

Environmental control and spatial composition are intrinsic elements in Alvar Aalto's architecture of free-flow open space as traced here in his project for Viipuri Library (1927–1935).

Atmospheres of space: the development of Alvar Aalto's free-flow section as a climate device

Ulrike Passe

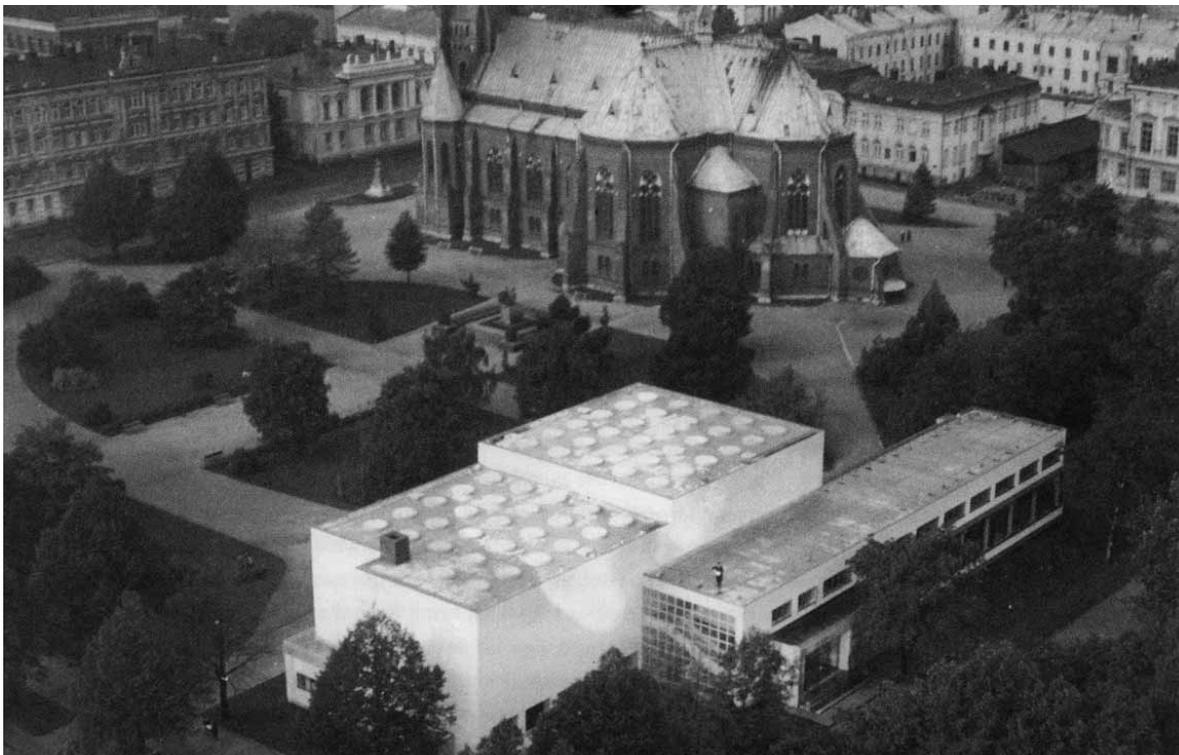
This paper is part of a broader research agenda, which aims at an environmental re-reading of selected icons of Modern Architecture that share one characteristic, the development of a free-flow open section.¹ The complex relationship between spatial composition and thermal and climatic conditions within buildings is explored both qualitatively, using analytic drawing, and quantitatively, using simulations with computational fluid dynamics. I am seeking patterns common to both and the work has become an investigation of the concept of architectural space at the intersection between art, technology, climate and perception. Most architects of the Modern Movement addressed this relationship in one way or another. They either praised technology and the emerging 'machine age' or rejected it. Today most architectural production appears to have an ambivalent and sometimes contradictory position on technology. For example,

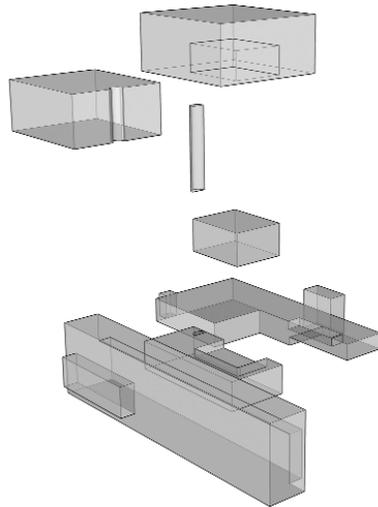
in Chapter 8 of *Differences*, Ignasi de Solà-Morales states:

*The mission that so-called high-tech architecture seems to have chosen for itself is precisely that of responding positively, with prophetic optimism, to the need for a reconstructed relationship between new technology and new architecture [...] by putting forth clean, energy-controlled architectures that would, in short, offer comfort and happiness to the user [...] His [Foster's] architecture is ultimately the most refined manifestation of conservative ideology and the most stable support of established society.'*²

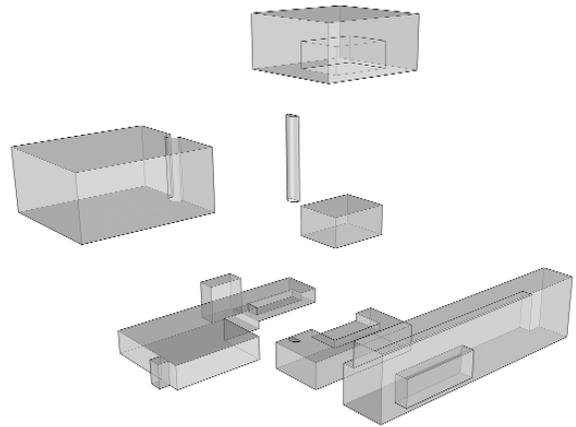
My research balances a search for objective measurement of the spatial phenomena of air movement and the architect's conceptual

¹ Aerial photograph of Alvar Aalto's Viipuri Library in its original urban context

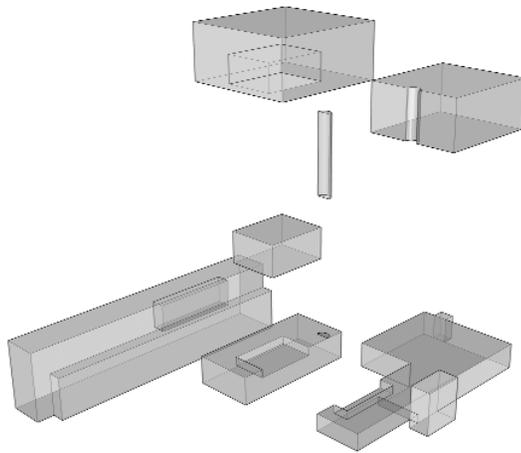




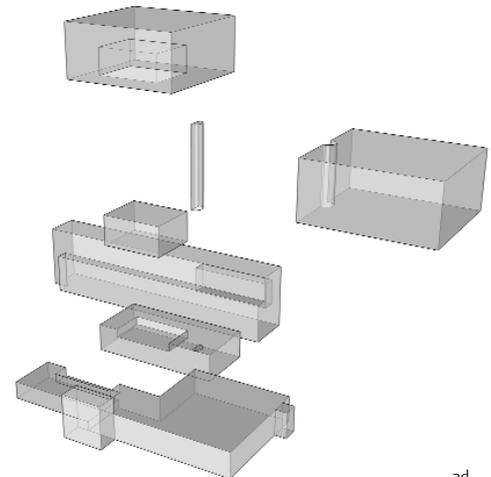
2a



2c



2b



2d

understanding of spatial composition. I investigate these relationships through the work of Alvar Aalto, who expressed doubts about the achievements of technology:

*'Rational calculations are no more reliable than faith or dreams [...]. Thus the attempt to eliminate the human factor is a sign of helplessness, a prayer for advance pardon, a wish to replace the knowledge of life's uncertainty with absolute certainty and some kind of truth, but the result is, that the same margin of error that was inherent in emotional calculations is transferred to rational calculations. The hope to eliminate the human factor by absolutist measures remains an illusion.'*³

Aalto adored Charlie Chaplin and often wrote of the necessity for his architecture to relate to the 'simple man', like Chaplin's characters in *Modern Times* and *Gold Rush* who faced the overwhelming power of modern technology.⁴ Aalto once recalled an incident that happened when he started teaching at MIT: his students presented a quantitative and technological analysis for a children's hospital and Aalto asked if

they had taken into consideration what would happen when a lion jumped through the window?⁵ He thus criticised the students for neglecting intuition and chance in their design strategies.

