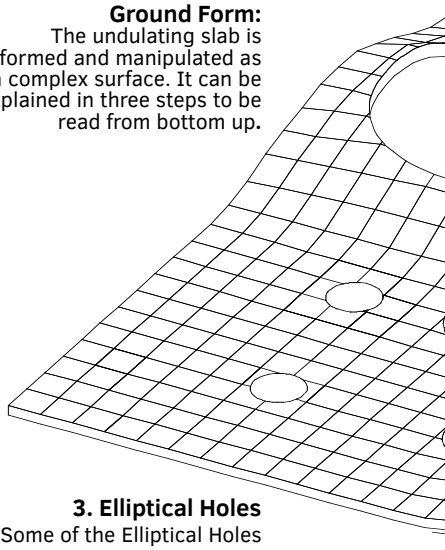
complex manipulation of the topography in favour of the creation of spatial illusions. This kind and sophistication of landscape manipulation is of the order of design strategies that are the result of a landscape process (ch. 2.2.3).

Under spatial form I will show more spatial features that are unique to the manipulated artificial ground. But in this area I also observe a series of allusions to creating a park like landscape. The result is the deliberate introduction of an unusual movement pattern and manipulations of inside and outside views.

FIG. 5.5.1.5 Roman Florence (1) with extensions and fortifications of 1173, 1258, 1333 1544 (Steenbergen Reh 2003)



Ground Form:
The undulating slab is informed and manipulated as a complex surface. It can be explained in three steps to be read from bottom up.

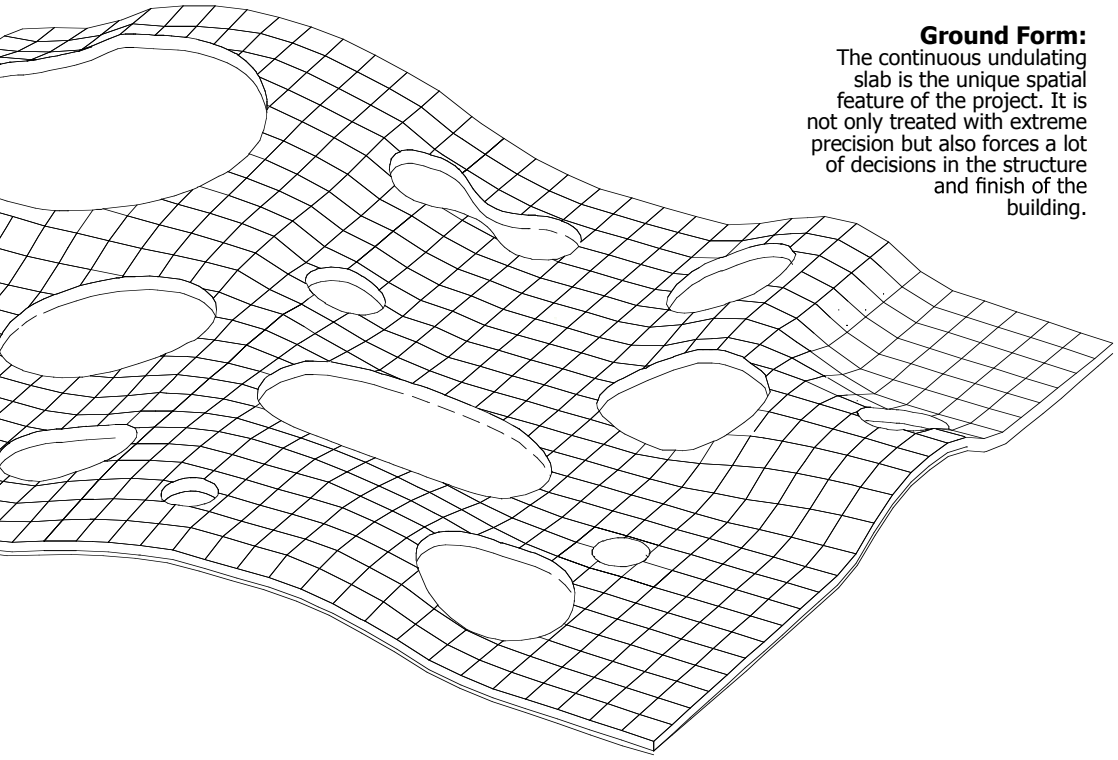


3. Elliptical Holes
Some of the Elliptical Holes intersect with the elevated areas of the slab e.g. the two hills. This provides access to the upper surfaces of the undulating slab.

2. Rectangular Cut
A rectangular shape, oriented to the cardo and decumanus of the campus, cuts the two hills open on three sides. Since they are hollow shells, the cuts provide five entries under the slab: two entries to the smaller hill and three to the higher one.

1. Two Hills
Two hills arise on the site. They provide an elevation high enough to view the campus on the north and to provide a view to the Lac Leman and the western Alps in the south.

FIG. 5.5.1.6 **read from bottom to top** Rolex Learning Centre at EPFL, Lausanne (Drawing: author)
Ground Form



Ground Form:
The continuous undulating slab is the unique spatial feature of the project. It is not only treated with extreme precision but also forces a lot of decisions in the structure and finish of the building.

FIG. 5.5.1.7 View from South into large opening under VIP restaurant (Photo Ariel Huber)

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5.5.2 Spatial Form

Two spatial systems interweave at the Learning Centre: the lower continuous large space with two passages and the undulating space between the double shells that cover the lower one. These two systems interconnect through those eight holes that touch the base. Not all of these connections are used as entries - and it is not fully clear which entries are closed on purpose by the architects, and which are regulated by the users. In spite of this, two main entries can be defined as the central access points and three or four can be defined for direct access to the library, forum, and restaurant respectively. The access points are thus free and open and can easily be conceived for flexible usage in the future. The particularity in the spatial form is that we have a system of one and a half times the footprint of continuous spaces connected at one single level. Unlike Jussieu the stacking of floors is reduced at the Learning Center in favour of maximum extension which I relate to an anti-hierarchical impulse of the architects, depicting an ideal space of academic exchange and scientific encounter at the University.

The architects stated that people do not move and meet on straight lines but on curved ones (inauguration speech 15.2.2010). Circulation paths are of particular importance for understanding this architecture. The rectangular box is approached from four sides mostly in an orthogonal direction frontal to the flat facade. Even access points across are bent by the outside path system so that one always enters the templum either from the cardo or decumanus direction. Once under the shell, any orthogonal order is given up. The main access points are to be found if one follows the light. They are not placed axially, but still in the central field of view. Views subtly steer the entrant towards the doors that are always to be found across from one of the openings. The access routes curve slightly into the light, and on the undulating slab, the spatial system is even more forced onto curved routes due to the slopes that oftentimes would not allow straight connections. Curving is forced also by the placing of furnishings and other objects in a dispersed field, without straight hierarchy.

I found an open and anti-hierarchical circulation system that favours freedom. The curved path and absence of hierarchy also propagate a dynamic view of the outer and inner landscape connecting various sights and views. Even the blind walk on curved paths along a guidance system of white flexible plastic lines (fig. 5.5.2.1.).

Much emphasis was placed on vistas or visual relationships to and from the building towards the EPFL, the UNI Lausanne, the Lake, and the Alpine Panorama. The connected spaces are inviting to the outside through the big gate-like openings under the shell, but also connect to each side of the campus with reduction and open transparency. Besides the views across the facade enhanced by raising the floor up to 7m, the views across the holes play a crucial role. As a structural engineer pointed out, the architects would insist throughout the exhausting structural design process that the hills were high enough and the slopes steep enough in order to see across the openings onto the roof (Grohmann 2008). This explains for example the position of the biggest hole in the southeast; through this hole is the important view to the Alps of the canton de Vaud, the alpes vaudoises. Also, the undulating of the roof plane is connected to this for other reasons I will show in the next paragraph. Especially at three elevated points - the library belvedere, central belvedere, and foyer belvedere (named by the author) - the visitor finds himself surrounded by a variety of views through inner landscapes, roof landscapes, and the exterior landscape. These vistas and panoramas are carefully designed and taken care of throughout the design and building process. Architecture based on such a rich variety of views is particularly rare. Its spatial system is connecting the inner landscape to the surroundings, extending the illusion of a seemingly endless space. In that sense, SANAA's holes enhance the illusion of limitless space through a disguised border. In this regard the effect is similar to the ha-has of the English landscape garden, where an edge hidden below the viewing field would give the visitor of an estate the illusion that the estate extended into the pasture with grazing cattle up to the horizon.

Spatial Form:
Circulation Paths

drawings on this page by the author

Spatial Form:
Connected Spaces

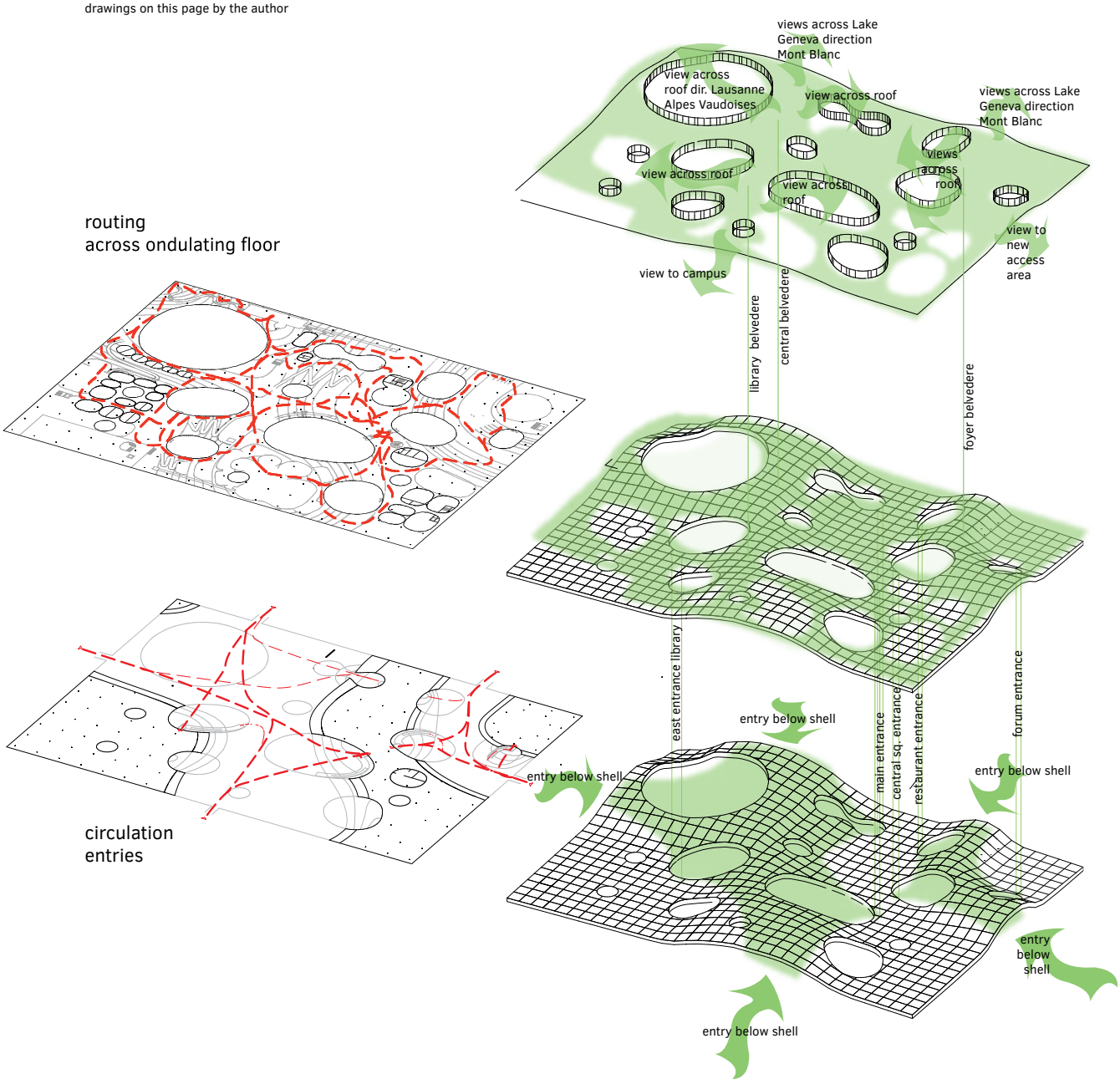

FIG. 5.5.2.1 **read from bottom to top** Rolex Learning Centre at EPFL, Lausanne (Drawing: author)
Spatial Form

