

# Ambiguous Rationality: The Structural Design of Alvar Aalto

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## Abstract

Unlike "humanizing", "expressive forms", and "phenomenological significance of materials", Aalto's structural conception has been seldom recognized as masterly touches and even misunderstood by some theorists as "a-tectonic" and "irrational." Since initiating practice, he had developed a "surface + frame" composite as a structural solution. Then a "thick partition" formed with ambient spaces, became a basis to fully explore in spatial, lighting, and signifying dimensions, breaking a new path long before the "skin + bone" prototype of modern architecture received sublation from the younger generation.

This paper chooses three built churches throughout Aalto's career for a serial case study and reveals, through analyses from drawings to actual construction, how the composite system acts as a reasonable stress system and construction basis, participating in controlling the force system and force flows, how the "thick partition" mediates the spatial flows and directs the light-shadow interplay, and how such webs of significance have transcended the high modern architecture.

**Keywords:** Alvar Aalto, structure, church, surface+frame, composite system, thick partition

## Introduction

Alvar Aalto's masterly place mainly lies in his unique contributions to then-popular "international style" by humanized space, natural materials and organic forms, as theorists repeated.

For example, Sigfried Giedion titled the chapter on Aalto "*Irrationality and Standardization*" supplemented to the fifth version of "*Space, Time & Architecture, the Growth of a New Tradition*", where the seminal standard-bearer of modern architecture related his friend's renown outside Finland since 1930s to the paintings of Joan Miró and Paul Klee, praised his new expression of the time by a bold leap from rational and functional to irrational and organic, represented by undulating walls, inflection of spatial flows, relationships between horizontal planes, and the human side. (Sigfried Giedion 1967, 498-511)

In 1976, the year Aalto passed away, Manfredo Tafuri and Francesco Dal Co co-published "*Architettura contemporanea*" and stated that Aalto's naturalism was an abstract organism with metaphor and allusion that renewed the public image oscillating between a quest for atemporal significances and subtle psychological and sensorial suggestions. (Manfredo Tafuri & Francesco Dal Co 1976, 278-280)



*Giedion and Tafuri  
on Aalto,  
irrationality and  
organism*

*Frampton on Aalto,  
relating his  
organism to Taut  
yet still overlooked  
his tectonics*

In 1980, Kenneth Frampton shared Tafuri's "organic" tag on Aalto by relating him "conceptually close to the ethos" of Bruno Taut's Glass Chain and others, the 'group' of Northern European Expressionist architects..." in his *Modern Architecture: A Critical History*. (Kenneth Frampton 1992, 202) His rumination on expression led to *Studies in Tectonic Culture: the Poetics of Construction in Nineteenth and Twentieth-Century Architecture* in 1996, where Aalto occupied only a paragraph in the introduction, for his phenomenological awareness in Säynätsalo Town Hall reflected in the first-dark-then-bright passage from the entrance to the council chamber with full tactility. (Kenneth Frampton 1995, 12) His mistake for the actually dim-lit chamber with dense shutters seems to reflect his neglect for Aalto's tectonic side in expression while even Utzon won a dedicated chapter in that way.

However, there did come out sporadic studies on Aalto's structural design, hopefully, to fill in the gaps. Also in 1996, Randall Ott proposed a seminal concept: a-tectonic, when he interpreted the "unexpected and rather irrational interior vaulting" of the Finnish wooden churches, supported in such perplexing manner that "defies any simple explanation, either visual or tectonic". Right in the a-tectonic sense Aalto went further into the "spectrum between Norwegian clarity and Finnish ambiguity". However, such perspective remained largely "expression"-oriented with "tectonic" and "rational" reasons left over. (Randall Ott 1996, 511-521)

Then in 1998, Juhani Pallasmaa did try the structural view of high modern architecture in Aalto's Villa Mairea that despite his disrespect for modular coordination, the "spontaneous, almost whimsical experiential" villa was surprisingly found to be executed upon a grid by 2850 X 2850 cm, only blurred afterward to wishfully "express". (Juhani Pallasmaa 1998, 12-15) However, with on other works repeating such grid afterward, such conclusion of an method of adding variation to a uniform grid to obtain degrees of freedom cannot cover Aalto's whole oeuvre so abundant in structural and spatial logic.

*Ott and Pallasmaa  
on Aalto, focusing  
on his structure yet  
failing to see its  
positive role fully*

Though unfolded from different aspects, both interpretations share a similar starting points that to Aalto's expression, the structure is only an upholding participator to be concealed. So they actually continued those of Giedion, Tafuri, and Frampton's: even though Aalto's structure entered discussion, it remained a subordinate role adapting to the space. It's too much biased on expression even when compared with Aalto's own words: "On deeper examination, architecture is not merely a set of given structural results, but to a much greater degree a complex process of development, whose inner interaction steadily produces new solutions, new forms, new building materials, and constant changes in structural ideas," a far more positive view. (Alvar Aalto 1938, 98)

This paper chooses three churches in Aalto's different periods to discuss his structural design ideas for the following reasons:

Firstly, the church pursues spatially and atmospherically so exclusively as Aalto claimed ever since beginning his practice: Instead of decoration, a church "needs something else and needs it urgently. It needs pure and devout forms, whatever these forms may be," "something as rare as good taste" by which he did not mean "the trivial experience of beauty", but a *quality which is a special gift and without which no creative work can be assessed, a quality which has a more positive significance today than ever before by its extreme scarcity...* (Alvar Aalto 1925, 37). The subsequent discussion in this paper will lead us to see how he took on structural and tectonic treatments to achieve what he envisioned.

Secondly, the church proved to be the building type that Aalto had explored earliest and longest. Among the renovation of traditional Finnish wooden churches that commenced his career, the concluding Korpilahti Church (1926-

*Chose three Aalto churches for the church's own quest, his input, and the "thick partition" matured therein discernible in many other works*

1927, Fig.5) allowed Aalto to remodel the ceiling to change the lighting and interior, which deepened his understanding of the binary interplay possibilities of the surface and the frame. During his honeymoon with Aino in Tuscany in 1924, he keenly visited the local churches. Both had influences discernible on the Muurame Church being designed right then. With the entry of concrete technology into Finland as Aalto fully experienced in Turku in the late 1920's, given his earlier attempts, it would easily enable a composite system of "surface" + "frame".

Meanwhile the "thick partition" that such composite system with its ambient spaces composed also offer a creative new spatial pattern. All his following church projects were of the concrete structure but unbuilt, until the commissioned Vuoksenniska Church in 1955, which won acclaim as the first free form in Finland and a masterpiece comparable to Le Corbusier's Ronchamp. (Teivas Oksala) The last church in Aalto's career was the Riola Church in Italy, which began design in 1966, constructed on the eve of Aalto's death, and completed two years posthumously in 1978, the only Catholic church in Aalto's oeuvre.