The Viipuri Library [1], designed in the period 1927–35, is a striking spatial composition and very rich phenomenological experience. While the early critical reception of the building (see Giedion,⁶ for example) focused on the undulating ceiling in the auditorium, more recent criticism examines the building's spatial ideas. I will extend Michael Spens' argument and say that the asymmetrical spatial shift – the open section and its resulting environmental effects – are the key contributions of this building to architectural history [2a–d].⁷ The library integrates, *spatially*, the environment systems for lighting, heating and ventilation. My overall research goal is to show how the composition of free-flow open space and its contribution to occupants' wellbeing and comfort correlate to thermal properties and natural ventilation flow.

Free-flow open space (*fließender Raum*) and environmental control

Free-flow open space, as distinct from free-plan architecture,⁸ is my term for spatial compositions that address flow and continuity along all three axes of space. Such spaces are connected by wall apertures, open passageways, niches, stairways, split levels, interior windows, galleries or double-height spaces. Enabling interlocking connections in plan and section, free-flow open space blurs the boundaries between individual rooms and between inside and outside. Through the phenomenon of the partial enclosure, intermediate spaces are created that belong to more than one system of spatial relations and offer multiple possible movement patterns for air, light, people and vision. In Alvar Aalto's work this spatial concept is already apparent in early works such as the Villa for Terho Manner built in 1923 [3a–b].

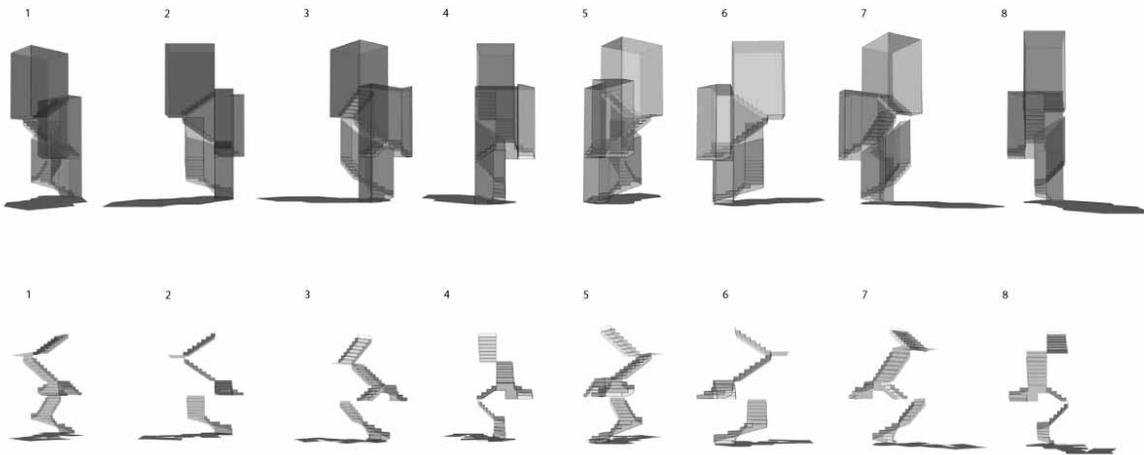
Modernism often achieved the simultaneity of inside and outside through a solely visual connection. This apparent 'flow' is achieved by

sealing the interior of the glass box from its exterior climate. In order to take advantage of the physical properties of air – weight, pressure, temperature, and thus flow – interior space should engage more than one climatic condition.

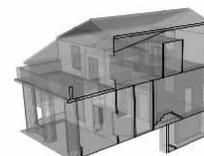
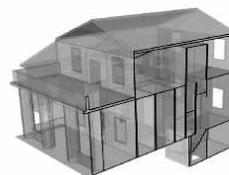
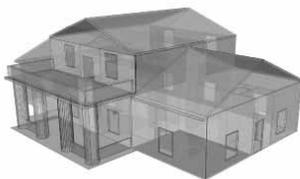
To position Aalto's work in context, I will offer a brief re-reading of Modernism's relationships to mechanical control of the environment and then present an analysis of the design stages of the Viipuri Library leading to the final built version. Aalto aimed at a Modern space for vision as well as for the environmental senses: thermal, tactile and acoustic.

Space in modernity

Sensual perception of modern space as an expression of the Modern age was, and often still is, reduced to a matter of visual aesthetics.⁹ Architects, theoreticians, and critics all address Modern buildings as exclusively visual phenomena. For example, Giedion, in *Space, Time & Architecture* hardly mentions the importance of environmental conditions at all.¹⁰ László Moholy-Nagy, an important protagonist of the



3a



2 a–d Aalto, Viipuri Library. Exploded axonometric drawings showing main volumetric elements of the composition

3 Aalto, Villa Terho Manner
 a The evolution of space in-between; axonometric drawings of the staircase
 b Cross-sectional axonometric drawings highlighting space in-between

3b



4a

Modern Movement, argued for the development of a new approach to space, calling for the 'The New Vision' of space-in-motion, a purely visual device, leaving the rest of environmental design issues to mechanisation.¹¹ The possibility that spatial composition can have a climatic effect (so crucial to the contemporary rediscovery of passive strategies for heating, cooling and ventilation) is neglected by architects. Control systems for thermal forces have been separated from space and vision. Beatriz Colomina realised this contradiction in the work of Le Corbusier. She indicated in her analysis 'Windows' that Le Corbusier's separation of vision from all other environmental forces (and senses) can be seen as one reason for the placelessness of modern 'man', an essential concept of the Modern Movement.¹² The liberation of vision and space from the limitations of building mass and historical styles was facilitated by an absolute control of the thermal environment and related energy flows.

Reyner Banham and mechanised environmental control

During the late 1960s Reyner Banham, in the *Architecture of the Well-tempered Environment*, reminded architects that environmental forces have shaped architecture throughout history and that environmental systems should always be manifest in architectural form.¹³ He also brought back to light early Modernists like the visionary Paul Scheerbart who had a comprehensive understanding of the environmental implications of, for example, an all-glass building. Banham quotes Scheerbart's call to 'remove the sense of enclosure', to dissolve the building's mass with '[...] whole walls of colored glass [...]. The new milieu for a new culture'.¹⁴ Scheerbart realised that all-glass buildings required new technical strategies such as a double wall with insulating air space against heat loss. Today, 'green'



4b

4 a-b Interior of Aalto's Villa Mairea, showing the suspended wooden ceiling which is perforated to allow the passage of conditioned air

5 a-b Aalto, Viipuri Library. Interior and exterior view of conical skylights

designers are returning to marginalised passive strategies. Reyner Banham himself was a person of his time and emphasised the mechanical solution, assuming a structural approach was passé or belonged to the vernacular (see Banham's final chapter).