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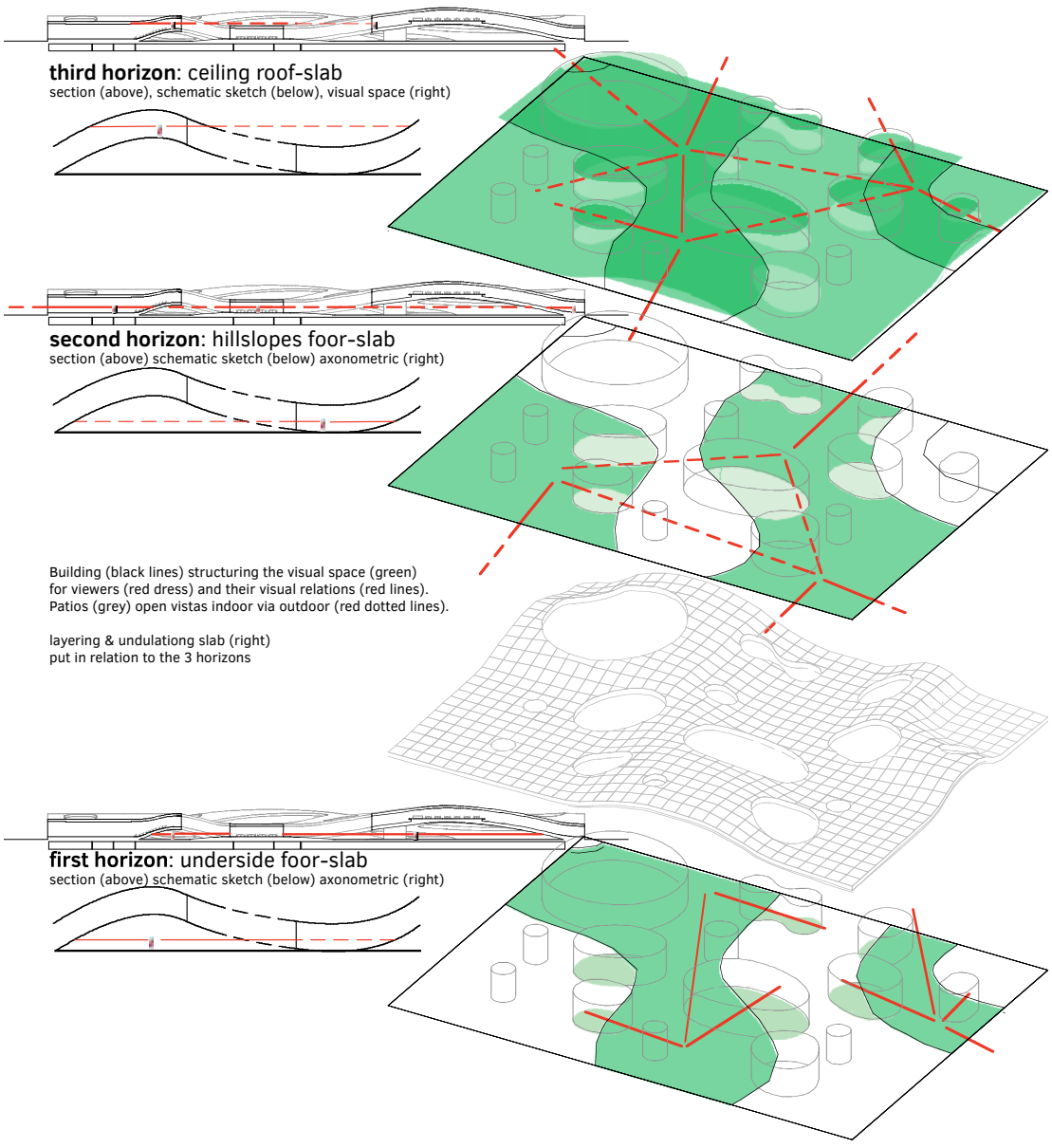

third horizon: ceiling roof-slab
section (above), schematic sketch (below), visual space (right)

second horizon: hillslopes foor-slab
section (above) schematic sketch (below) axonometric (right)

Building (black lines) structuring the visual space (green)
for viewers (red dress) and their visual relations (red lines).
Patios (grey) open vistas indoor via outdoor (red dotted lines).

layering & undulationg slab (right)
put in relation to the 3 horizons

first horizon: underside foor-slab
section (above) schematic sketch (below) axonometric (right)

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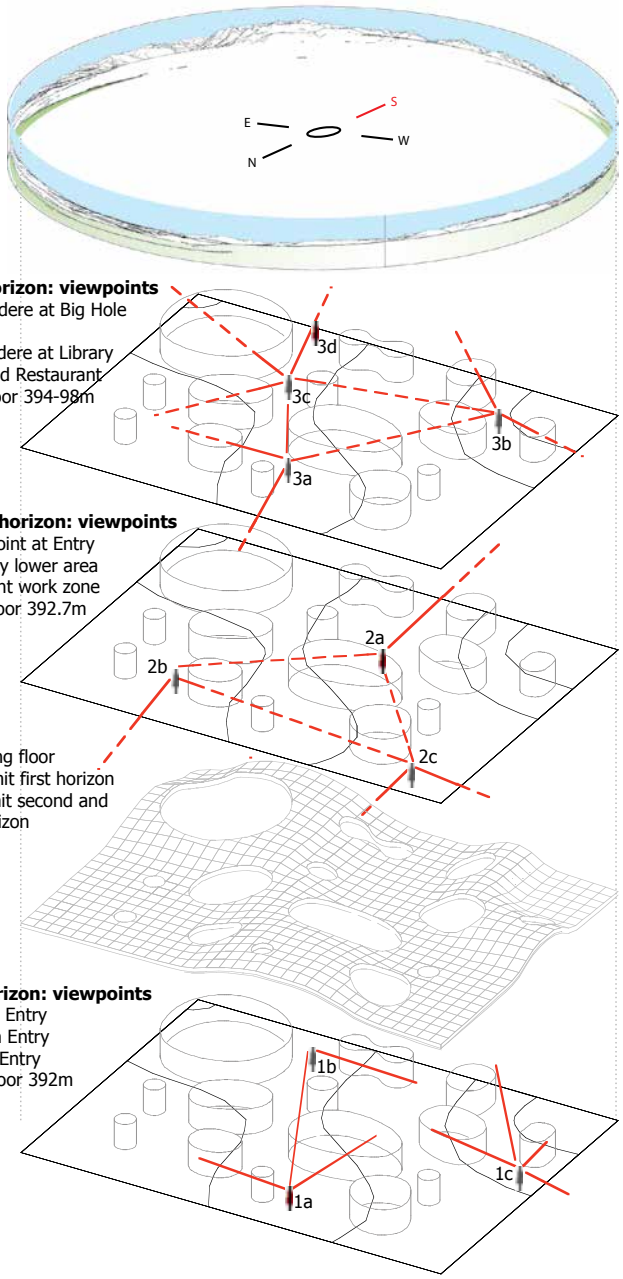

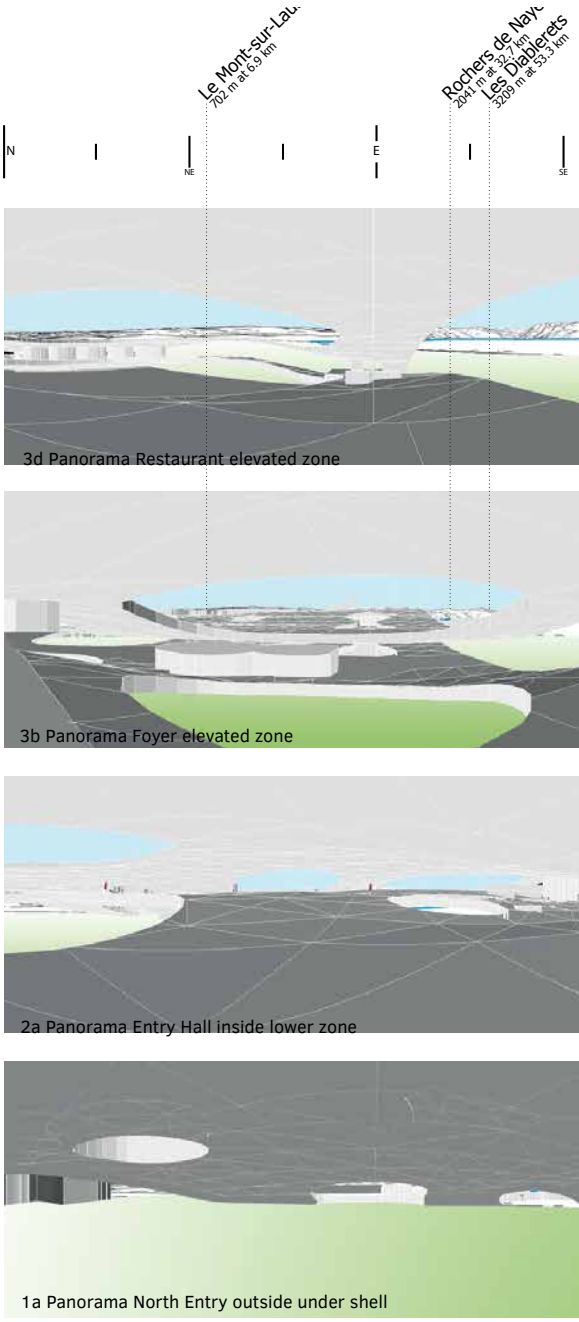

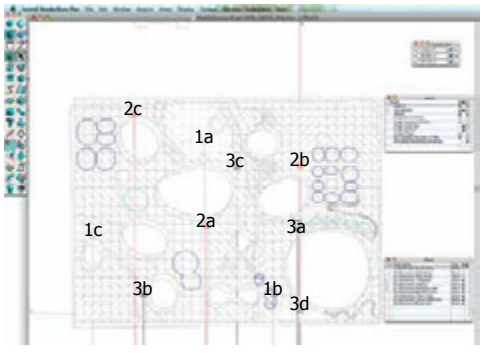

above right: Panoramic Perspectives CAD / GIS

relation roof (light gray), undulating slab (gray)
site topography (green to white) lake (blue)
visual realtions to mountian skyline (to light blue)
GIS (digirama swisstopo) CAD & montage author

left: CAD model plan view (screenshot by author)

right: visible surface form Learning Centre (black)
GIS Visability map Swiss Grid 533248/152209/405
Digital Height Model 1:25'000 (source swisstopo)