Finally, arguably Aalto bestowed the church with a higher "design density," to be reduced when applied to other building types. Not exactly a disciple of Louis Sullivan's "form follows function" that would equal form to type, he preferred trans-functional experiments as following: The columns in Aalto Studio's House of Culture (1955-58, Alvar, A. F. & Alvar, A. A. & Alvar, A. M. 2018, 102) and the more enriched series of experimentation in his Summer House (1953) known as the "experimental house", (Ibid 37-41) followed by those applied with the very composite system and "thick partition", namely the Lecture Hall in Otaniemi that resembles the continuous frames in Riola, only differing in its directional tapering from the latter's equal frame, the Maison Carré (1956-1959, Fig.1) where the horizontal beams closing the single curved ceiling at the entrance reminds of then just-completed Vuoksenniska Church. Even in the Seinäjoki Library (1960-65, Fig.2) , where in the slender columns of the hall seem not supporting, but tying the curved surface to the ground, also works Aalto's interplay of the surface + frame system. Only in such secular buildings he didn't expose the frame on the curved surface to confuse the visitors, or cross-section out the "thick partition" for light-shadow variety. In the Council Chamber in Säynätsalo Town Hall (1950-52), the way the ceiling partially detached from the beams also means a "surface + frame" system.



**Figure 1. Entrance of Maison Carré.** Drawing and Photo by Author  
**Figure 2. Seinäjoki Library.** Photo by Author, c. 2021

*Aalto's ready and handy attempts of modern architecture*

*However, the orthodox dogma of modern architecture's cannot explain Aalto's mature works*

## Additive Elements

### The frame + curved surface composite system

As reinforced concrete technology took shape, it greatly impacted building structures. Among them, the most influential and far-reaching construction system is undoubtedly the Domino system proposed by Le Corbusier in 1914. The floor supported by pillars and stabilizing stairs help the building gets rid of the heavy masonry walls, leaving the facade and interior freely dividable, the architect capable of internal fluidity and external oneness.

In the far corner of Europe, Finland was also influenced by this trend. In the late 1920's and early 1930's, Aalto, the forerunner of modern Finnish architecture, completed a series of such works composed of reinforced concrete pursuing openness. For example, the Tuberculosis Sanatorium at Paimio (1928-1933, Fig.3) had an all-glass canteen wing except for the structural columns and strip window at the dormitory wing's corridor; the Turun Sanomat Office Building (1928-1930) (Michael Trencher 1998, 13) had not only glass-partition cubicles, making the entire office floor an open whole.

However, the Corbusierian "Five Points of New Architecture" and domino structure cannot explain Aalto's mature works. Most obviously, it is the tendency of the enclosure as his heyday representative works the University of Jyväskylä (1955, Fig. 4) and Säynätsalo Town Hall show in the primarily red brick walls and discrete openings other than the Bauhaus curtain wall or Corbusierian strip window. Moreover, the structural system becomes complicated and less legible than the column-grid sanatorium, which culminates in the Vuoksenniska Church, where the curved surfaces appear together with beams and columns, making it even difficult to judge if the building is a shell structure or a frame one.



Figure 3. Entrance of Paimio Sanatorium Photo by Maija Holma, Alvar Aalto Museum

Figure 4. Jyväskylä University Photo by Author, c. 2019

Therefore, this paper hopes to discuss that in addition to inheriting the orthodox modern architectural and structural norm, Aalto also incorporated another construction idea germinated in him much earlier. It helped him extract a surface + frame composite system to run throughout the career. Relying on their collaborative dialogue between the surface and the frame, the two established an "Aalto-style" space on the rational ground. Though initially not mutually equal, one being main and the other additive, as limited by the construction and technical means.

*Two sources that shed light on Aalto's operation on Murrame Church, one Finnish wooden churches and the other the Tuscany churches*

### Composite System in Muurame Church

In 1921, after completing his studies at Helsinki Polytechnic, Aalto did not stay in the capital but returned to his youthful hometown of Jyväskylä to run his own business named Alvar Aalto, Architect and Monumental Artist (AAF 2014, 12) until 1927 there—initially engaged in relatives' house and furniture design. At the same time, he renovated several local wooden churches. The churches took the frame and the load-bearing wall as the basic structure; thereupon, the decorative needs led to some thin wood cladding that formed the internal ceiling and external roof while not wholly fitted with the frame.

In 1924, Aalto and Aino honeymooned in Italy (AAF 2014, 12), namely Venice, Florence, and so forth. The critical churches in Florence were marked on the map he carried with him as the focus. In structural terms, such Tuscan church puts upon masonry load-bearing walls wooden trusses sometimes decorated. For example, in the Church of the Erimitani in Padua (Fig.6), visited by them (Jari Jetsonen & Sirkkaliisa Jetsonen 2020, 99), the trusses were infilled with various barrel-like cladding.

Whether a Finnish wooden church or a Padua wooden roof-truss dome, it mostly imitates masonry domes and vaults by cladding onto wooden frames as structural supports. Due to the non-rigidity nodes and the thinness of the material, the cladding meant little to the structure. The frame responded to the loading bearing and bracing, which then lends the lightweight cladding a certain degree of freedom. That is to say, the form combination of the curved surface and the frame can bring wider spatial variety.

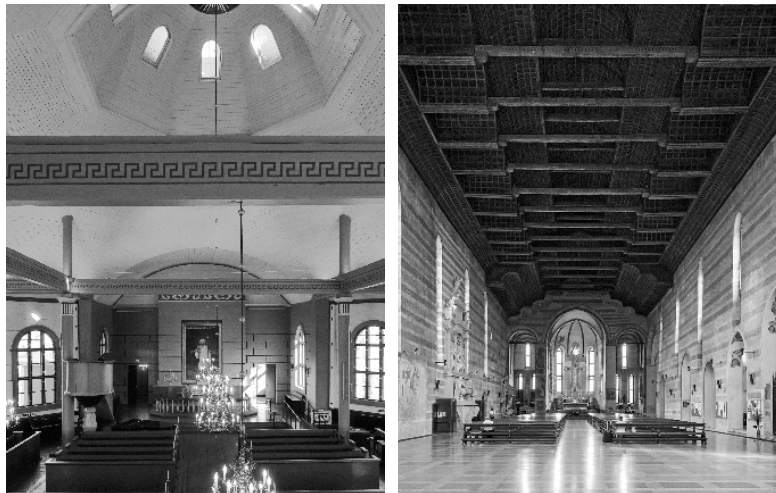


Figure 5. Interior of Korpilahti Church, Photo by Author, c. 2019

Figure 6. Interior of Church of the Erimitani in Padua, Photo from Didier Descouens, c. 2017