Banham also analysed Le Corbusier's *mur neutralisant*. In *Towards a New Architecture* Le Corbusier discusses the relationship of technology and art, technological invention and space.¹⁵ His *mur neutralisant* was supposed to provide the interior with the same uniform 18 degrees Celsius all year round. While visually relating his architectural promenade to the exterior,



5a



5b

Futurist synthetic theatre: *Sensualità Meccanica*

In the chapter ‘Architecture of Sensation’ of his book *Questions of Space*,¹⁶ Bernard Tschumi points out a less well-known development with a very different approach to new technology, atmosphere and comfort. In the early years of the twentieth century, the Futurists aimed to liberate space from its boundaries and leave architecture as it was known completely behind. The Futurist performances of Filippo Tommaso Marinetti and Fillia (pseud. Luigi Colombo) hint at where this new ‘architecture’ was supposed to lead. In Fillia’s *Mechanical Sensuality* we read that:

*Temperature was intended to be an aesthetic element [...]. Ventilators on three sides of the hall or auditorium were to change the temperature during different parts of the presentation. In the first part, the room was to be “very cool” in the second “normal” and in the third “very hot”.*¹⁷

With the same urge to challenge the sensual boundaries of space to create excitement and manipulate perception Marinetti used modern technology. In his *Total Theatre* he introduced odour by using a ‘perfumer’, while in the *Tactile Quartet* tactility was emphasised by using fruit skins. In his manifesto *The Futurist ‘Atmosphere-Structure’, Basis for an Architecture* (1914–15), Enrico Prampolini writes that ‘Futurist architecture must have an atmospheric genesis since it mirrors the intense life of motion, light and air which nourishes Futurist man’.¹⁸ These examples show that in early Modernism the curiosity to explore and distort conventional perception went far beyond the visual and extended to smell, thermal comfort and tactility using the mechanical ventilator as an experimental tool in the same manner in which others had used the camera.

In summary, three approaches to the control of environmental forces can be traced in Modern

Le Corbusier also needed to close it off from the changing seasons, the evening breeze. He allowed solar gain in winter but did not prevent it in the summer. The *mur* in the Salvation Army Building in Paris was first built with neither mechanical cooling nor shading, and the unbearably hot spaces on the unshaded, south-facing side led Le Corbusier to what Banham calls ‘the last structural invention of environmental control: the *brise soleil*’. In the end, the *mur neutralisant* was not a mediator or a membrane, but a harsh barrier between inside and outside.



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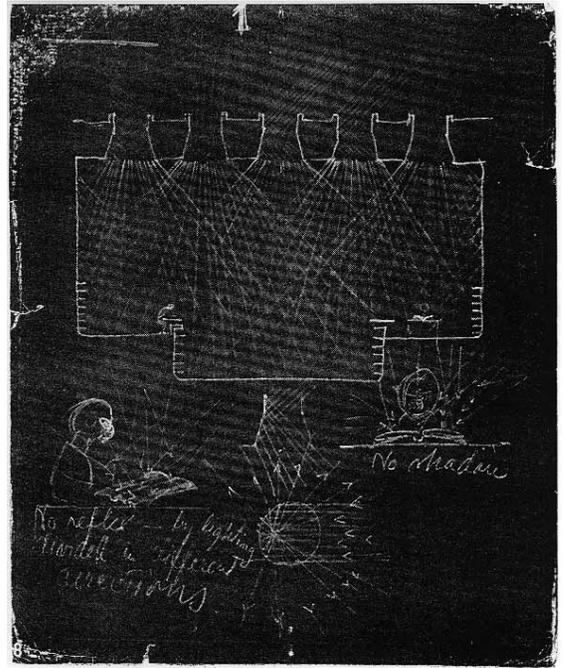
6 Aalto, Villa Mairea
7 Aalto, Villa Mairea
a Sauna and space
in-between
b Overgrown passage
to courtyard
between the main
house and the sauna
building



7a

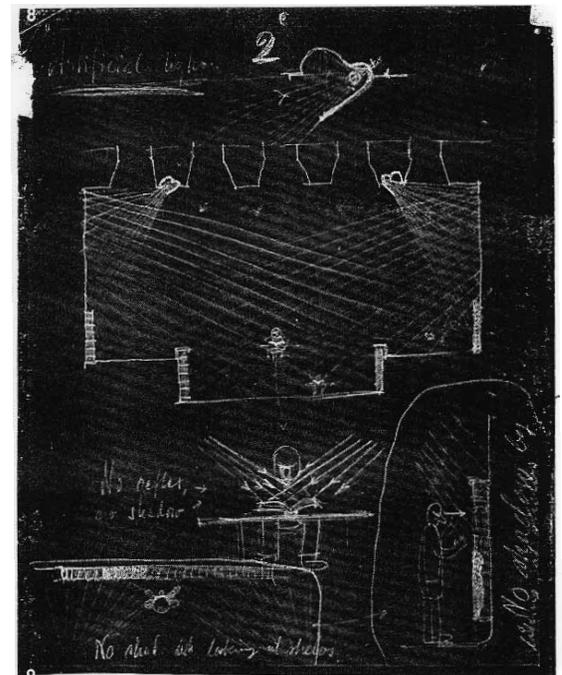


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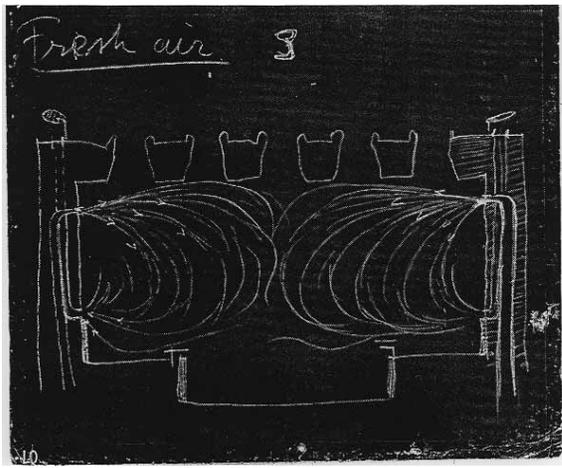


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8 Design sketch by Aalto for the conical skylight ceiling of Viipuri Library, indicating the idea for indirect daylight
9 Design sketch by Aalto for the conical skylight ceiling, indicating the idea for indirect artificial light
10 'Fresh Air', design sketch by Aalto for the conical skylight ceiling, indicating the idea for forced air ventilation into the main library space



9



10



11

11 Neo-Renaissance architecture (1890) at Torkkeli Knuutinpoika (Tyrgil Knutsson) Square, Vyborg, in ruinous state, 2005

13 Vakuutusyhtio Karjala insurance company by Olli Poeyry (1943), Vyborg

12 View of Vyborg in 2005 from train entering the city, showing its setting on the Baltic (with Vyborg castle island to the right)

14 Art Nouveau residential complex in the city centre of Vyborg



12

architecture's position on the relationship of the interior and the exterior climate. First, the structural approach that Reyner Banham rediscovered in historical European and vernacular architecture, an approach that has been re-discovered by the green design movement. Second, the formalistic approach that detached spatial form from environmental control systems. And third, the manipulative approach, which valued the machine more than spatial composition of architecture, the aim being to free human beings from the boundaries of space by fully controlling the quality and temperature of air, essentially creating architecture of air.

Finally, the aim to liberate the new human being from the boundaries of traditional space was achieved by leading 'him/her' into a new physical dependency: the occupant and user lost control over his/her thermal and visual environment. There were no curtains to mediate and filter the incoming sunlight, no visible switches or thermostats to control the thermal output of the new machines. Nothing applied to the free forms of the building, or to the bare body – naked, as in Paradise. Architecture, like clothing, was deemed unnecessary: technology could provide all the requisite thermal comfort.

Concern for the manipulation of the thermal environment appears at regular intervals in architecture and became vibrant again in the 1960s in such projects as the technological utopias of Buckminster Fuller (such as his geodesic dome over Manhattan) and Superstudio's universal comfort grid. I would suggest that Yves Klein's 'Architecture of Air',¹⁹ which proposed an extreme utopian city conditioned by a roof of air, also falls into this train of thought. After serious discussions with an air-



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conditioning firm in Hamburg,²⁰ Klein realised that this idea was not technologically possible at the time. More recently, Diller & Scofidio's Switzerland Expo 2002 'Cloud' presented a miniature version of this notion of immaterial, climatic spatial manipulation.