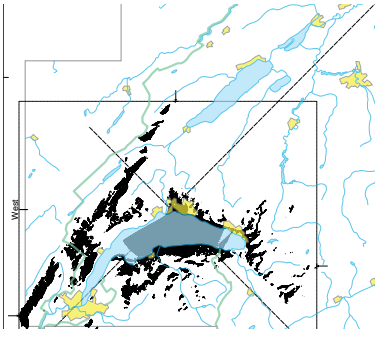

FIG. 5.5.2.2 **read from bottom to top** Rolex Learning Centre at EPFL, Lausanne the three different horizons as experienced through level (Drawing: author)
Spatial Form

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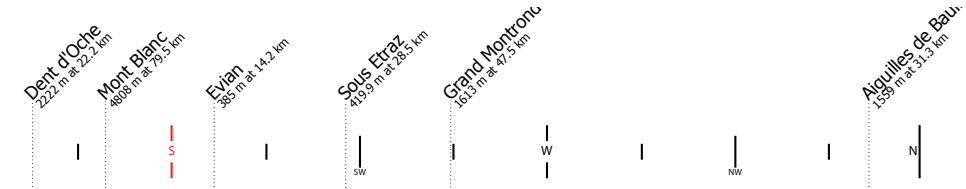
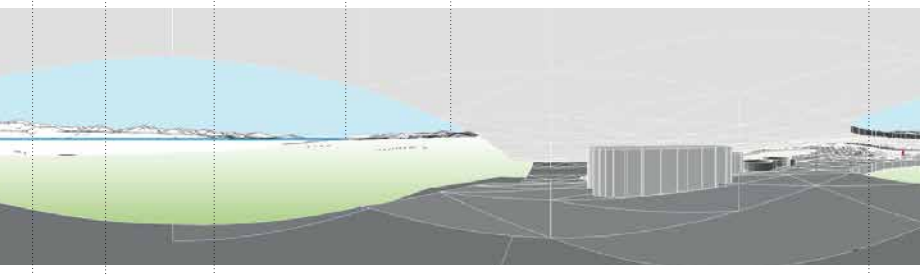
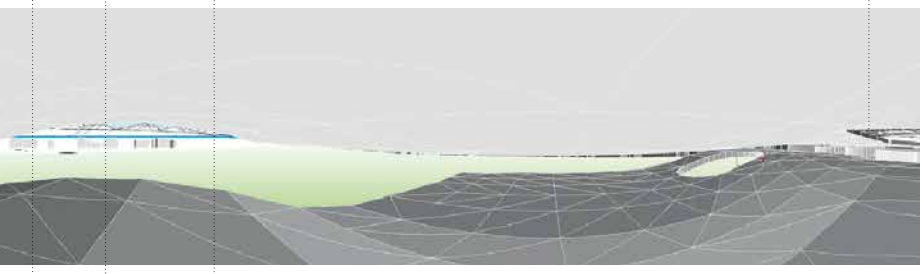
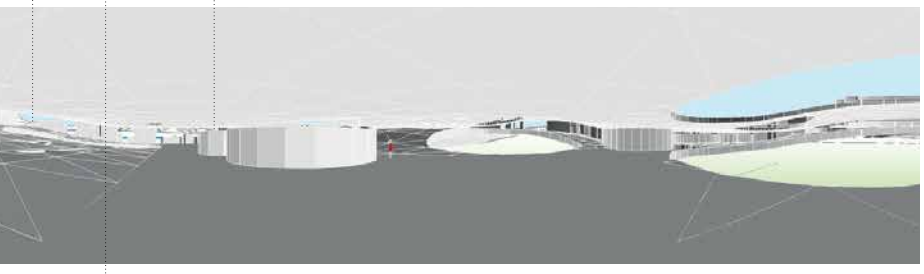




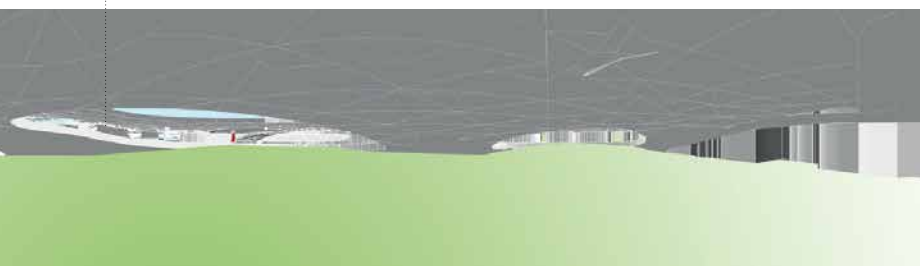

Restaurant




Foyer




Entry Hall inside




North Entry

photo above: Ariel Huber, further above: author

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The spatial play between continuity and framing of the landscape through the manipulation of the horizon is another design feature of the spatial form specific to this design strategy. In my spatial form analysis I could define three different inner horizons in addition to the existing external one. Each of these manipulated horizons is connected to a system of spatial relationships (fig. 5.5.2.2 to 5). The first horizon is related to the ground level (+0m) and is constrained above by the upper shell distorting itself before it even enters the building. The second horizon is related to approximately 60% of the surface inside that is flat and slightly above ground (+0.75m). It is more conventionally limited and shaped through hills, although this manner of treating space is only conventional for parks, never for buildings. This horizon plays a very important role for the spatial system since it allows for separation into three functional zones: the foyer, the central entry and restaurants, and the main area of library and other scientific program. The second horizon replaces walls as a spatial separator. The quality of a hill as space divider was used to create a degree of privacy through topography (Interview Nishizawa A2.1.3.).

The third horizon causes another particularity of this design. One would expect that the freedom of such a designed landscape would best be experienced in a big hall under a continuous flat roof. But the architects insisted on having the roof undulating with the floor slab, almost parallel at one height, except for the higher area of the auditorium. This limits the views from the hills (approx +7m) at some areas in an upward direction (much like the first horizon), but it also allows the views onto and across the roof that were explained before through multiple openings. The openings play a crucial role in establishing a complex system of visual relationships. It is often surprising how the openings are placed as if space was allocated to enhance the variety of inner visual relationships. In the first horizon, one could survey all the entrances from a point approximately 10 meters after passing each gate-like entry (red lines in first horizon fig. 5.5.2.2). In the inner space again, some major areas are connected by a system of interiors, as well as important exterior views that are already provided at ground level (red lines in second horizon, dotted if they cross outdoor space). Again the crucial role of the holes is evident, even more so for the internal visual relationships of the third horizon. From the hills, viewers on the previously defined three belvedere areas would see each other enjoying the panorama across a complex system of holes and crossing landscapes of the roof. These numerous horizontal viewing relationships compliment the downhill vistas that are tangent to the main routes to form a complex spatial system that equals the rich complexity of the spatial systems of vistas in the English landscape garden. An important distinction to visual landscape systems like the Woodland Gardens at Castle Howard (fig. 5.5.2.6) still has to be made: in the Learning Centre, the visual relationships are seldom related to landmarks or monuments, but more like in a natural landscape only to (artificial) topographical features of the designed landscape. Therefore the system is also less distinct and hard to pin down on exact locations - but nevertheless clear in its appearance. Again, the desire for freedom seems to be dominant across the establishment of hierarchy.

5.5.3 Image or Metaphorical Form

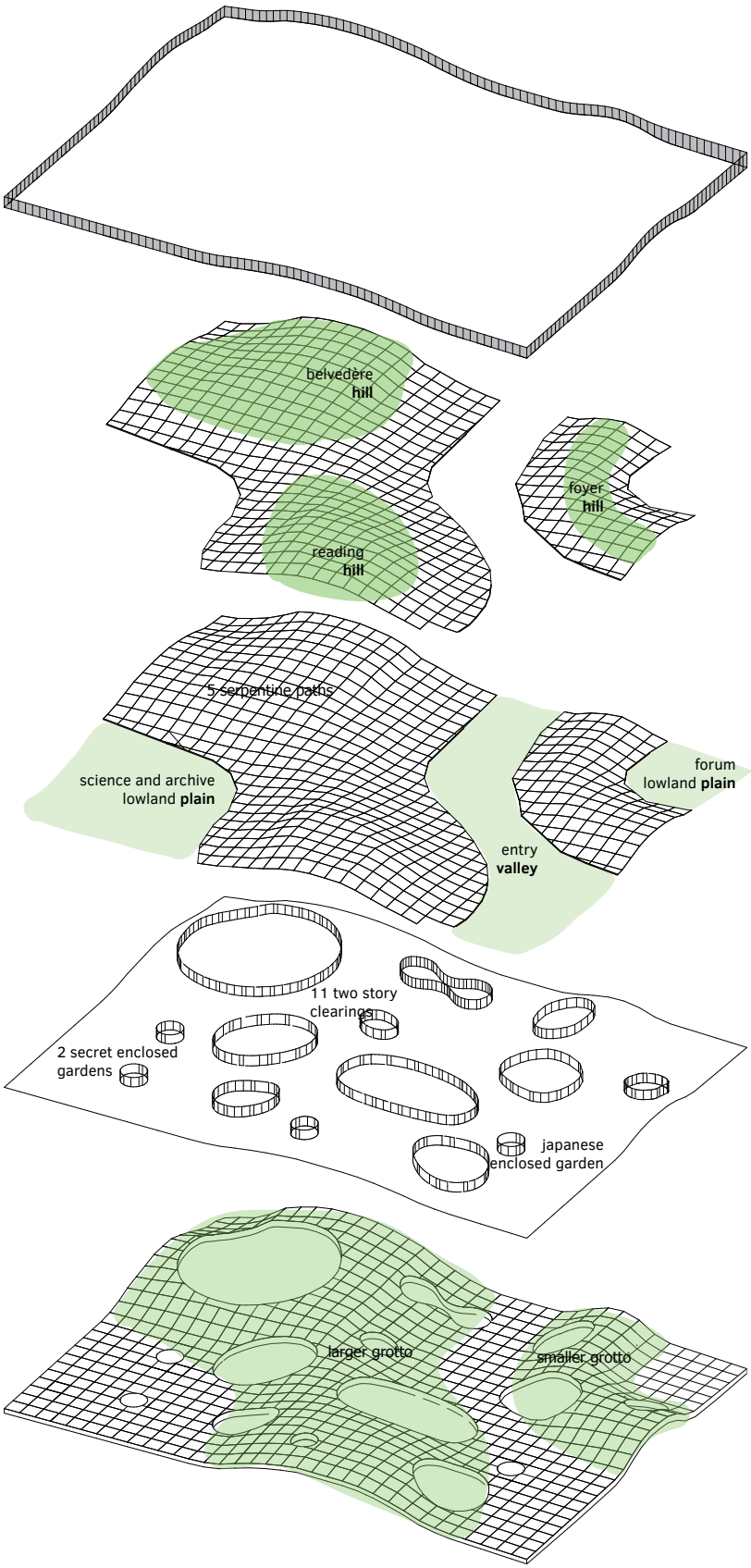
It is in this perspective of creating greater freedom that the metaphorical structure or image form of the Learning Centre project should be understood (drawings fig. 5.5.3.1-2). Different than the architects at OMA, SANAA would avoid a direct metaphorical language in their architecture - they are advocates of abstraction. If I asked them for landscape references, the architects did not want to be specific (Interview Nishizawa A1.2.3.). The following metaphors are my own working propositions as the author of this thesis and not necessarily supported by the architects. As mentioned in spatial form (ch. 5.5.2.) the images are not part of a system of fixed reference points. Rather, they are spread like sheep in an Arcadian field, which is also a specific design attitude, called field condition (Allen 2000).