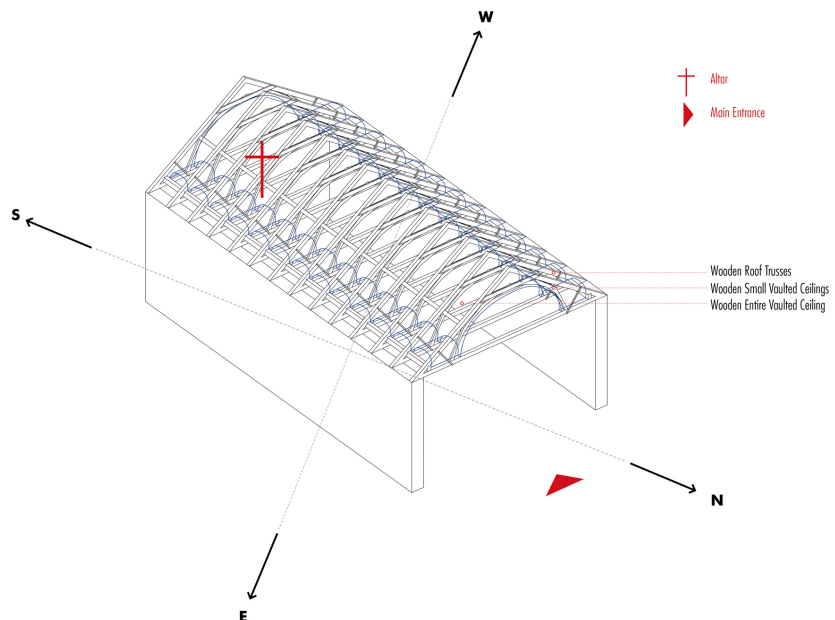
In the late spring of 1926, Aalto was commissioned by Muurame Church (Ibid, 94), by which he aspired to reproduce a Tuscan church there. As Aalto stated, "natural beauty... with its boldly curving lines... an opportunity to create a powerful harmony, its landscape has a kinship with the hill and mountain topography of Tuscany, and is of such a character that allows the individual from to come into its own." (Alvar Aalto 1926)

*Envisioned and completed effects in Muurame Church through the composite system; the ceiling as a stage for light-shadow interplay*

Despite the about-to-prevail modern architecture, Aalto did not follow the fashion when it came to the church, as he stated in an interview at the beginning of 1928: "We cannot create a new form where new content does not exist." (Jari Jetsonen & Sirkkaliisa Jetsonen 2020, 98) So the plan took a simple longitudinal one, no less than Aalto's own words that "giving a modest impression due to its starkness." (Alvar Aalto 1926)

The Muurame Church was constructed similarly to those in Tuscany: two opposite masonry walls bearing the load, then topped by a triangular-wooden-truss roof. (Fig.7) Such nostalgic tendency may also be explained by the fact that Aalto did not know much about the spatial possibilities freed by the modern structural system.

In between the wooden trusses, Aalto filled in a ternary ceiling. In the middle area, the entire hall space runs through the entire hall vaulted ceiling parallel to the direction of the church, while a series of small vaulted ceilings parallel to the roof trusses were set between the two roof trusses on both sides. As seen from this rich early design drawing, his design bore similarities to the Church of the Eremitani's ceiling composition. Aalto himself described the ceiling in Muurame as "a two-tiered wooden vault with painted ornamental parts." (Ibid.)



**Figure 7. Frame and Surface Diagram for Muurame Church, Drawings by Author**

Compared to the decorative feeling in Padua, Aalto's ceiling is deeper and more spacious. The vertically oriented ceilings on both sides even echo the continuous chapels commonly found in a Tuscan nave, whose perpendicularity to the central axis enriches the roof space further. The tie beams of the wooden truss form a composite system in the space along with the surface of the ceiling, the former defining a horizontal plane by continuous density and the latter giving a wave-like forward momentum over it. Therefore, the perceptible role of the ceiling in separating the interior from the exterior is blurred, and a new intention is created: the boundary becomes a domain spanning from the tie beams to the curved ceiling.



In Muurame, the sketches showed its top as the focus of the whole interior spatial performance through a light-shadow interplay. (Fig.8) Instead of openings for natural light, Aalto made there wholly a light-receiving surface. Intense light enters through the window on the side of the altar, which makes the symmetrically arranged barrel ceiling diffusely reflect soft but complex light and shadow effects. The tie beams are projected on the barrel, enhancing the complexity of light and shadow.



Although the completed ceiling is not as complicated as the three-way to the full play of light and shadow as envisioned, the frame takes on the role by forming an accommodating space between itself and the relatively free ceiling arched over it. Overhead there is a stage putting the shadows on show. (Fig.9)

Likewise, in the Säynätsalo Town Hall, the very dimly-lit council chamber also has an even dimmer pair of wooden butterfly beams overhead, over which Aalto deliberately detached the ceiling above the corners to create profound darkness. (Fig.10) While the North Jutland Art Museum (1958-72) makes a brighter version: three curved surfaces freely bounce up between the four girders spanning the hall, acting as both reflectors and shutters in basking the painting exhibition hall under in uniformly full skylight. (Fig.11)

**Figure 8. Sketch by Aalto for the design of Muurame Church,** Alvar Aalto Foundation  
**Figure 9. Interior of Muurame Church** Photo by Author, c. 2019



**Figure 10. Säynätsalo Town Hall, the truss in the Main Hall,** Photo by Author, c. 2021  
**Figure 11. Main exhibition hall of North Jutland Art Museum,** Photo by Author, c. 2019

Here it can be concluded that the treatment of each part with different colors reflects the construction ways. The additive curved surface means little structurally, and can only be filled in between the dominant frames, while the latter takes on all the structural duty with even less freedom left. However, Aalto's expectation for their interaction remains legible.

## Interactive Elements

### "Thick partition"

Newly introduced concrete allows different components to work into a whole structural role with higher flexibility bestowed on each, enhancing the overall spatial freedom that allows more space, light, and shadow to form a "thick partition."