Transparency, the grid and optics

Transparency in architecture was made possible by Enlightenment philosophy, science (thermodynamics), and industrial production (the steam engine and glass production). Architects tried to position themselves within a culture where 'all that is solid melts into air',²¹ to express contemporary culture in their work. Unfortunately transparency was often only possible with elaborate mechanical systems that used an abundance of (then) cheap

15 Aalto, Viipuri Library. Exterior view of the library approaching through the park

16 Entrance to the children's library from the park

17 Stucco falling from the walls around the main staircase window

18 Bare reinforcement bars on the office wing of the library

19 Repairs along the facade of the lecture hall

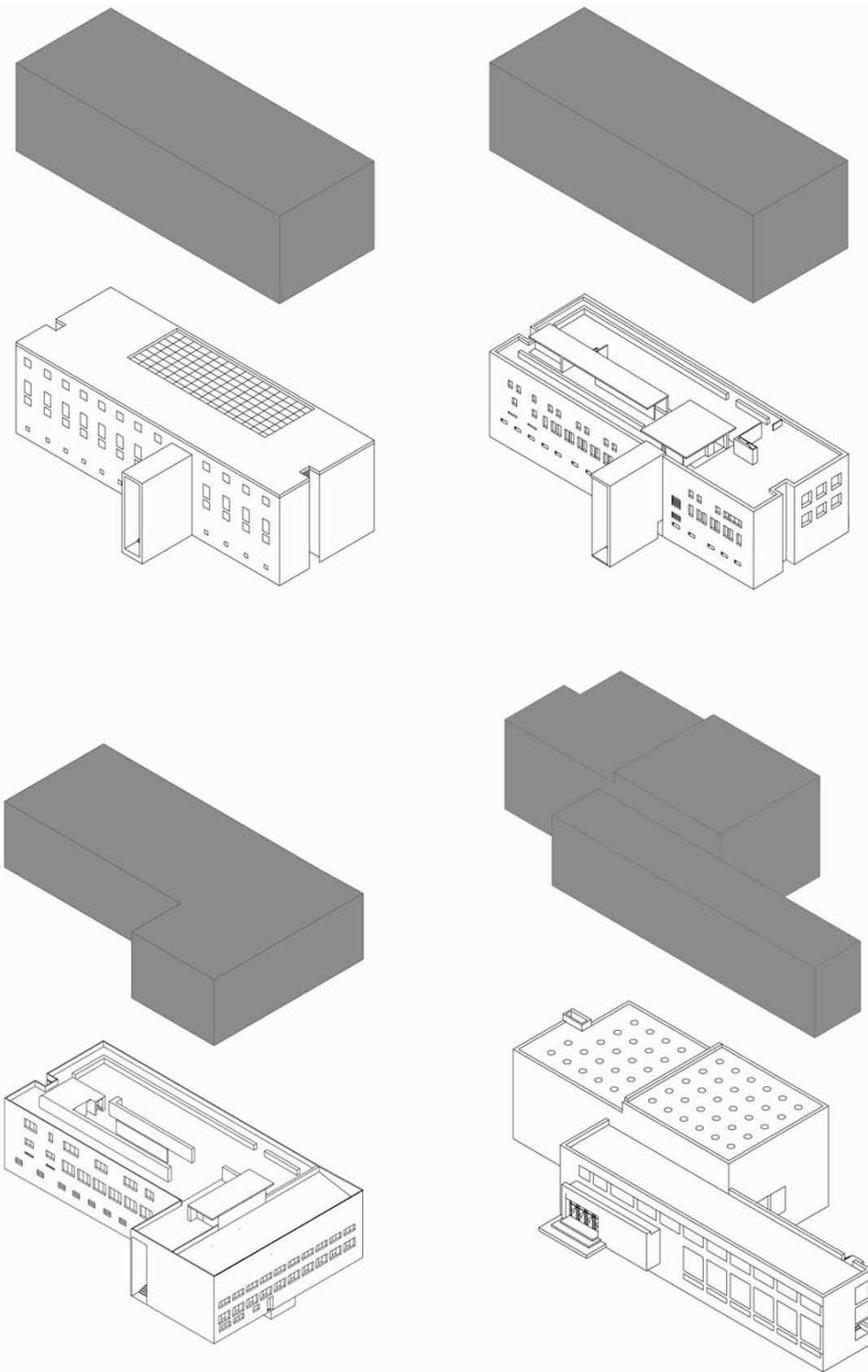
20 Entrance towards the newspaper room



electrical energy but still sometimes failed to provide adequate thermal comfort. Today we are facing the social and environmental consequences of our demand for energy to heat and cool our glass or cardboard boxes.²²

Rosalind Krauss provides one last concept for consideration in her essay 'Grids' in which she traces the origin of modern gridded space in painting and architecture to the rise of optics in the nineteenth century,²³ grounding the grid to the visual. 'There are two ways in which the grid functions to declare the modernity of modern art. One is spatial, the other is temporal [...]. It is what art looks like, when it turns its back to nature [...]' . She finds that research into