Mostly it is the materialisation and detailing decisions of the architects that - however reduced in their language - remind me, as any visitor, of their chosen theme of landscape. Again very different from other designers, they use abstract imagined landscape features as working references. For this analysis, the images were separated into two groups: The first group consist of images that refer to elements of natural landscapes like we would also find in a park as a representation of nature in an artistic manner. The second group is not images in the strict sense of Steenbergen and Reh (2003 or 2008) since they do not refer to nature but to elements of cultural landscapes or even of infrastructure or the built environment. Nevertheless, all are beyond the conventional metaphorical vocabulary of Western architecture and chosen by the architects to support their general concept of a built landscape. I will summarise both groups in this same chapter but treat them separately.

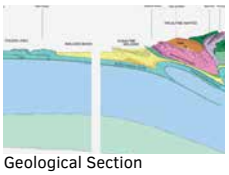
The first element, referring to nature, are the hills. They are not only a basic and spatial form but also cherished and treated as imagery. The same idea applies to the expressive exposure of the undulating slab in the facades; it looks like geological sections of a feature we recognise from OMA's Jussieu design which has rarely been seen, and never before at such an excessive scale of 166 meters in length (more than 500 meters of facade around four sides) with only one basic idea acting as the driver.

The treatment of the ceilings under the shells in raw concrete, together with the gravel surfaces and the dramatic lighting schemes, make the two passages and access zones seem like a grotto. The openings could also be described as clearings in a forest, especially after a few solitary trees with scarce foliage were removed to simplify the structural design of the south terrain. Their design according to lighting and cutting into the endlessly deep space could allow for this metaphor to take root.

A metaphor related to cultural landscapes is found in the different kinds of terraces. The round and stepped areas in the library are reminiscent of rice terraces in Asia, while the straight and simple moments comprising the restaurant terrace call to mind a renaissance garden at Palazzo Picolomini in Pienza (Bernardo Rossellino 1459) or the Villa Medici in Fiesole (Michelozzo 1458 - 1462; Steenbergen Reh 2003 p.32-41). At the Learning Centre terracing is used as a classical and straightforward approach to solving functional problems of slopes (compare to OMA's issues with book-shelves on sloped floors at Jussieu in ch. 4.4.). The same engineering or 'hands-on landscape' approach is visible in the handicapped ramps that are placed like serpentine roads. They are a playful allusion to the Alpine streets, a Swiss contribution to a mass culture idea of landscape as in the film Goldfinger (1964). Another way of mise-en-scene in the landscape manner is the placement of the info-point as a central actor; the position enhances a panoptic surveillance for the porter. The placing of rows of chairs like in a Greek amphitheatre, using the artificial hill slope (instead of a natural one) is another feature often found in landscape parks.



Sections



Geological Section

View form South East

Hills

Valleys

West 8 Expoparc Yverdon

Clearings

Clearing Iwan Schischkin 1896

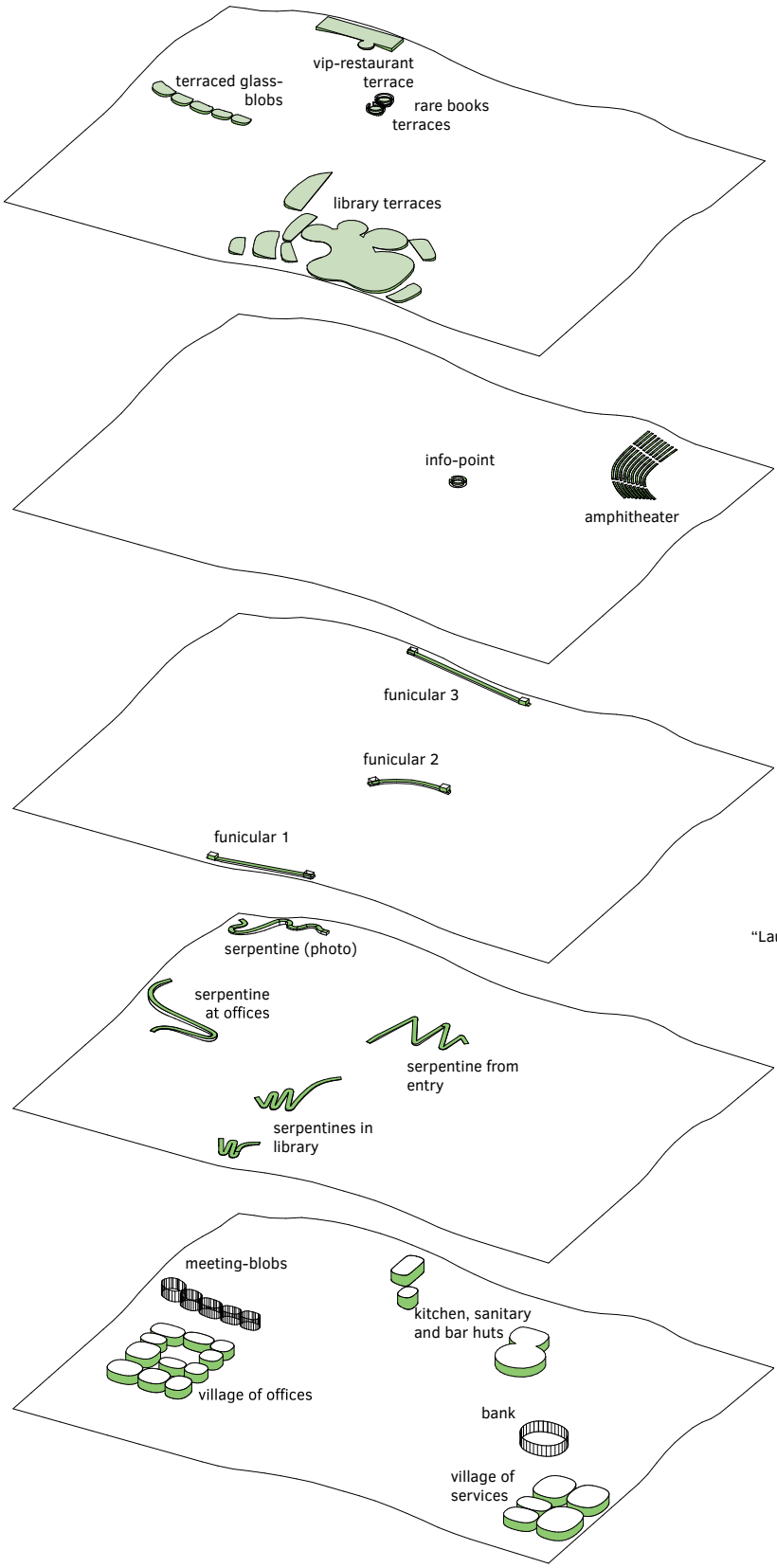
Lightfall. photos: author

Grottos

Painshill enjoyengland.com

Entry photo: Ariel Huber

FIG. 5.5.3.1 Rolex Learning Centre at EPFL, Lausanne **Natural landscape forms** (left) and **anthtopogenic Landscape** forms (right) (Drawings: author)
Image or Metaphorical Form



Terraces

Rice fiel in Hyogo, Japan

Terraces in Library

Theater

Delphi photo: Leonid Tsvetkov

Forum Rolex

Funiculars

"Lausanne - La Gare du Funiculaire" ca. 1882 source funimag.com

Funiculaire phot:M. Azéma

Serpentines

Furka Pass street (Goldfinger)

Serpentine Path

Villages

Village of Offices

FIG. 5.5.3.3 Slope raising to smaller foyer hill, view towards Lake Geneva across fences at opening 2010 (Photo Ariel Huber)

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The complex topography leads to treating non-public programs as a kind of miniature urbanism. The groups of offices are not placed in large contained areas or massive buildings inside the structure, but as clusters of tiny one or maximum two room huts. These could be seen as villages placed into valleys almost in an urbanisation of the designed landscape. Note the similarity to OMA's understanding of Jussieu as a city of books in a landscape. The pastoral landscape garden also knows such allusions to the villages as part of the picturesque.

The technical treatment of the landscape elements can be understood as the architects' comment on the many modern engineering works in the landscape of which both Japan and Switzerland have a wide range of examples. Sejima and Nijshizawa pointed out that Lausanne has "many beautiful examples about how to deal with the topography" (Nijshizawa Interview No.1 A2.1.2) and how they "went a lot of times" (Sejima idem). The city of Lausanne's relationship with the topography inspired them. This counts for the medieval and baroque city structure up to contemporary architecture. Bernard Tschumi's Flon transferium (1988-2001) dramatically articulates the verticality as public urban space. Also the three cable car elevators at the Learning Center remind a tourist attraction in Lausanne: the urban transport from lake (below, Ouchy), through station (centre, Gare), to city (above, Flon) is on similarly steep track cable cars.

As a large scheme, the composition of elements is not a hierarchically structured spatial enactment but rather a wide open field. The balance of elements and the use of the floor plan is laid out like an abstract painting. Besides functional requirements, the emphasis of the architects is on developing a proper equilibrium and sufficient space for the continuity of movement. Also it seems, as imagery is not important to their design attitude, it is not only disguising any obvious metaphorical allusion, but the composition hides certain spaces, allowing for the wider landscape to be foregrounded and the smaller elements to be reduced or set back.

5.5.4 Form of the Program

The last in our four layer analysis will be the program form. Here I can again show a very specific landscape approach to the issue of programming a large building of mixed uses. If it was important to the architects not to establish hierarchies, this approach will certainly be most affected in the distribution of program. This initial idea of non-hierarchical ordering on one floor is a programmatic one in the first place. It is the general attitude of the architect towards the spatial program as formulated in the brief and his specific answer is creating a continuous landscape as opposed to a building of staked floors (Interview SANAA A1.2.4.). So the functional zoning is not expressed with building up borders between zones. The emphasis is on exchange. The topography is used for allocating programs like they would be spread in a city according to various topographical fractures. With softened shapes and fluent transitions, the designs simulate organic growth. The functional groups are organised in valleys and on hills, like urban neighbourhoods of a large city, spread out or settled onto the topography according to rules of vicinity, accessibility, and views. These considerations are augmented with orientation advantages for light sensitive books to the north and light seeking restaurant-goers to the south.

If we again start from outside, the first group of programs are the two outdoor spaces under the slab. They connect to the central entry zone with a reception area and system of open hallways that first connect to the spaces we called public events on the south side. Two restaurants and a bar including the one with the required panoramic view on top of the larger hill are directly reached from here. A foyer takes the smaller hill in a classical disposition as an in-between buffer and noise protection zone for the auditorium, with a backside that could be used for foyer exhibitions.