*Aalto's mastery of  
concrete structure  
right upon its advent*

In 1927, before the construction of Muurame began, Aalto left Jyväskylä and moved the entire studio to Turku, the capital of Finland, until the early 19th century, the most advanced Finnish city being closest to Sweden. Here he met Erik Bryggman and Hilding Ekelund, the earlier Finnish to accept modernist ideas (Fig.12) ; the former's Complesso Hospits Betel, just completed in the center of Turku, is recognized as the first Finnish modern architecture for its reinforced concrete structure and all-whiteness (Vilhelm Helander & Simo Rista, 1989, 19-20). By serial co-working with Bryggman Aalto familiarized with the Turku architect circle and even the Swedish godfather-architect Gunnar Asplund. (AAF 2014, 21-23)

In the same year, he won the Southwestern Finland Agricultural Co-operative Building competition, built in the following year with reinforced concrete and freestanding window openings when Aalto traveled to the European continent and met Le Corbusier and others. In early 1929, Aalto won the competition for the Paimio Sanatorium. The corridor of the ward wing adopted an all-strip window, with the wall above totally suspended from the beam. The internal reading mezzanine is suspended from the beams on the upper floor by slender steel cables. Such vast space was so advanced that it deterred the Finns from sitting in case the structure fell. (Ibid, Fig.13)



**Figure 12. Exterior of Complesso Hospits Betel** Photo by Author, c. 2019

**Figure 13. Dining room of Paimio Tuberculosis Sanatorium**

Aalto had fully attuned himself to reinforced concrete properties, whose one-piece casting allowed planes in all forms and thicknesses to participate in the structure by distributing the steel. Soon after, he went out of the prevalent norms to explore new possibilities for concrete in the way he encountered the composite of curved surface and frame before: The two began collaborating in structure to create a richer performance.

Such structural collaboration liberates more freedom, embodied in more light let in with spatial and shadow effects. The around-arctic Finland has daylight varying between polar night and day, which is much more prosperous than in lower latitudes. Compared to the delineating Tuscany brightness, here dominates ambiguity and arbitrariness. The curved surface acts as not only a concentrating plate and reflector but also a light adjustor and shadow projection screen for the frame.



*The “thick partition” that facilitates light-shadow interplay and turns the interior-exterior dichotomy into a varying domain.*

*The fully concrete-wrapped Vuoksenniska Church and its communal role in modern society as Aalto beheld*

Such intervention of light-shadow space turned the interior-exterior dichotomy into a varying domain.

When working together, the elements mentioned above are sensed as a whole intervening by a “thickness,” which, unlike the absolute size of the load-bearing walls of traditional masonry buildings, means a fusion of frame and surface, the nuanced space and light-shadow interplay. Operating on each variable will generate possibilities in spatial layers and encounters that replaces the typical “thin” of modern architecture with a “thick partition” originating in Muurame and culminating in Vuoksenniska.

Moreover, through openings by section, the interactive elements of the “thick partition” could be revealed, and the interior extended imaginarily in vision until fulfilment in guiding the spatial flows and pause, presenting the light-shadow interplay and meaning.

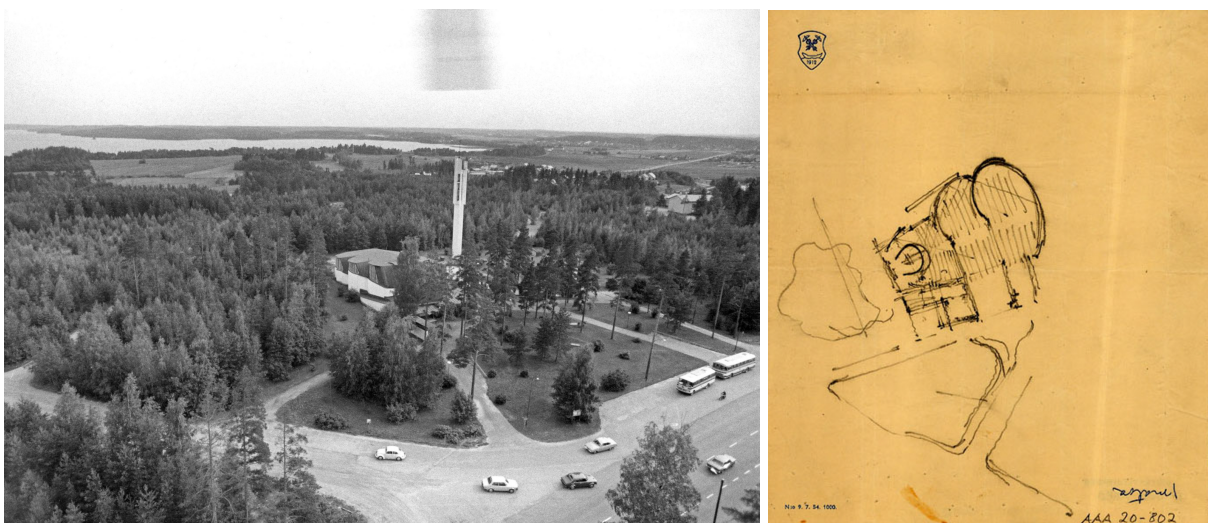
### **“Thick partition” for structure and construction**

The composite system of surface and frame only partially appeared in Muurame. However, it wrapped entirely the Vuoksenniska Church with the help of reinforced concrete. Namely by the “thick partition”, it comprised with ambient spaces that also became the church's structural and enveloping system. The interactivity featured spatial shaping, lighting mediation, and meanings making.

After the 30's and 40's with few work, Aalto had his next built church, Vuoksenniska Church, commissioned in 1955 and completed in 1958, a period with not only Aalto's understanding of the church's role in modern society but also ready mastery of modern construction methods represented by reinforced concrete.

He believed that churches in modern society meant not only religiously but also communally by accommodating such activities. (Sofia Singler 2020, 1) To this end, he contrived a new layout: “the full form of a church, while seeking to provide adequately for social activities without compromise.” (Alvar Aalto 1959, 201)

Imatra is a typical industrial town; the church lies amid its edging forest, with the east near the birch woods and the altar facing north. Visitors mainly reach the small west square through the north road and then enter the church. (Fig.14)