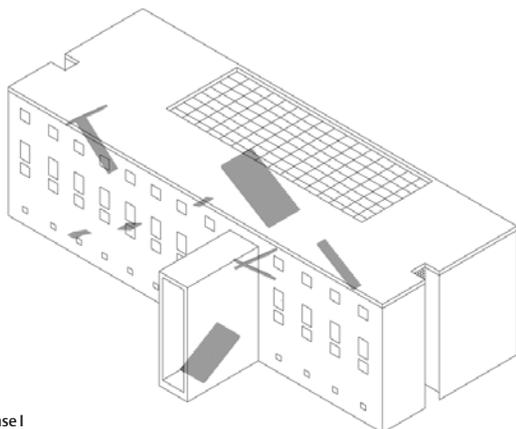
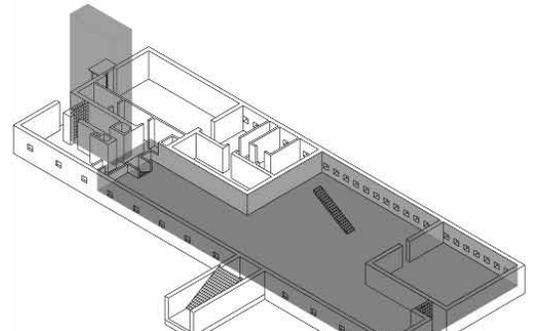
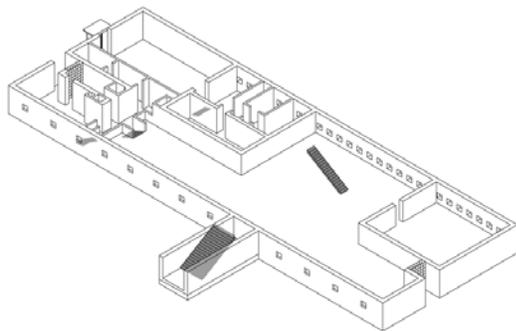
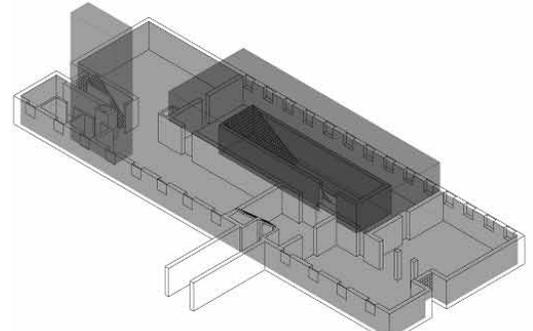
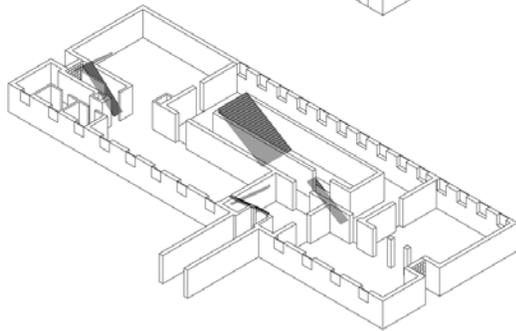
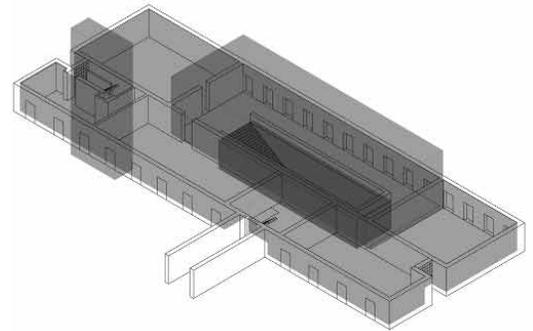
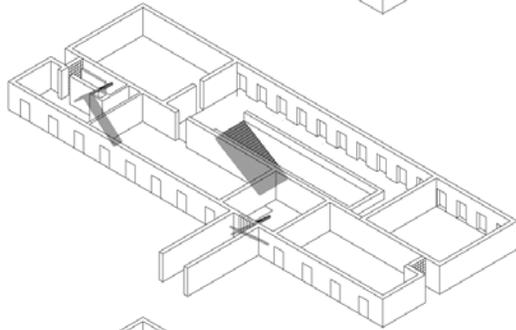
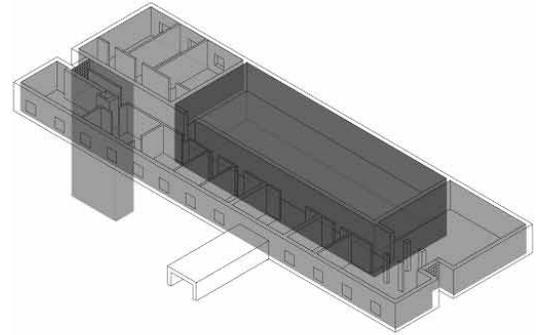
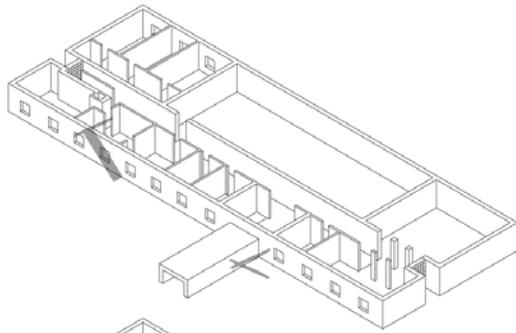
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21 Repairs at the entrance to the children's library

22 Phases I-IV, overall volume progression

22

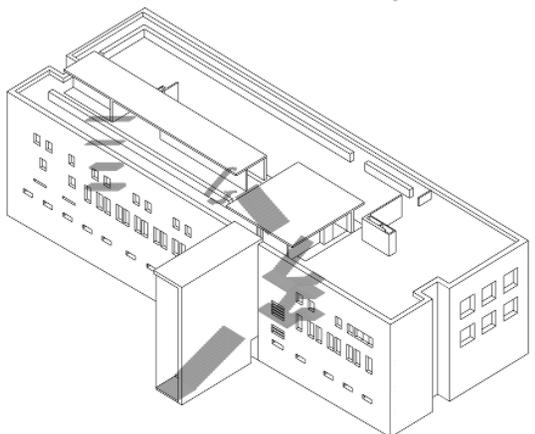
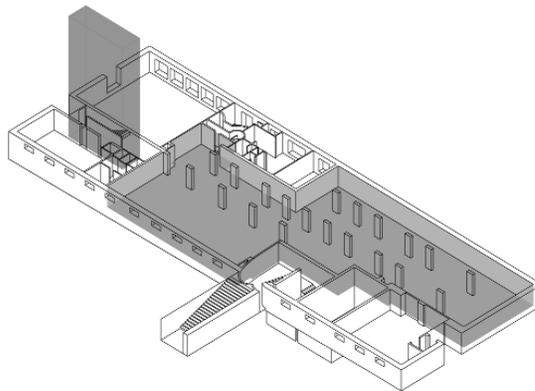
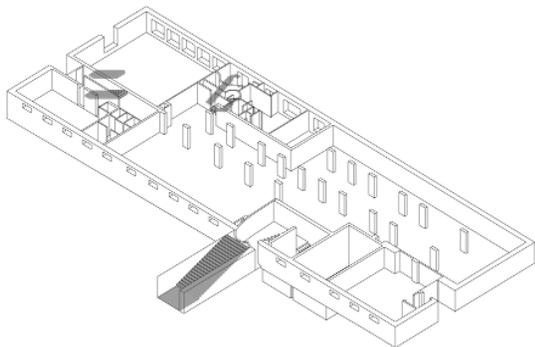
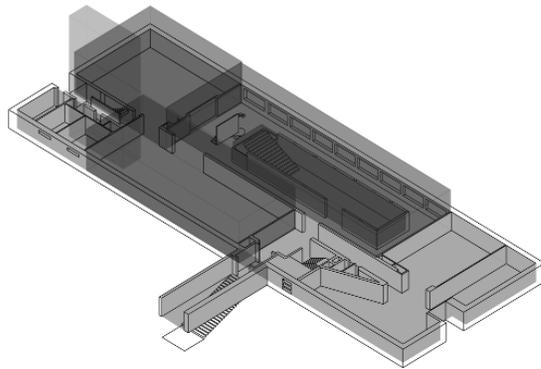
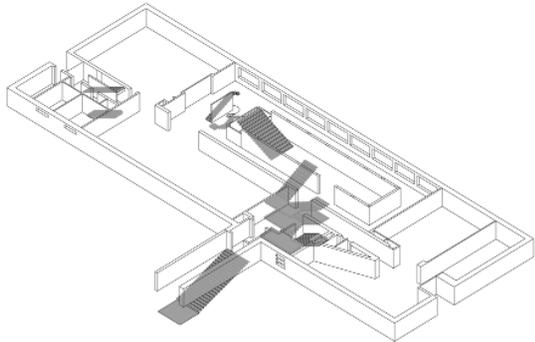
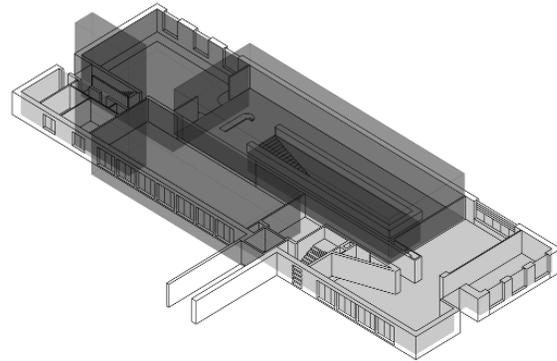
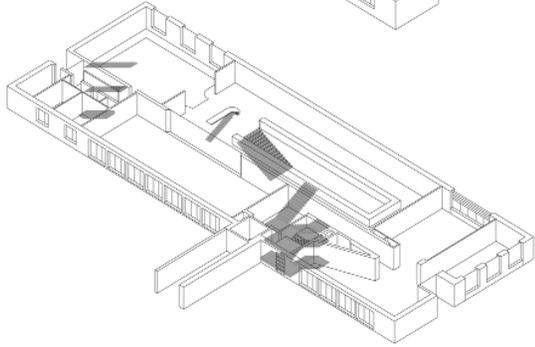
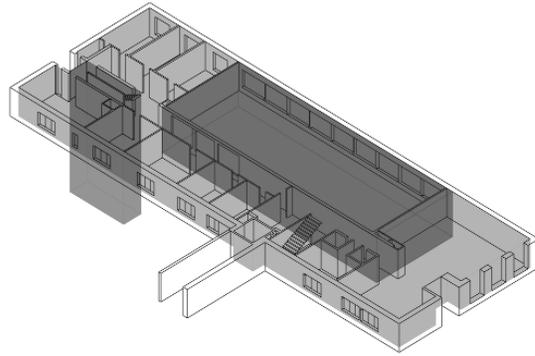
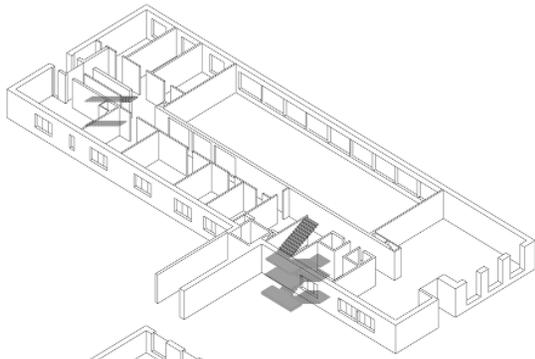