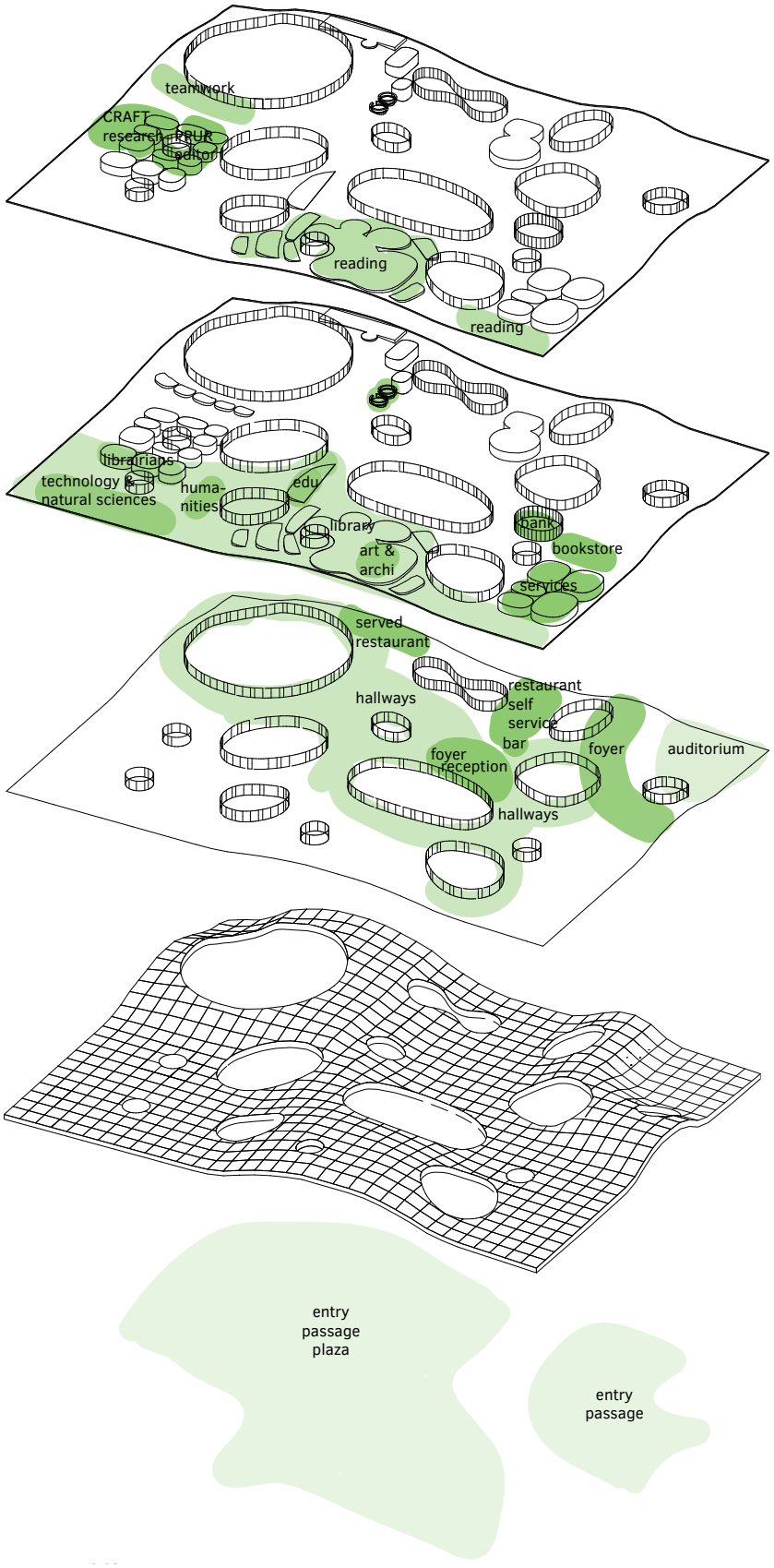
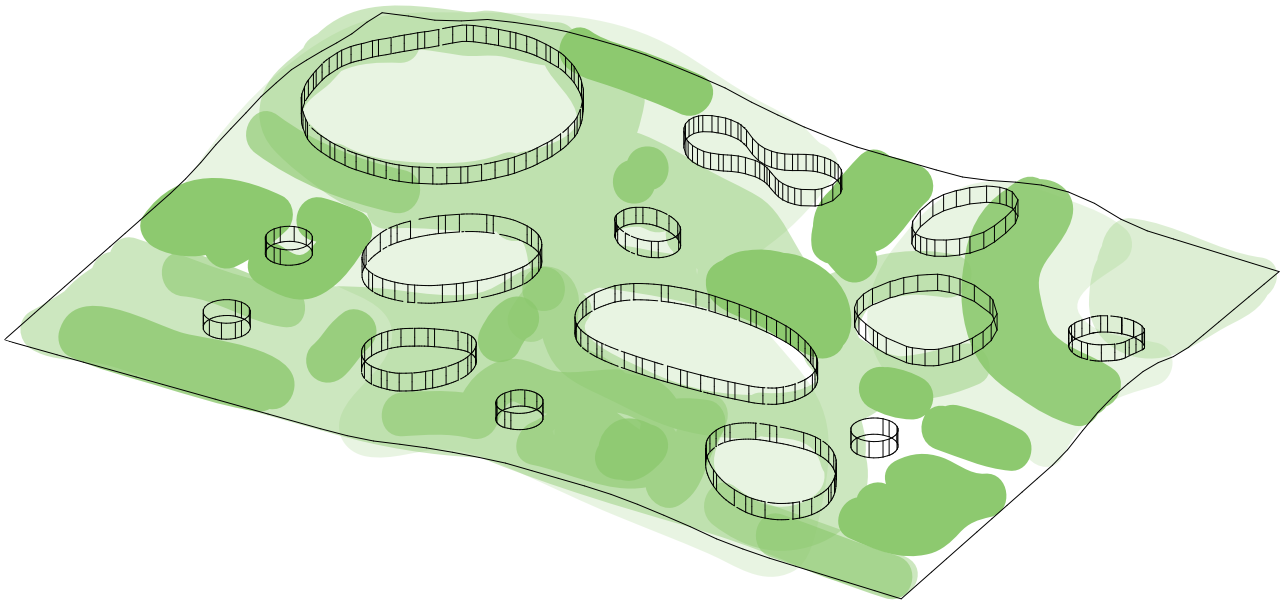


FIG. 5.5.4 Rolex Learning Centre at EPFL, Lausanne (Drawings: author)
Form of the Program



In the central valley back to the north, a series of services is placed behind some working desks on a quiet north facade. Across the larger hill eastwards one would reach the library with a reception desk on top of the hill and a back office behind. More offices are found there for the university publishers and one research institute for teaching with new media (CRAFT) that is related to the general program of the future of learning. All of these described zonings are meant to loop into each other. Chance encounters, and fruitful exchange in the freest possible way with the least necessary hierarchy is the main programmatic idea that led the architects to design this building as a landscape – in their vision the equal to uttermost openness and freedom of choice.

5.5.5 The Composition

To summarise the composition of Learning Centre and its distinction into layers, I connected them in one drawing (fig. 5.5.5.1). Juxtaposing these layers, we can find two extremes in one design: on the one hand, the design is light, playful, it has humour and irony, and at many points it's simply funny. Especially image elements scattered across the hills and valleys make this almost seem like a huge scientist's playground. SANAA also indicated they would love to see children use the building and were to go on with a school design (Interviews SANAA No1 and No2 in A1.2.) as their next project. Science could be seen as a cultivated kind of game: the readiness of EPFL to play is part of their innovation approach. They wish to be a global player in the world of top technical universities. The EPFL supports multi-million dollar high tech gaming like the winning America's cup sailboat design of Alinghi. Play is certainly a facet not to be underestimated in the university culture of institutes that want to reach for a top position in technology development. It is gaming for example that established the biggest leaps in the mass culture of computers. Landscape could be seen here as the architects' proposal for the scientists' favourite playground – if you would agree that this can be playful, it can also become a positive cultural attitude.

Another and different conclusive observation about this composition of landscape layers is a great will for abstraction and clarity in means of expression. Of all three projects (and many others in the appendix) the Learning Centre most intensely plays with landscape methods as design strategies but is also the most abstract in its formal references. It not only feels surreal like walking on the moon, it could be seen like the architect's model of a landscape more than the gardener's replica of nature. This is definitely a landscape but the landscape is built of concrete, steel, glass, white paint, shiny surfaces, and light grey carpet. As the last pieces of nature are stones outside, the architects do not seem too disappointed that previously planned trees where not planted in the end (Informal Interview Yamada in A1.2.1.). So even if this architecture has a voluntary landscape composition, it comes without any greenery, without any direct influences or unobstructed references perhaps outside of the white painted surfaces.

However complete and sophisticated the landscape vocabulary in this composition, there are no one-to-one copies. Everything is not merely used as an analogy but used in a translation into design strategies, which is gratifying for my research. A Landscape analytical method flipped into a design strategy is to reverse the ground form of a building within its larger context, flipping landscape inside the templum. In spatial form the rich vocabulary of spatial and viewing relations of landscape is adopted and used in sophisticated manners. Images are not displayed or copied but used as engineering or theatrical strategies to solve functional problems and disguise anything that would disturb the primacy of the landscape experience of space. Program is not organised by walls or floors but spread across a landscape to enhance continuity.

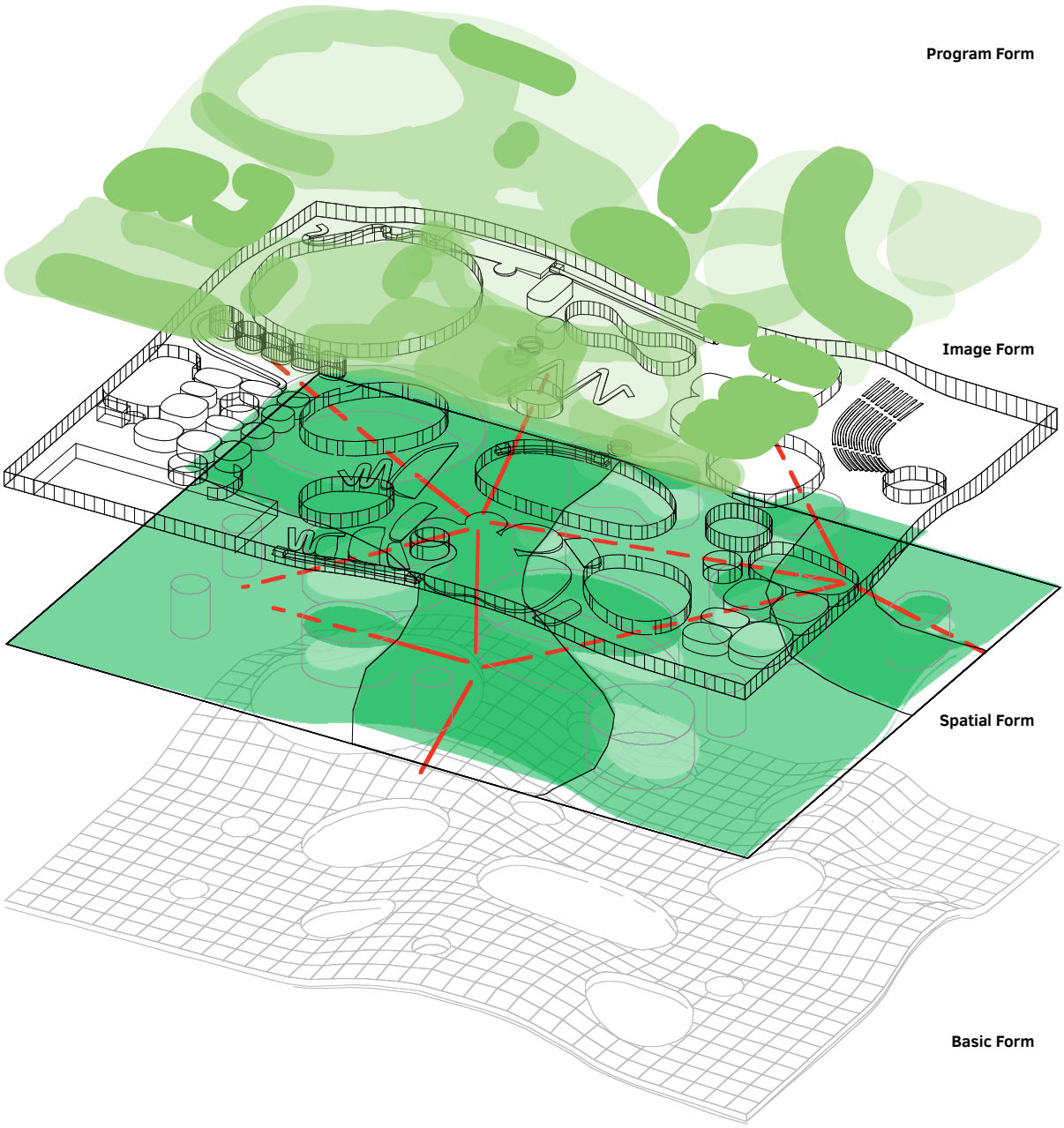


FIG. 5.5.5 Rolex Learning Centre at EPFL, Lausanne (Drawings: author)
The Composition

5.6 Specific Methods of Design Analysis for Learning Centre

The importance of spatial and viewing relations for the Learning Centre's architecture has not exhaustively been documented in my previous analysis of spatial form. The combination of geospatial data and architectural models has led me to new insights during this analysis. I brought up the hypothesis that mathematical analysis of my spatial data would also allow insights into the qualities of the space and create a new application for landscape related research methods into architecture.