**Figure 14. Bird view of Vuoksenniska Church interior.** Photo from Alvar Aalto Foundation

**Figure 15. Sketches by Aalto for Vuoksenniska Church Design,** Drawings from Alvar Aalto Foundation

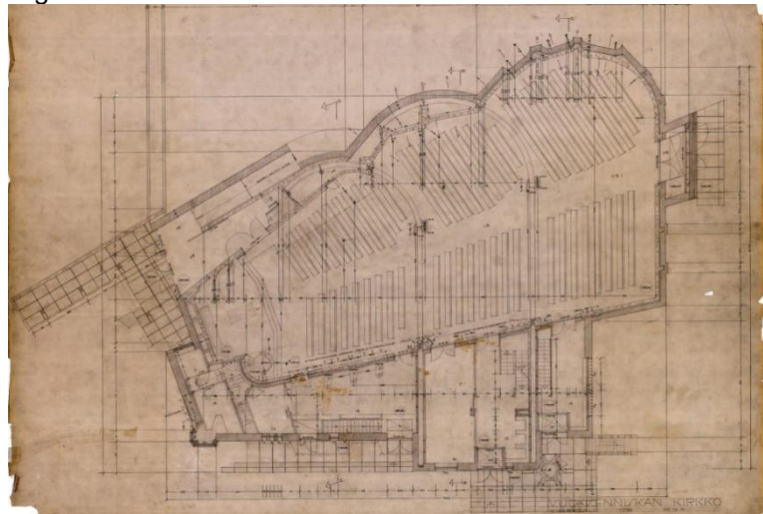
Aalto designed three halls for it. (Fig.15) Of the three *halls*, the *alter section is regarded as the actual church. It is the only one for which fixed pews were built. The two halls could be used for various congregations' events and have movable chairs.* (Jari Jetsonen & Sirkkaliisa Jetsonen 2020, 119) They each have an independent vestibule and are lower consecutively from the altar for an acoustic reason. They are separated by retractable partitions with cavities to hide when merging into a whole hall. (Fig.16, Fig.17)

The construction underwent in Aalto's own words: "The church takes its form from three asymmetrical vaulted structures, which in section is connected with the wall structure by means of a shell system, which is also asymmetric, giving the structure a form associated with the church tradition." (Alvar Aalto 1956)

### *The triple domes/halls and the corresponding structure*

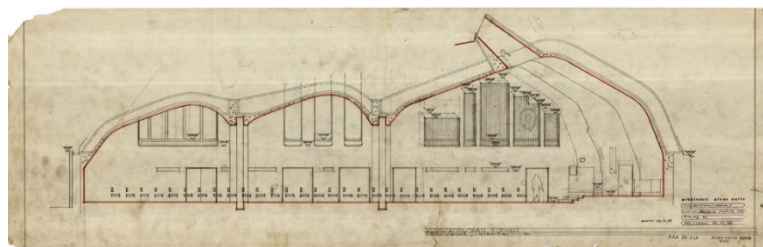
The triple asymmetric, dome-like halls and retractable mobile partition walls set the starting point for the church's overall layout and structural design, whose central axis consists of the horizontal beams that support the partition tracks. The beams furcate into three at the eastern end, each borne upon a column. This way, the lateral stability is strengthened while the stress is distributed, like the attenuated furcation shows. Two pair of double columns stand in the middle of the halls' two abjont lines to bear each beam set. At the western end, the beams lie upon the load-bearing walls that separate the three vestibules. (Fig.18)

Each of the two trident beams not only accommodates the suspending tracks of the partitions but also supports the roof structure. Longitudinally, the triple domes are ribbed with likewise arching and falling beams upon the trident beams, thus transferring the whole roof onto the latter and both far ends of the church.



**Figure 16. Plan for Vuoksenniska Church Design,**

**Figure 17. Section for Vuoksenniska Church Design,** Drawings from Alvar Aalto Foundation



In turn, the curved surface integrates all the beams and load-bearing walls into a whole, taking on static loads and wind and seismic forces in different directions. The latter necessitates each component with certain freedom around its

reasonable force-addressing point, while the surface remains thin for its only role, no more than bracing.

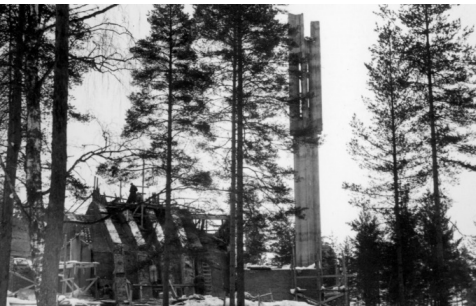


Figure 18. Frame and surface Diagram for Vuoksenniska Church, Drawings by Author

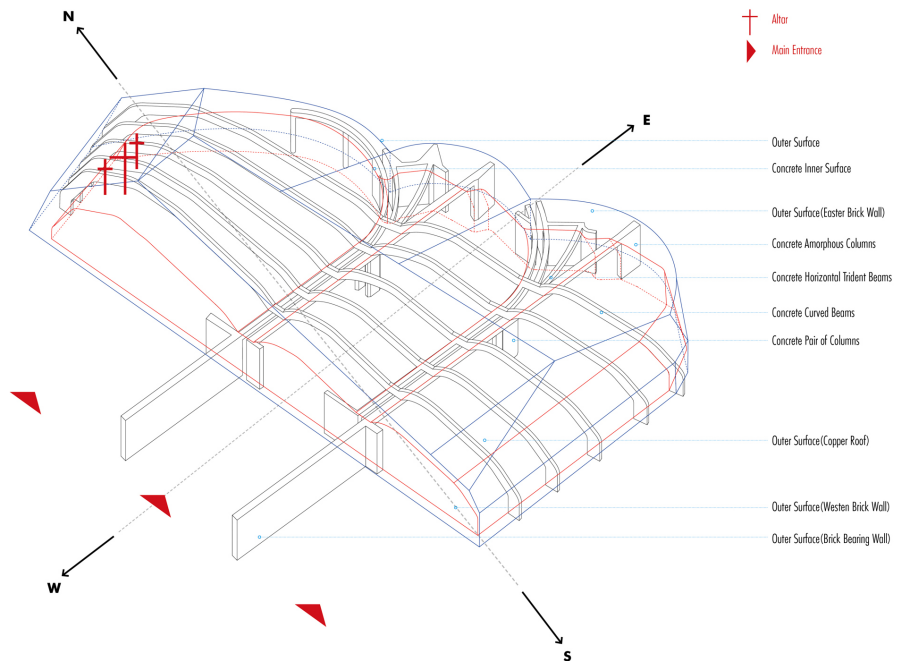


Figure 19. Vuoksenniska Church under construction. Photo from Alvar Aalto Foundation

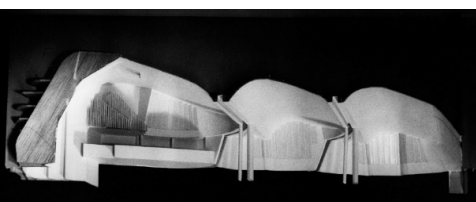
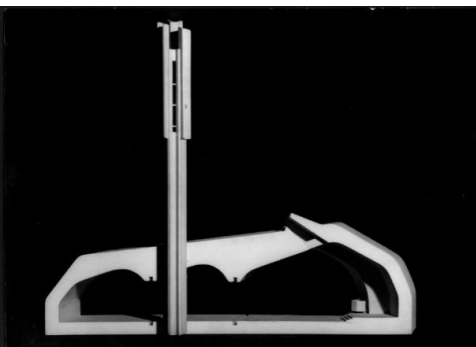


Figure 20. Concept model of Vuoksenniska Church. Photo from Alvar Aalto Foundation

Figure 21. Concept model of Vuoksenniska Church interior. Photo from Alvar Aalto Foundation

Besides the structure, Aalto wrapped one more surface, a copper one rising likewise towards the altar and so light that they directly find support on the arching beams. Meanwhile, the lateral walls, though heavily masonry-ed for the harsh climate (Fig.19), are set somewhat back from the main structure, therefore distinguishable from the inner surface. In this way, the structural system, along with such a loose envelope, forms a "thick partition" spanning over all the ternary hall. Furthermore, where the coloring treatment differs in Muurame is all uniformed in whiteness here, simply as the structure as a whole goes (Alvar Aalto 1956).