23 Phase I
a Circulation
b Interior volumes

23a

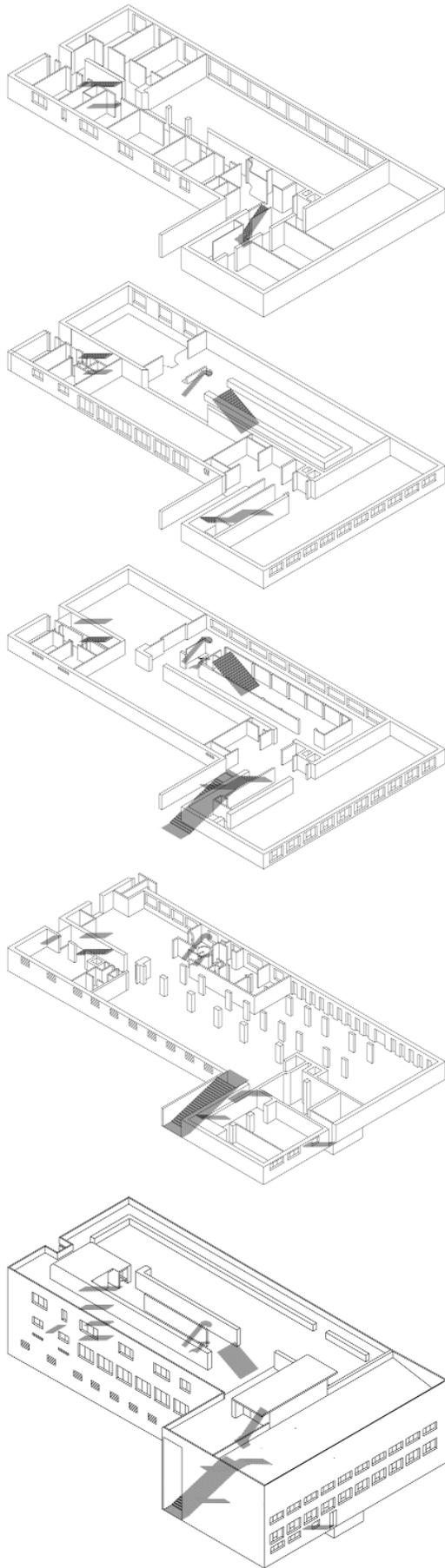
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24 Phase II
a Circulation
b Interior volumes

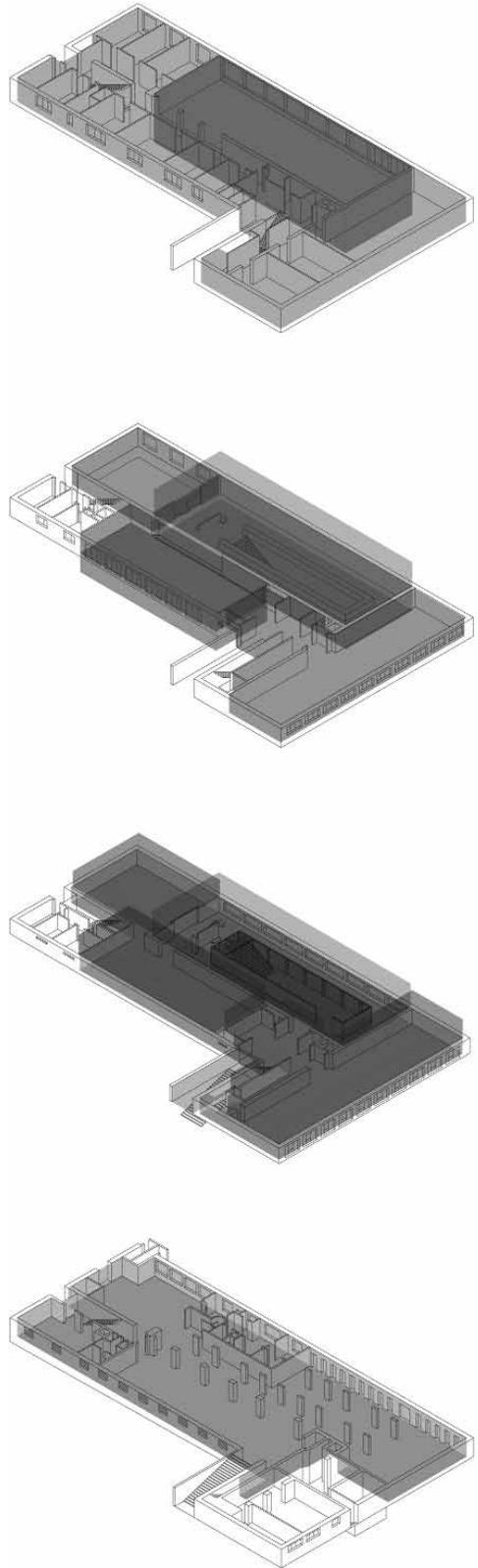


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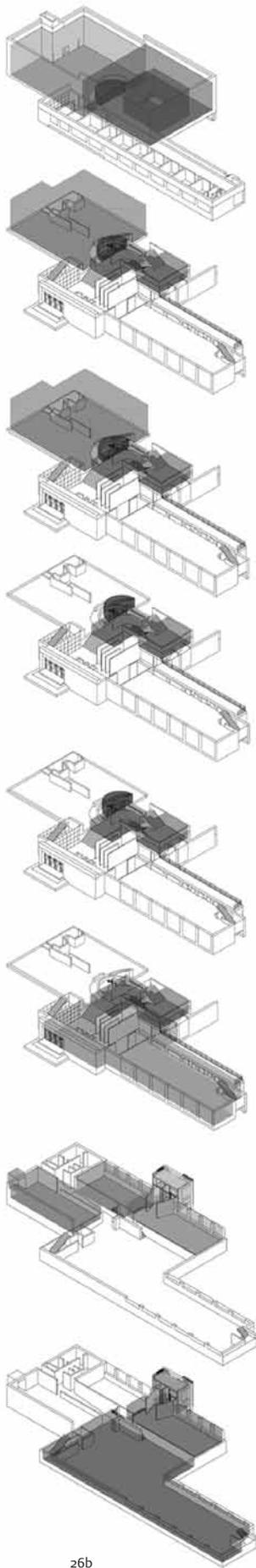


25a

25 Phase III
 a Circulation
 b Interior volumes

26 Phase IV
 a Circulation
 b Interior volumes

27 a Looking down on entrance hall from passageway to main library space
 b Looking up from entrance hall into passageway to main library space and beyond



27a



27b

visual perception split in the nineteenth century into the ‘analysis of light as such and a branch of optics, that concentrated on the physiology of the perceiving mechanism [...] light and colour as they are seen’. The grid became a ‘matrix of knowledge’. The grid becomes an ‘infrastructure of vision’. The grid is an ‘introjection’ of the boundaries of the world into the interior of the work: it is a mapping of the space inside the frame onto itself. This overemphasis on the visual that is carried through from optics into the Modern Movement in architecture acknowledges the physiology of the visual environment but ignores the relationship of optics to the thermal environment.