During the research process therefore I came to collaborate with two colleagues at TU Delft that had developed specific software for isovist field analysis, which is analysis of measurable effects in visual space. In this section I apply isovist-based measures on my own three-dimensional modelling to evaluate the Learning Centre.

An isovist field represents the view a person has from a given point in an urban, landscape or architectural space. In our disciplines of environmental design it is used for orientation or way finding in the urban fabric, for understanding visual impact of landscape features or (less peacefully) to know the shooting range of a visually guided weapon in military science (Benedikt 1979). Before Computer Generated Imagery CGI became available for architectural research, such analysis was drawn and built manually: Minkowski-models of space-time phenomena (like movement or growth) allow one to visualise time and space in a physical model. Such models were cut out of cardboard or transparent plastics. They are named after Hermann Minkowski (1864–1909) who formulated space-time mathematics as a common mathematical structure to explain his former disciple Albert Einstein's theory of special relativity (Minkowski 1909 and 1910, Einstein 1905, et.al. 1925).

For this case we chose a novel isovist application developed by two colleagues in the department of Urbanism (Bilsen & Stolk, 2007). Our method was described in our common paper for the Geospatial Summit Delft of which the following abbreviated description is derived (Stolk, Jauslin, Bilsen 2014).

Isovist analysis is applied in research on urban forms (i.e. Stolk 2015), regions (i.e. Lynch 1976) and landscapes. Surprisingly it is very rarely used in architectural space. To create space, architects still seem to rely on intuition rather than on numerical analysis. Furthermore, isovists are often two-dimensional and do not involve the more complex relations of three-dimensional space in architecture. Nowadays 2D isovist analyses are used for design purposes in landscape architecture and urban planning carried out i.e. with the Depthmap software in SpaceSyntax or in the Geographical Information System ArcGIS (Nes 2011). We could however seldom find applications in architecture with the sole exception of an analysis of Frank Lloyd Wright's house Fallingwater by Peponis and Bellal (2010).

In their study of Fallingwater[117] Peponis and Bellal (2010) use isovists with Depthmap on the inside of the building. Beyond (open-) plan study, they cross levels taking into account (relatively

117 For Wright's concept of modern "natutal architecture" at Fallingwater see my section 3.1.7. in this thesis.

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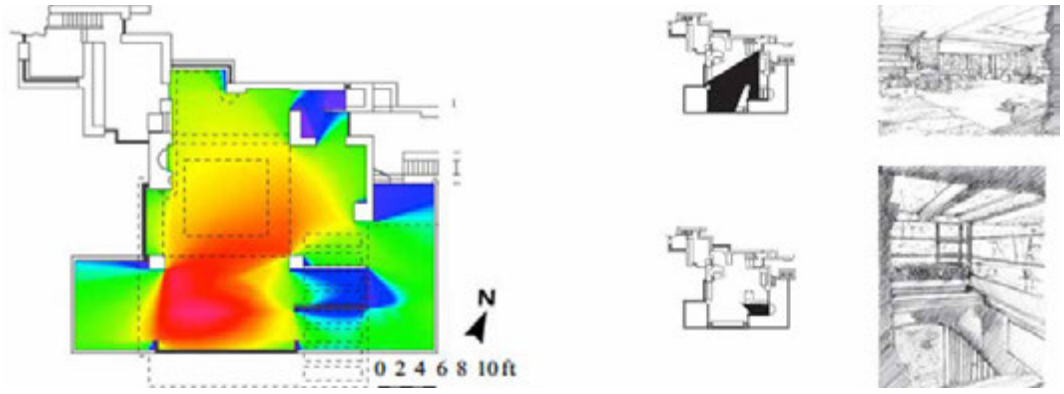

FIG. 5.6.1 Isovist analysis of Fallingwater by Peponis & Bellal (2010, p.7,11)

controlled) views across stairways. However, their visual space analysis remains only at the interior, concluding with a behavioural focus on usage of the interior space and plan (fig. 5.6.1). They are not addressing the crucial continuity of inner space at Fallingwater into the outside landscape, nor Wright's design development based on the unique landscape feature of the Bear-River falls. So even if this house is a case closed to my field of research, Peponis and Bellal leave inside-out view relations as a gap in isovist research.

The novel software called Aisophist was developed especially for 3D isovist analysis at TU Delft by Van Bilsen (Stolk, Bilsen 2012, Nijhuis, Lammeren, Hoeven 2011). The particularity of Aisophist is that it uses three dimensions and describes the view shed as a volume (fig. 5.6.3 3D-Isovist) instead of a surface (fig.5.6.2 right, 2D-Isovist, Stolk 2015 p.306)

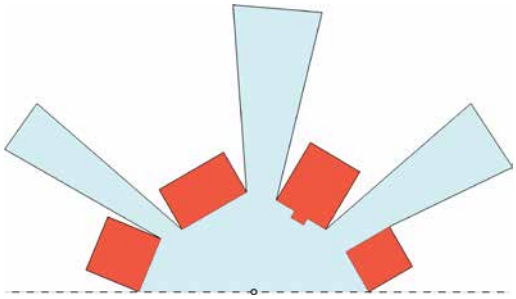

FIG. 5.6.2 2D-Isovist plan

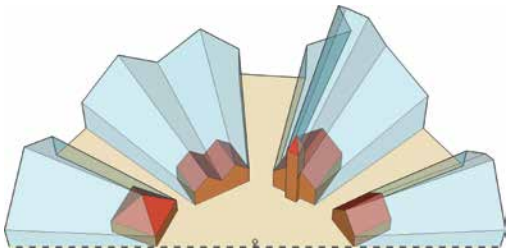

FIG. 5.6.3 3D-Isovist perspective (both: Stolk 2015 p.306)

Since their introduction by Benedikt (1979), isovists have been an active field of research on landscape qualities or systematic urban research of axial relationships in Space Syntax (Hillier and Hanson, 1984). We felt however that existing analytical methods are too far from real human visual experience. The aim of our specific new analytical isovist field method we consequently developed for the landscape method analysis of the Learning Centre. It applied the current state-of-the-art isovist calculations to a curved building shaped as a landscape, and allowed us to numerically support the design analysis of the spatial form.

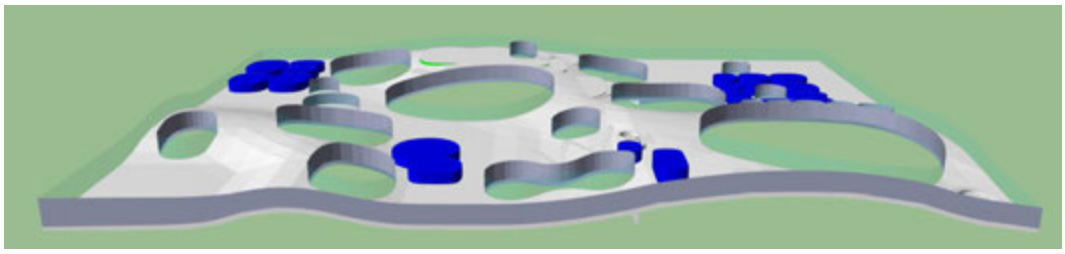

FIG. 5.6.4 My FormZ 3D-CAD model of the Rolex centre as used for the isovist analysis without the roof. (CAD-modeling: author)

The Leaning Centre has a curved floor and a lot of glass. The building geometry poses a severe technical challenge to our proposed analysis methodology and interpretation of the results. Transparent materials represent a technical complication in computer isovist analysis which was not yet been addressed in the literature. This problem had to be technically overcome (as further discussed in Stolk, Jauslin, Van Bilsen 2014) .

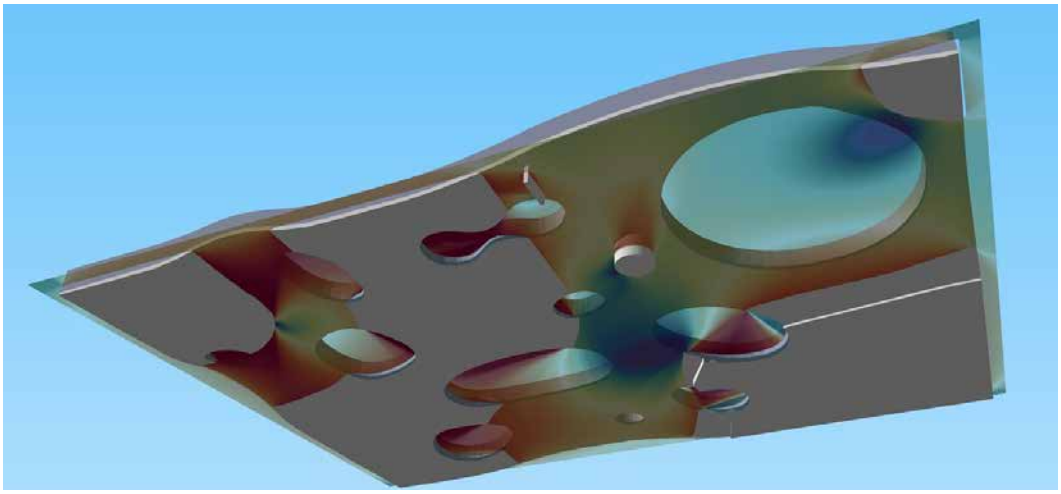

FIG. 5.6.5 Result of our isovist analysis (drift), together with my model, looking from below
(Data and visual: author and Arthur van Bilsen)

The analysis results cover isovists in two planes of 579,100 and 677,764 vantage points, each 1.75m above the (curved) floor, and with 390,150 lines of sight. resulting in a total of 490 billion lines-of-sight. It took about 15 hours of computer calculation. [118]

One of the my main claims developed in my analysis for the spatial form (section 5.5.2) involves complex sight lines and the thesis of three horizons. With my colleagues we looked specifically at a 2D isovist measure called diameter. The diameter is the length of the largest stick through the observer's position in the isovist. It tells us on which positions in the Learning Centre observers can have the longest lines of sight in both directions.

Fig. 5.6.6. The 2D isovist measures diameter from the interior space. We indicated three perpendicular view directions, indicated by white lines with black endpoints.

118 On Intel Core 2 Duo CPU E6550, 2.33 GHz, 32 bit OS, 2 Gigabytes of RAM, and 2 Nvidia Geforce 8800 GTX graphics cards in Sll mode with 1.5 Gigabyte of memory between them.