**"Thick partition" for space and metaphor**

As Aalto stated: "...industry has a special interest in this church building and in the church form itself, in that it is a church serving the special needs of the industrial region" he aspired to use the church to provide a unique experience for people. In his words, "The actual architectural principle behind the church can be described as follows: a consequence of church actives...yet in this complex, the author has aimed for an intensified church character." (Alvar Aalto 1959,201)

It is Aalto's operation on the elements inside the "thick partition" with respect for the structural role of each that carries out his promised "intensified church character." (Fig.20, Fig.21)

On entering, each vestibule is followed by an L-turn to face the altar, which lies at the far end of Hall A, therefore engendering two trends in Vuoksenniska, one from the secular south consecutively sublimated into the religious north, the other being a flight from the industrial west to the wild east. (Fig.22, Fig.23, Fig. 24)

It is highly integrality immunizes the structural validity from partial sections into the surface. In the front top of Hall A, namely the whole nave's zenith, and the lower back of Hall C only higher than a human height, transversely carve out two openings to fully direct the spatial boundaries. The former turns the inner surface onto the outer with a height gap, forming a light cannon slanting southward with a depth enabling the concentration of light beams onto the triple crosses at the altar at any time; the latter spans all the arching beams' ends that formed serial shallow openings in accordance for community activities.



Figure 22. In Vuoksenniska Church interior, view from Hall C.

Figure 23. lights towards the nave and the altar of the church in Hall A.

Figure 24. In Vuoksenniska Church, View from Hall A. Photo from Alvar Aalto Foundation

*The structure gave the "thick partition" a full play to fulfill his promised "intensified church character"*

The "thick partition" on the east and west sides differs entirely, reflecting the contrasting industrial and natural atmospheres. This flexible variation also depends on the outer surface free from the main structure composed of the inner surface and the frame. Therefore, the west wall overlooking the town is composed of regular straight lines and closely paralleled double walls; In contrast, the east wall facing the birch woods is much livelier, the inner and outer walls each having their characters and shapes, interspersed by distinctive columns, trident beams, and partitions. (Fig.25, Fig.26)

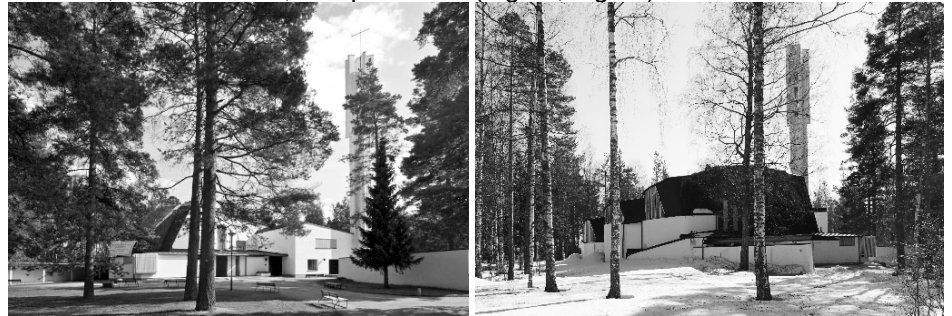


Figure 25. Entrance Plaza of Vuoksenniska Church. Photo from imatra.kuvat.fi

Figure 26. Eastern side of Vuoksenniska Church, Photo by Author, c. 2019

The thinnest "thick partition" at the west wall is a backdrop for the contrasting variations. Between there and the three vestibules is a slit to connect the ventilation ducts of the basement boiler room. In contrast, louvers are adopted at the height above the vestibules to cover all the openings to filter the west slanting sunshine. While at the upper-floor level of Hall B that allows no direct opening, an upward light cannon similar to that at the altar is made to penetrate the roof and wall, with a depth that substantially softens the light let in. So, the double surface of shutters and glasses there could be beheld as a display of the thinnest "thick partition" at the lower double walls. On the one hand, it means a response

to the absence of a skylight in Hall B; on the other, the super-deep opening contrasts with the western "super-thinness," too. (Fig.27)

The east wall reflects both trends, taking on the naturalized side of the axis from its more artificial western end while turning from religious into a secular atmosphere from north to south. Besides are a variety of functions it carries, namely the openings for sunrise necessary to the rituals and cavities to retract both partitions.

Figure 27. In Vuokseenika Church, View from Hall C.

Figure 28. In Vuokseenika Church, Eastern wall and windows of Halls B and C. Photo from Alvar Aalto Foundation



The hefty and austere walls perpendicular to the ground earn the church the nickname of "bunker" locally, with the windows right above featuring vertical mullions echoing the erect birch woods. Meanwhile, the interior is so silk-smooth and subtly curved to surprise one when finding it cold concrete. In Halls B and C, once over the human height, the lateral walls take a rather abrupt inward slant as if posing to the visitor, with the slope degrees accumulating to adapt to the trend of the nave's lowering height. Moreover, by peeling out an open curve like this, the columns wrapped in the surfaces now reveal themselves behind in a detached gesture. (Fig.28)

The gradient inward slanting culminates in Hall C by an almost falling-down gesture as if reflecting the secular frivolity that replaces the religious serenity. (Fig.29) Besides the asymmetric mullions in the outer walls, a "thick partition" comes into being as a nuanced light filter with the detached columns within acting as the reflective panels whose materiality seems to fade in the light domain. So, it can be concluded that the interplay of the surface and the frame lends the "thick partition" a highly complex, featuring a multi-layered light domain that blurs differences between formal elements while screening the interior from the exterior.