Alvar Aalto’s position towards technology and art

Interestingly, Banham’s historical analysis neglects Alvar Aalto’s work. Banham might have placed Aalto in the vernacular category since the work is indebted to an architecture rooted in climate and nature. At closer inspection, however, Aalto’s work is not so simple. He embraced technology and used new developments wherever he could to provide the desired comfort for his users. Since he does not completely separate himself from either tradition or technology, Alvar Aalto occupies a special place in the context of the Modern Movement in architecture. He is able to find ways to combine vernacular typologies and free-flow open space, bridging the gap between the extreme external climate in which his buildings are located, cultural memory and a modern language of space.²⁴ Villa

26a

26b



28



31a



29



31b



30

- 28 Looking down into sunken reading space from highest level of library
- 29 Looking back down into central passageway
- 30 Looking back down from sunken reading space into central connecting passageway

- 31 a Central space of librarian on top library level
- b Looking out from hidden central staircase to librarian station
- c X-ray axonometric drawing of library highlighting the central internal staircase

- 32 Interlocking volumes and shifting sectional planes
- 33 Diagonal visual connection of all levels
- 34 Phase IV ventilation diagram

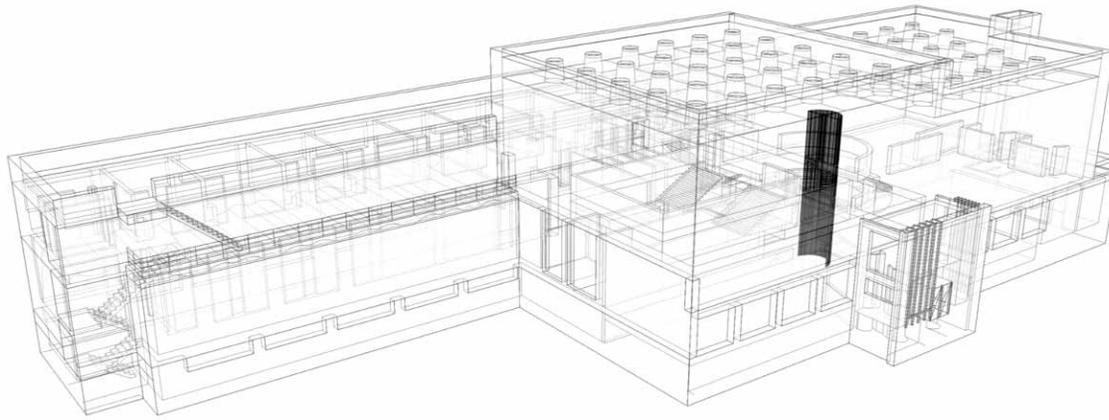
Mairea's perforated ceiling [4a-b] and the Viipuri Library's daylighting ceiling [5a-b] that mimics the heat and light of the sun are technological inventions embedded in an understanding of the Finnish culture which still retains a fairly harmonious relationship to nature, a strong relationship to the outdoors. Although Villa Mairea [6] can be air conditioned to protect Maire Gullichsen's collection of exquisite

Cubist paintings, which are still displayed in the house, today one can still open windows or slide doors apart and wander between the living room and the sauna across the courtyard lawn [7a-b].

In an essay written in 1947, Aalto expressed doubt about progress and technology. He compared the United States and Suomi-Finland revealing his understanding of comfort. Highlighting the *New Yorker* as the world's foremost 'humour magazine', he writes:

*The best pieces are Chaplinesque and show man in the stranglehold of mass production [...and also in the stranglehold of rigid environmental control...] In a land where there are streamline beds and beds without covers – the covers being replaced by an industrially produced layer of warmth – they have truly come far.*²⁵

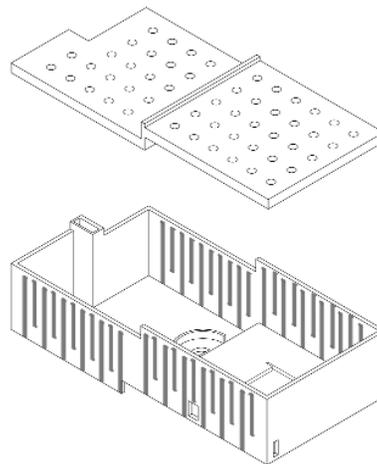
Obviously he does not think that this is the way progress should go, but he still uses a cushion of hot air, which is blown into the main reading space of the Viipuri Library above the reader [8-10].



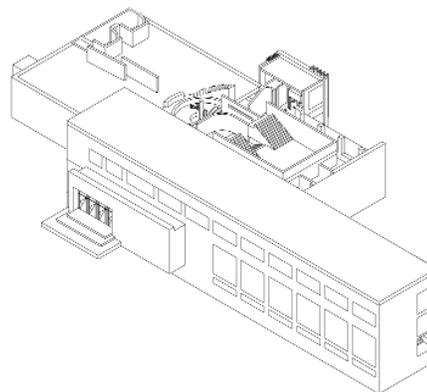
31c



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Viipuri Library: the cultural text

The old Finnish-Swedish town of Viipuri in Karelia is now named Vyborg, after being ceded to the Soviet Union at the end of the Second World War. It remains part of Russia and having fallen not only between two countries, which had twice been at war,²⁶ but between two harshly different economic and cultural systems, part of Vyborg's cityscape is still derelict, even ruined, in spite of its splendid topographical setting on the Karelian Isthmus of the Baltic Sea [11–14].²⁷ The library's white cubic volumes, still scarred, blend into the snow-white park of the city centre, where the cathedral once stood [15–17]. The exterior is in bad condition [18–20], although much has been achieved since the international call in the early 1990s to rescue the library from further decay [21].

Russian readers occupy the building as enthusiastically as Finnish readers doubtless once

did prior to the Russian-Finnish Winter War. While Aalto said the building 'lost its architecture' after the Second World War,²⁸ and while it has been written out of many architectural history and theory books,²⁹ it has served as a civic centre for Vyborg ever since its first restoration by the architect A. M. Shver in the 1950s.³⁰ Since then Vyborg has had to deal with much cultural diversity and neglect.³¹

Towards the free-flow open section

The design genealogy of the three stages prior to the built version [22] clearly shows a shift of axis in section and plan with progressive interlocking of the volumes and development of the cavity envelope. The double wall serves air movement and the thick volumetric roof slab with conical skylights directs light. Aalto redirected the spatial concept of the window, which in traditional buildings serves

lighting and ventilation purposes combined. Still used as compositional devices for the main reading space in the first three phases, they have disappeared in the final built version. My main sources here are a personal visit, drawings from the archive, interviews with the Aalto Foundation, the comprehensive book by Michael Spens and the DOCOMOMO publication.³²

Phase 1: the winning competition entry 1927 [23a–b]

All stages of the library design share the incorporation of a double-height, homogeneously-lit reading space restrained within a Classical cubic volume but not symmetrically enclosed. The overall composition already reveals the asymmetrical shift in plan. Suple shifts between axes are visible from the entering staircase to the main reading space, which is also not placed centrally into the cubic volume. Turning the corner three times implies a movement around a visual diagonal in space.

Phases 2 & 3: leaving behind the mask of Classicism

Phases 2 (1928) [24a–b] and 3 (1929) [25a–b] were drawn up as adjustments to the jury comments,³³ addressing a criticism of the glass roof, Aalto's initial idea to cover the reading hall and providing some organisational reallocation. Now equipped with the confidence of the commission and his emerging international reputation due to the Paimio Sanatorium and the Turku Sanomat building, Aalto dropped the Classical 'mask' but still kept within the constrained cubic volume, which partially addressed the urban situation. He started to pull volumes apart to make room for a more intensive spatial connectivity. The interior shift of axis was revealed on the exterior only during the final redesign when a new site further down in the park allowed for a more spread-out building envelope.