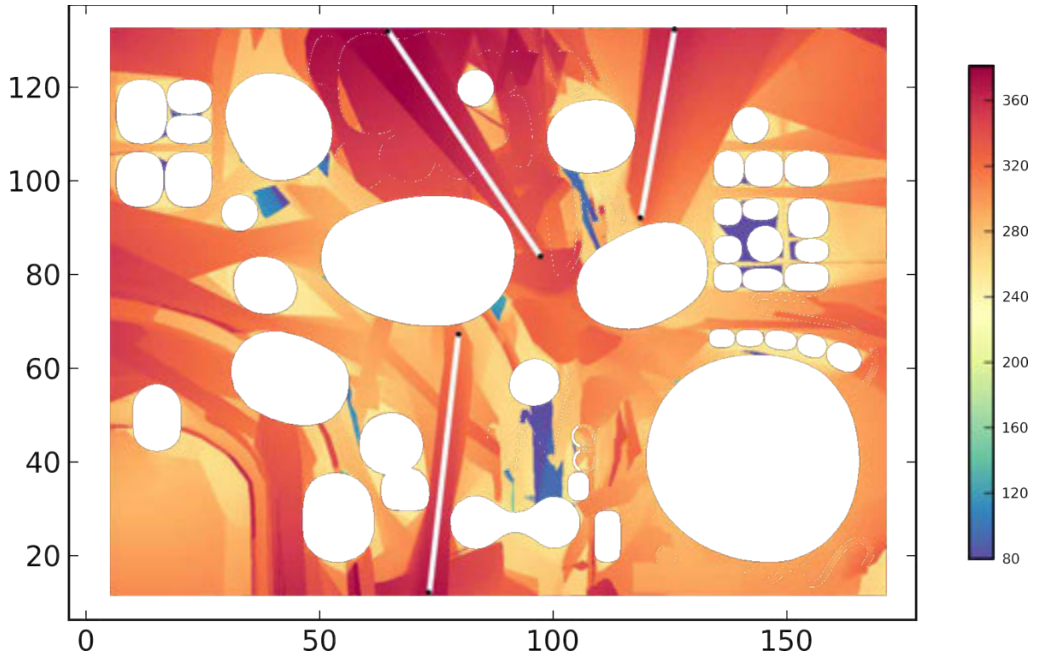

FIG. 5.6.6 The 2D isovist measures diameter from the interior space. We indicated three perpendicular view directions, indicated by white lines with black endpoints.(Data and graph: author and Arthur van Bilsen)

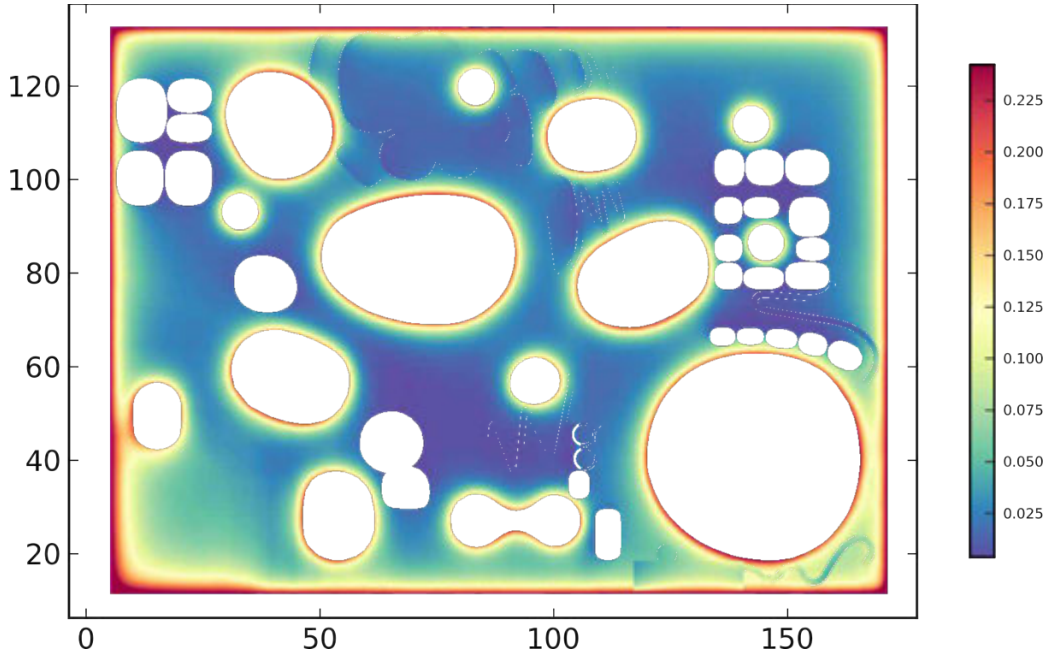

FIG. 5.6.7 The isovist measures sky, from the interior space. The red and yellow areas, receive relatively more natural lighting. (Data and graph: author and Arthur van Bilsen)

In my panoramic collage at chapter 5.5.2. I have demonstrated how the architectural landscape provides for a varied scenography of channelled and panoramic views that interweave the building with its campus, the city at 3km distance, Lake Geneva and several peaks of the alps, including Mont Blanc, 79.5 km south on the French side of Lake Geneva. The Isovist analysis of the outer view relations puts that into a plan relation.

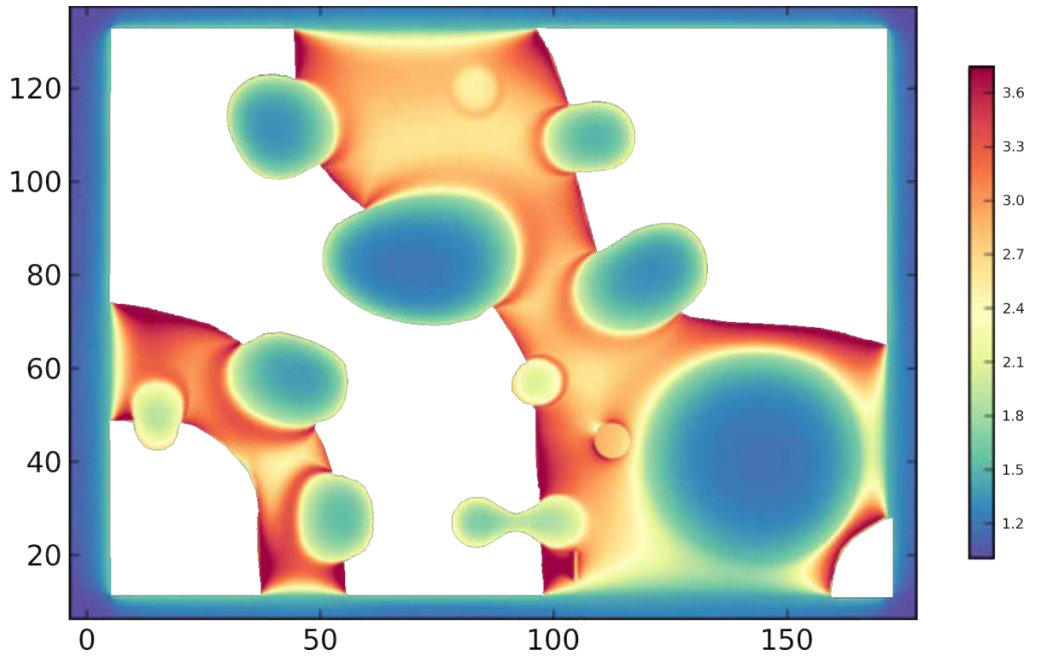

FIG. 5.6.8 The isovist measures relative standard deviation from the exterior space.
(Data and graph: author and Arthur van Bilsen)

From the isovist field sky (fig. 5.6.7.) we can show how that outer wall made of glass provides a large amount of natural light. Looking around, one experiences the wavy floor as hills. From which one can look outside unobtrusively to the horizon. The field also shows lighter rounded areas (bounded by glass) where the sky can be seen. That may remind the observer of open spots or ponds in an elsewhere darker forest. The lower left area receives the most sky light, and this corresponds to its functional design as an atrium.

In the building process description (section 5.4.) I explained how much effort was put into the design and structural engineering of a particular visual relation from the inner elevated areas through these round openings across lower roofs towards the surrounding landscape (Grohmann 2008) that we called clearings.

For the lower ground, dividing the standard deviation by the average yields a measure (STAV-30) marks open spaces (blue bubbles on Fig. 5.6.8.) as well as walls (red). The blue bubbles are the holes we called ‘clearings’ in the metaphorical form analysis. They would show up here not only on the edges but in the centre of the building. They include an entry - which is in the centre of the building - a particularity of the design of the Learning Centre. The blue areas show many gathering spaces in the open of the ground floor, that are in the midst of the building - a sequence of open spaces that qualifies the two caves under the hills as a unique feature in this building. The complex pattern in our diagram inside, as opposed to the simplicity at the border of the building shows how the encounter of ‘outdoor’ and ‘indoor’ space is spatially much more diverse inside the plan than on its edges.

The Rolex centre, with its curved floor and ceiling, its complicated shape and inside-outside interaction, posed a severe challenge for isovist analysis and interpretation. Nevertheless we showed that 3D isovist measures can rigorously be applied to architectural spaces, while at the same time we highlight the challenges of 3D isovists.

The great variety of landscape strategies that have been used in designing this building can better be understood through the specialised analysis with isovist. For my thesis I can derive from this specific analysis, that landscape in architecture could enlarge architectural design with the use of more advanced methods of numerical analysis of spatial qualities. Up to now architects often leave such numerical modelling to specialists (i.e. in daylight simulations, acoustic simulations or shadowing studies). The main field of visual space interaction and its design is however still managed mainly by model building and perspective drawing, like since the renaissance, even if at increasing speed through computer modelling. If we would integrate spatial analytical tools like Aisovist into our daily understanding of space in architecture – and into the daily practice of computer software – a new spatial understanding of the built space as a visual environment would trigger more landscape experiences – and in this, a wider quality of space in architecture. With the above application of isovist analysis to the Learning Centre I point out a direction of possible knowledge transfer from landscape and planning analytical methods to architectural design strategies, that so far have not been used.

5.7 Landscape Architectural Attitudes at the Learning Centre

Just how much do SANAA use the design attitudes of landscape architecture? (Marot 1999, ch.2.3). Their relation to the anamnesis of the site is certainly intense, although approached clearly and intuitively from the view of an urbanist that does not delve into geological or even lengthy historical research. Although incorporation and reinterpretation of the existing context, be it built or natural, occurs in kind, SANAA's approach to history is rather one of creating a story than one of reacting to it. It's almost a work of science fiction creating a surreal landscape rather than an actual reaction to the existing landscape. The autonomous figure only relates with a few elements to the site. Compared to the far outreaching historical relations of our other two cases, theirs is rather light and playful - avoiding even at times exact relations in preference of an autonomous statement.

The process attitude can be seen in the creation of an 'anti-object'. Even if the Learning Centre's artificial landscape is distinct and intentionally designed, it is also a complex relational system. The design process that led to Learning Centre seems rather intuitive but with disciplined control, in a kind of formal mystification, we find a functional synthesis. Natural processes, as we would expect them in landscape architecture, are not involved in this purely formal design except maybe for the treatment of natural lightning during the day in the depth of the building. I would like to describe the attitude toward landscape process at the Learning Centre mostly as a transformation of the whole campus through implementation of a new activating core: the new insert acts as a sort of urban pacemaker with relations across both campuses and into the city and the surrounding landscape: The architects were curious as to how people would actually use their design (Interview No2 A1.2.). They seem to be triggering a certain process of institutional transformation by creating a new learning environment. This experimental composition with a new mixture of ingredients seems to refer to the transformation processes as we find them in landscape designs - like a park can transform or structure an urban tissue this building acts on its (not very vegetated) campus environment.