*More Nature- than Deity-orientated, a journey freeing the modern man into the relatively unknowable yet more organic*

The trident beams and partitions fulfill the visitor's transitional experience along each axis. The former indicates an absolute horizontal plane by equal height and guides the visitor along the main gaff towards the altar. (Fig.30, Fig.31) The latter embodies in a supporting way turning from the load-bearing wall into sturdy double columns and finally the fanned eastern wall complex. As if a plant, sprouting into roots before breaking the ground, then shooting the stalk straight towards the sun, then forking and thinning, until the tender tendrils tapering into the air. Such a cycle is embodied in the partitions dynamically, which emerge from the dark cavity only accessible to human imagination, pass through the center of the halls and the people, and finally enter the nuanced light filter without people entering. Besides religious metaphor, it is more probable to experience as a modern man's journey freeing from known molds into the organic, vivid, somewhat unknowable, and hardly hierarchical Nature.



**Figure 29. Eastern wall and windows of Hall C.** Photo by Heikki Havas, Alvar Aalto Foundation



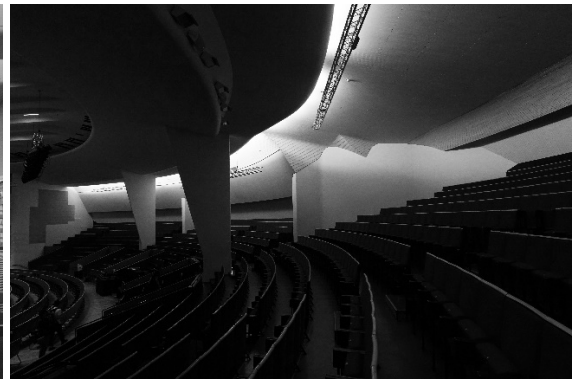
**Figure 30. In Vuoksenniska Church, View from the A hall.** Photo by Author, c. 2019



**Figure 31. Eastern wall and windows of Halls B and C.** Photo by Heikki Havas, Alvar Aalto Foundation

Through carefully weaving each part in the "thick partition," Aalto created a highly sophisticated space. When all three halls are put into use, a spatial continuity can be sensed, and when separated by the partitions, each of them finds its character.

After Vuoksenniska, the columns directly roll in the curved surfaces, a way blurring the two- and three-dimensional that Aalto repeatedly used. Besides the columns seemingly anchoring the curved surface to the ground in the Seinäyoki Library, the lateral-skylight-ward opening in the 2-nd floor reading hall of the Otaniemi Library (1964-70, Fig.32) also sees curved surfaces supported by continuous cylinders. Also, the amorphous pillars supporting the wavy surfaces in House of Culture (1955-58 Fig.33,)



**Figure 32. Aalto University, library,** Maija Holma, Alvar Aalto Museum, c, 2007

**Figure 33. House of Culture,** Photo by Author, c. 2019

In his famous paper "Structure, Construction, Construction" (p.92-95), Eduard F. Sekler states that what matters foremost is not "the most suitable and efficient construction" but the visual expression. The Gothic cathedrals are often cited as a perfect example of tectonic expression. However, *in order to spiritually guide the minds of the onlooker upwards, a play of power is most dramatic and draws directly through empathy, even if what happens behind the scenes with ribs and shafts may differ from what we are led to believe.* Another example is Mies van der Rohe. And his famous corner details are not really construction, but tectonic express "the experience of the force associated with the form in the building." (Eduard F. Sekler 1965, 93-94)

*Aalto's difference  
from or  
transcendence over  
Sekler's master, i.e.  
Mies in  
Vuoksenniska,  
unveiling ambiguity  
other than  
highlighting  
structural logic  
(though surprising  
often)*

*If Vuoksenniska's  
the most  
complicated, Riola  
Church makes the  
simplest, yet  
developing highly  
nuances from the  
simplicity*

Aalto's case differs from Gothic and Mies's. His expression is not false either, and it's also from actual construction and structure. But he only revealed partially for the very subtlety instead of entirely for the structural logic. In other words, he would not like the structural components free from the architectural expression, nor the structural logic prioritized over the spatial one, which also means that his handling of the expression would not be limited to "force related to form in a building."

In Vuoksenniska, with the frame bearing the loads, the curved surface primarily takes up the vision indoors and outdoors, making the impression most plausible that the church is a shell structure. However, at second sight and thought is, the openings from sectioning the roof at Halls A and C with actual frame discernible behind, which denies any intention to "fake a monolith of a shell."

To the visitors entering the church, the exposed curvy morphology generates a kind of a "worldview" likewise, which soon after is denied by the revealed elements so widely as if another world of "truth" exists behind. We could arguably say that the veiled world means more beauty than religion, or rather Nature that breeds everyone or the individuals that compose the community.

Aalto's operation on the "thick partition" parallels an expression through interacting with the structural elements therein, which are indeed tectonic, and even transcending those masters in this way in Sekler's discussion on expression about "construction" and "structure." The Aalto expression often nourishes metaphors in depth about the human, the society, the Nature, and the universe, all transcending literal "architecture."

## Intertwined Elements

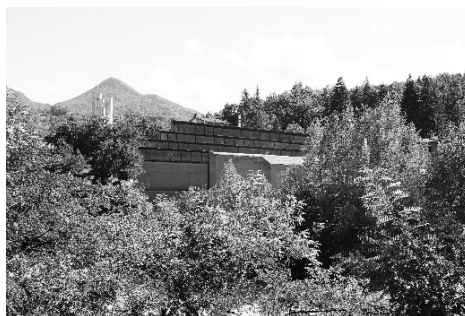
Suppose Vuoksenniska means the most complicated church of Aalto's, undoubtedly Riola Church makes the simplest, which makes a highly varied space with six lines of the frame and four pieces of concrete. Balancing each other both structurally and spatially, they intertwine like warp and weft, arguably the culmination of interaction for the composite of curved surfaces and frames.

The Riola Church near Bologna, Italy, was Aalto's last church design, commissioned in 1966. The design and construction continued until 1978, after Aalto's death.

The church is located on the north bank of the valley where lies its village. Visitors from outside mostly arrive at the railway station on the opposite bank, then turn south to detour for the bridge, with the volume in vision cascading along the slope towards the sun and the valley. A ritual square with the entrance on its right comes past the bridge. (Fig.34, Fig.35)

**Figure 34. Riola Church, View from Riola Railway Station,** Photo by Author, c. 2019

**Figure 35. Main entrance of Riola Church.** Photo by Richard Einzig Alvar Aalto Foundation



The interior layout is more straightforward than Vuoksenniska, somehow back to Muurame's entrance-altar directness. However, Aalto did not give up enriching

the spaces by crossing the processional axis with a transverse one, along with and against the contour lines, curved surfaces, and frames.