Viipuri's spatial system and climate envelope

*'When I designed the city library at Viipuri [...] for long periods of time I pursued the solution with the help of primitive sketches. From some kind of fantastic mountain landscape with cliffs lit up by suns in different positions I gradually arrived at the concept for the library building. The library's architectural core consists of reading and lending areas at different levels and plateaus, while the centre and control area forms the high point above the different levels. The childish sketches have only an indirect connection with the architectural conception, but they tied together the section and the plan with each other and created a kind of unity of horizontal and vertical structures.'*³⁴

The change of site offered Aalto a possibility to investigate a fourth design scheme [26a–b] and gave him the courage to try a new approach. Within a rather simple box-like exterior, the library became an extremely complex split-level free-flow open space in plan and section with three different routes through the reading spaces, all leading to a contemplative sunken reading area [27a–b, 28–30]. The librarians' stations are connected by an internal circular staircase [31a–c], enabling them to look up or down into all the library spaces including the children's library. This 'cubistic shift' opened up

spatial connections for view, air and people at all levels in plan and section [32–33].

Aalto first introduced mechanical ventilation and an under-ceiling heating system in the library,³⁵ which is described elaborately in the DOCOMOMO publication.³⁶ The system introduced warmth from above, as from the sun in nature, to enable a homogeneous reading climate [8–10]. Thus he introduced spatial (the roof) and mechanical (the overhead heating and ventilation system) means to create as natural conditions as possible.³⁷

Aalto's own description of the mechanical heating and ventilation equipment he introduced is as follows:

*'The same ceiling also acts as a heating source with the so-called panel-heating-system. As the ceiling is divided into lighting parts and solid parts, in the area remaining between these has been placed a dense network of radiant heating pipes, thus the ceiling of the library hall has been completely used for these functions, which in the open air are served by the sun [...]. The building has a mechanical ventilation centre, from which fresh air is distributed via special ducts into the building's different parts. The distributing branches of these ducts are glazed fire clay or cast iron. The ventilation system can, by adding some extra parts, be changed into a complete acclimatizing apparatus.'*³⁸

The first three schemes share a conventional exterior appearance of window openings in the main building volume of the library. In the fourth, built scheme there are no windows on the major library volume. The openings for daylight have transformed into conical rooflights and moved upwards onto the horizontal roof surface to provide perfect daylight to the reader. The openings for air movement have moved inside the reading space to provide fresh air from a mechanical forced air system [34]. This compositional move gave Aalto the freedom to elaborate his free-flow open section and experiment with the new technology of forced-air ventilation.

Aalto aimed at creating a well-tempered space for books (with no direct light on the bookshelves) and people (with thermal delight during all seasons and no glare, while still perfectly lit). He succeeded on the lighting side and became world famous for it. He to some degree succeeded on the radiant thermal side, but failed with the ventilation so far as it is known. It is not known whether the forced ventilation ever worked properly as Aalto had intended. The library is currently ventilated by natural convection through the interlocking free-flow open spaces by keeping a door open.

Modern space and temperate air

Aalto's position on technology within the Modern Movement is ambivalent and does not easily fit into the categories provided by Banham. He tries to come to terms with the challenge of the Finnish climate and to find a position on Modern technology by making use of available technology. He is very cautious and critical of not losing the relationship between user and culture. Nevertheless Aalto did create a warm thermal blanket in the Viipuri Library, the same as the one he so vividly satirised when talking about new technologies in America.

Notes

1. Michael Spens, *Viipuri Library 1927–1935: Alvar Aalto* (London: Academy Editions, 1994), p. 16, quoting Giorgio Labò, *Alvar Aalto: Architetti di movimento moderno* (Milan: Il Balcone, 1948).
2. Ignasi de Solà-Morales, *Differences: Topographies of Contemporary Architecture* (Cambridge: MIT Press, 1997), pp. 128–131.
3. Alvar Aalto, 'The Human Factor', in *Alvar Aalto: In His Own Words*, ed. by Göran Schildt (Helsinki: Otava, 1997), p. 280.
4. Alvar Aalto, 'Between Humanism and Materialism', in *Alvar Aalto: In His Own Words*, p. 177.
5. Alvar Aalto, 'Art and Technology', in *Alvar Aalto: In His Own Words*, p. 175.
6. Sigfried Giedion, *Space, Time & Architecture: The Growth of a New Tradition*, 16th edition (Cambridge MA: Harvard University Press, 1967), p. 632.
7. Spens, *Viipuri Library*.
8. Max Risselada, 'Introduction', in *Raumplan versus Plan Libre: Adolf Loos and Le Corbusier 1919–1930*, ed. by Max Risselada (New York: Rizzoli, 1988).
9. See for example: Martin Jay, 'Scopic Regime of Modernity' on 'Cartesian perspectivalism', in *Vision and Visuality*, ed. by Hal Foster (Seattle: Dia Art Foundation, 1988), p. 3.
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18. Enrico Prampolini, 'The Futurist "Atmosphere-Structure", Basis for an Architecture (1914–15)', in *Futurist Manifestos*, ed. by Umbro Apollonio (London: Thames and Hudson, 1973), p. 181.
19. Jonathan Hill, *Immaterial Architecture* (New York: Routledge, 2006), p. 86.
20. Pierre Restany, *Yves Klein* (New York: H. N. Abrams, 1982), p. 61.
21. Marshall Berman, *All That is Solid*

- Melts into Air: The Experience of Modernity* (New York: Simon and Schuster, 1982).
22. Giedion, *Space, Time & Architecture*
23. Rosalind Krauss, 'Grids', in *The Originality of the Avant-garde and Other Modernist Myths* (Cambridge MA: MIT Press, 1986), p. 8.
24. Demetri Porphyrios, *Sources of Modern Eclecticism: Studies on Alvar Aalto* (London; New York: Academy Editions, 1982).
25. Alvar Aalto, 'Culture and Technology', in *Alvar Aalto: Sketches*, ed. by Göran Schildt (Cambridge MA: MIT Press, 1978).
26. Giedion refers to these two wars as Finland's fight for its pure existence.
27. Ola Hansson, 'Introduction', in Michael Spens, *Viipuri Library*, p. 6.
28. Frederick Gutheim, *Alvar Aalto* (London: Mayflower, 1960), p. 267, as quoted by Spens, *Viipuri Library*, p. 13.
29. Giedion, *Space, Time & Architecture*, p. 632.
30. *Alvar Aalto Vyborg Library: Technology of Sensations – Technology Workshop and Seminar on Case Study*, ed. by Ola Wedebunn and others, DOCOMOMO Preservation Technology Dossier 7, September 2004 (Copenhagen: Royal Danish Academy of Fine Arts, 2004), p. 54.
31. Liisa Roberts, 'What's the time in Vyborg?', in *Alvar Aalto Vyborg Library: Technology of Sensations*, p. 69. An engaging creative writing workshop called 'What's the time in Vyborg?' initiated by Liisa Roberts, an artist based in Helsinki and St. Petersburg, was intended for teenagers.
32. Spens, *Viipuri Library*, pp. 20–35; *Alvar Aalto Vyborg Library: Technology of Sensation*.
33. Spens, *Viipuri Library*, pp. 20–35.
34. Alvar Aalto, 'The Trout and the Mountain Stream' in *Alvar Aalto: Sketches*.
35. Ulrike Passe, 'Space is Technology', in *Architecture & Phenomenology* (Haifa: Technion, 2007).
36. *Alvar Aalto Vyborg Library: Technology of Sensation*, p. 45.
37. *Ibid.*, p. 100.
38. *Ibid.*, pp. 127–8.

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