The spatial sequencing of course is a key attitude in this design. In circulation, continuous space, and the sophisticated treatment of horizons and views, this building achieves a previously unknown richness of an almost baroque density. The reduction of formal elements other than those details that describe the space enhances this attitude. A subtle but clear influence of the visitor flows to the forms gives a clear direction for the architectural detail language to support the predominance of space and movement. Routings and views are intensely used - but all of it is less directional than in the Jussieu project. At least in the initial set up (that was maybe too challenging) many alternative routings for each part and destination remind really of an urban park setting for a great variety of programs. I have particularly enjoyed this freedom in spatial experience - and the sophisticated composition of ascents, descents, strolls, and passages along a great variety of changing views. I think the spatial richness stemming from this freedom of movement is stronger here than any other building I visited, except maybe if the Jussieu libraries had been built.

The contextual relation of the new building in campus and surroundings is ambiguous: the composition is at once very autonomous but also very contextual. The architects regard the outer context as a means of orientation, carefully monitoring transparency. On a misty day it is not easy to orient oneself in the absence of these hierarchies. No conventional “turn left or right” kind of instructions apply. Through the inclusion of these contextual relations into the inside of the building contextuality is in such a way enhanced. The creation of a contextual system beyond the horizon of the building - rather than a solitary object - is what makes the Learning Centre a key piece to future urban development of the whole campus. The manipulation of the horizon in the building is rarely so strongly related to context than here.

TABLE 5.7 Resume Rolex Learning Centre Lausanne

Landscape Design Strategies at the Learning Centre Lausanne			
4-layer design analysis (Steenbergen & Reh 2003)			
Ground form	**Spatial form**	**Image form**	**Program form**
Continuous floor topography elevating to panoramic level, providing openings underneath. Also readable as two merged hills	Routing flows around undulation. Strong multi axial viewing system, reacts to form, consciously manipulated horizons,steered views in a landscape park style. Spatial principle of undulating hills.	Main image of single folded slab, simple geological section. Landscape imagery elements are: grotto, slopes, hills, terraces, amphitheater, huts, clearings, serpentines, funicular, small inner gardens. Key metaphor of minimalistic and surreal abstraction of a landscape	Programming strategy of colonising a landscape statically. The building re-framing an inner city in the open campus, contains a park as an interior landscape, like a reverted frame.
Landscape attitudes (Marot 1999)			
Anamnesis	**Process**	**Sequencing**	**Context**
Science Fictional and almost avoiding historic relations in favor of autonomous statement	Spatial and institutional transformation of campus through implementation of activating core.	Sophisticated sequencing of paths and views with several horizons. Less directional than Jussieu but with many alternative routes. Composition of ascents, descents, strolls and passages along variety of views.	Ambiguously both autonomous and contextual. Manipulation of horizon reaches beyond limits of the building.

5.8 Landscape Design Strategies at the Learning Centre

In explaining the Learning Centre, SANAA’s architects oftentimes referred to landscape and used the term as a guideline throughout its realisation. The Lausanne case is a key example of landscape as a concept in architectural design. It contributes to the amplitude, variety and reach of landscape strategies in architectural design. It would be very difficult to describe this building with different means than those relating to landscape design. As already stated in the composition analysis, landscape ideas have been translated here into design strategies rather than only quoted visual analogies.

How does SANAA apply landscape design strategies in architecture at Lausanne? What are their motives and goals to do so and what do they accomplish? (Q. 1.1.3.)

The main motive for SANAA in my opinion was to provide a single uniting space for all university members in a non-hierarchical way. To reach this goal the ground form and spatial form where manipulated, landscape metaphors introduced and programming of the space was set free from structural constraints. In the application of landscape strategies in the design they had to further develop the visual impact of grading with large scale physical models. New construction methods in particular for computer manufacturing concrete formwork and a complex reinforcement structure had to be developed to make a seemingly simple idea build-able. This included the use of complex topographical models and new digital tools developed for the formwork. The design resulted in a complex logistic construction sequence, as for example the continuous concrete pour of the large hill in only three days. In terms of building measure control, the limits between measuring natural morphologies and artificial topographies also become fluent in a technical sense.

Here again we see a social program as in the Jussieu project, though compared to the rough looks and the high expectations yielded by the Utopian and critical Jussieu project for two Paris Universities, SANAA delivers the perfection and polish of a well crafted and still more moderately novel project for EPFL Lausanne. A certain conformism that works well in the Japanese and Swiss social context is at play here – a Swiss Federal University in the 21st century is far from the socialist revolutionary context of Paris in May 1968 that was evoked at Jussieu. The architectural perfectionism of SANAA lacks that rebelliousness; on the contrary, the Learning Centre required the sponsorship of a luxury brand and a kind of consensus that is sympathetic to the architects' design in order to make this real.

I would like to elaborate my argument further than the documentation of an application of landscape as a design guideline into our own theory of landscape design strategies. I am more keen on showing their interrelation in a spatial composition than leaving each as sole elements. Landscape design strategies – this might be the most important intermediate conclusion from this case – will not be subdivided into particles nor statistically proven.

Which landscape elements are applied to architecture at the Learning Centre, what concepts of landscape are applied in architecture, and how is their formal composition developed? (Q. 1.1.4.)

In my four layer analysis I found a number of composition elements that contribute to spatial experience, unexpected and rarely known from works of architecture before this one. By means of inversion of the ground form the architects do not put a building into a landscape but bring the landscape inside of the rectangle of the building perimeter. In consequence, the spatial composition of inside outside relations is used to structure the building itself more like a park than like a house. The materialisation and single solutions use a whole vocabulary of metaphorical analogies to landscapes. The programming is consequently more a zoning in that continuous landscape, like on an urban plan than a division into rooms with the usage of a conventional floorplan.

The whole composition in all its elements prioritises the spatial experience, which I see as the core concept of landscape applied in this architecture. While using the four layer model in understanding this architectural composition I showed how the manipulation of the basic form and the spatial relationships influenced the three dimensional perceptive space. I also showed how landscape imagery appeared to be divided into natural and cultural references. If landscape is nature or culture is sometimes not differentiated by architects. I then found how a landscape approach could be an approach to program in a completely different manner than architects are generally used to

FIG. 5.8.1 Worn railing at barrier to books ...

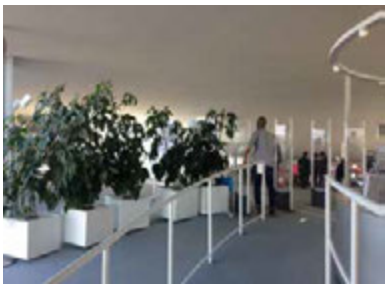

FIG. 5.8.2 ... library user slipping trough ...

FIG. 5.8.3 ... barrier of flower-pots.
(Photos: Matthew Skjonsberg)

dealing with: letting the program emerge from a manipulation of space rather then letting the space be manipulated by the program. All of these findings may not have been so clear if I did not follow the chosen analysis in the 4-layer model. It extracted useful methods, the first to be summarised under the term of landscape design strategies.

How does SANAA understand the idea of landscape and its design strategies for application in the Learning Centre's architecture? (Q. 1.1.5.)

I mentioned in the attitudes that SANAA established with the Learning Centre a contextual system beyond the horizon of the building. It is not a solitary object but strongly connected to a wider development strategy. The application of landscape design indoors serves a metamorphosis of spatial and intellectual context of the University.

If landscape strategies ought to be useful for architectural design, and not just about defining a new layer for art history or a limited space for "dumb theory" (Allen 2000 see ch. 1.4.) we will have to cherish their lively and dynamic character of constant metamorphosis.

The Learning Centre project, reflecting the future of science, is based on the dominance of experiential qualities. As evoked before, looking at landscape strategies is a holistic approach to architecture (ch. 3.1.4). Consequently I propose to understand this architecture as a whole experience rather then trying to cut it into slices with an experiment that is opposed to its nature.

What kind of landscape strategies are successfully applied to the design of these different cases of architecture? (Q. 1.1.6.)

I observed two peculiar types of reactions in the first weeks (which Ariel Huber or I were not allowed to photograph): students would use only flat spaces for working - especially to plug their laptops in at the tables. They would also move the available sitting bags towards the facade or a column to lean on that, looking for any vertical limit that the architects where so keen to avoid. On the official photo shoot before opening, the project manager carefully saw to it that these coloured sitting bags were arranged like sheep grazing in the pasture.

Also the other observation raises questions about the practicability of freedom. One of my first questions I asked to a librarian (on the December 2009 visit) was how they would ensure books from being stolen. The official plan then was to use an electronic system that would automatically charge a book taken onto the account of the one who removed it. However such virtual limitlessness did not seem to work as of April 2010. Instead, the librarians had to build up a wall of square (sic!) flowerpots left and right of the electronic control gates to force visitors through their checkpoint. They would cross the landscape in an ugly way. A visitor compared this to the Berlin wall, probably

referring to the ignorance of its spatial impact. The client's greenery absurdly cuts through the continuous landscape (fig. 5.8.1). Despite the flower-pot-wall, users regularly slip along bars to avoid the control panels or take alternative routes (fig. 5.8.2), which can be seen in the strong abrasion of the white paint (fig. 5.8.3).

Fig. 5.8.1-3. Improvised border building around the EPFL Library in March 2017- Photographs by Matthew Skjonsberg

Like many other innovative buildings, it is not always predictable in planning how experimental architecture will succeed. The Lausanne campus building and its usage are something to be watched further in the future to learn more about the possibilities and limits of application of landscape design strategies.

Still the second case here leads to an intermediate conclusion of my main question.

In what way do landscape design strategies change how we understand and create architecture? (Question 1.1.1.).

The architects' aim of creating a "landscape for people" (Nishizawa 2008 in El Croquis 139 p.31) is not a goal in itself but a means to an end; to create a human environment in relation to nature would be a goal for their landscape strategy. Like the architects I would like to keep walking though the Learning Centre before concluding, we ought to keep our thoughts in motion.

The analysis of the Learning Centre is surely an important part of my discovery of landscape design strategies for architectural design. Landscape develops here as the aesthetic mediator between nature and human. With the Learning Centre SANAA display their craft in organising a building space as a landscape. Aesthetically and intuitively the Learning Centre provides a unique spatial experience and in surprising and delightful ways connects the building and the environment in a skilfully arranged landscape composition. SANAA have broken down programmatic separation and provided for a continuous space on one level. All structures smoothly envelop human space while giving immediate access to surroundings, using no (or less) walls and defining space more to be explored - than separated.

The project serves a client's program but experiments with it or defines its own need. Certainly architects could engage in a more fundamental reflection about what we need and how we could achieve that. They may not be able to do it when competing for clients and their prestige projects.

With the Learning Centre SANAA remained playful but also precise in their design. Aesthetically and intuitively the Learning Centre provides a unique spatial experience and in surprising ways connects the building and the environment in an arranged landscape composition.

The conscious use of spatial means, the mastery of craft that we encounter at SANAA's works points in a direction where future architects may find solutions. Being conscious of the goals and needs of a human dwelling - living, working, and learning - prospering in an environment should be more of our concern. Making a liveable and lovable environment by transforming spatial conditions - such could be a fertile way to engage with landscape for architects.