Wholly concrete, the church has the serial curved frames as the primary support, with a row of concrete panels perpendicular there onto, which wrap the former like a loose Swiss roll. Therefore, the concrete panels right at the structural heights of the support act just as effectively as beams, transferring their loads and those of the cascading strip skylights onto the frames. Moreover, such Swiss roll also strengthens the latter that are mutually freestanding. The duo fulfills the structural needs in load-bearing and bracing. (Fig.36)

*The Swiss roll and the serial frames, each discrete and mutually intertwined*

The curved section has been carefully considered: each straight section carrying the glass is relatively wider, allowing its weight and that of the glass to transfer down to the curved frame at a low structural height; while the curved section is relatively thin because it only needs to bear its weight, and the higher height allows the force flows in the entire height range, lessening the internal load as the thinner material can bear. The higher height comes from the height of the windows, providing enough openings for the interior. The balancing weight on each side of the curved panels shown in the section also stabilizes the structure, especially the way half gripping into the latter braces it while keeping themselves from rolling too. (Fig.37)

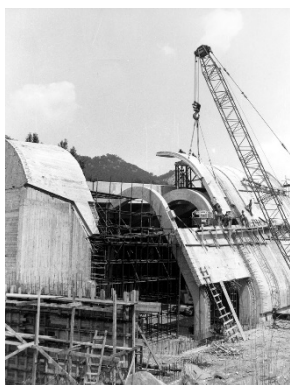


Figure 36. Riola Church under construction. Photo from Alvar Aalto Foundation

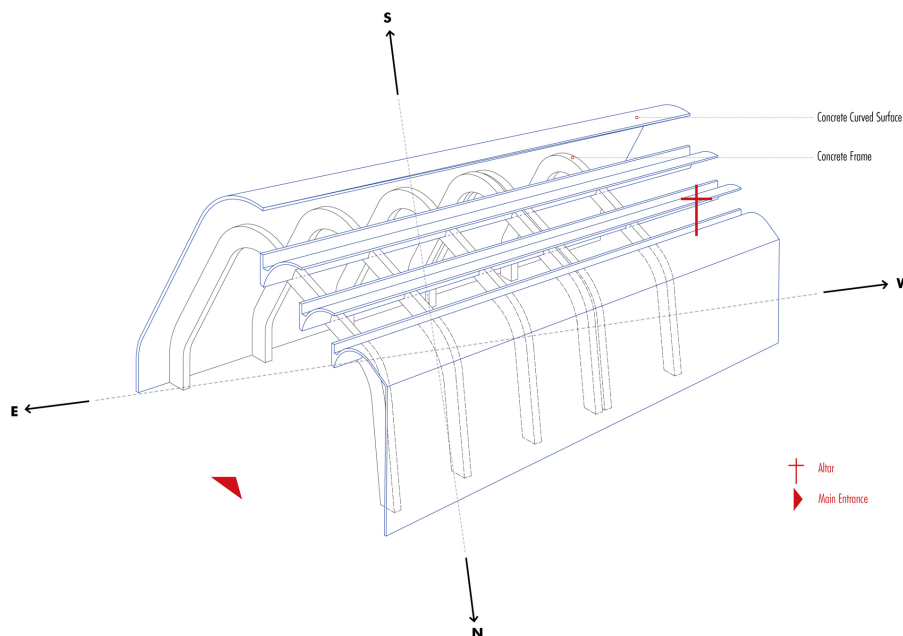
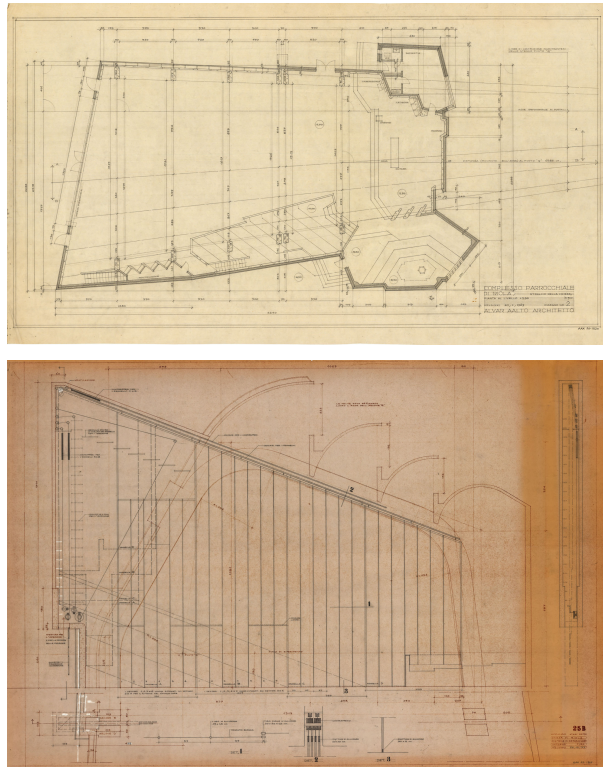


Figure 37. Frame and Surface Diagram for Riola Church. Drawings by Author

The shape of the curved frames resembles an arch, which on the one hand, efficiently transfers the loads to the ground and, on the other, enables the sunward skylights to cascade step by step for optimal lighting. The serial frames then taper along the central axis towards the altar, engendering a momentum for the visitor, only interrupted somehow between the second and third ones from the altar end, whereby a slight crevice Aalto reserved the room for the retractable partitioning curtain. Therefore, rather perceptibly than actually, the nave is divided into the core around the altar and its peripheries. (Fig.38)





**Figure 38. Plan for Riola Church Design,**  
**Figure 39. Section for Riola Church Design,** Drawings from Alvar Aalto Foundation

The sunlight entering the room through the Swiss roll is beautifully reflected and refracted through the three-sided curved surface and interacts with the frame, creating a rich contrast between "faces" and "lines." (Fig.39) The frames and the curved surfaces compose a "thick partition," then turned into a "domain of light" in the diffuse sunlight reflected inside the latter. Furthermore, under the very "domain of light," is right the nave feature as a "human space" clearly delineated by the frames in the light.

To quote Aalto's own words, "The architectural design of the church is associated with a renewed ritual. The main intention is to maximize the interaction between the altar, choir, and organ as well as the baptistery as an architectural form," (Alvar Aalto 1968), the latter is just realized through pressing and stretching the "thick partition."

In the north, the curved surface rests against the frames by concrete strips so slender that the delineating shadows suggest a thin void that widens upward until abruptly ending down when approximating the zenith with sunshine directly let in, then closely followed by a second curved panel rising likewise where it ends, with the gap allowing the sunshine into. (Fig.40)



**Figure 40. Interior of Riola Church.**

*The north vs. the south, the cascading panels (skylights) for sunshine and the ramp extending the landscape*

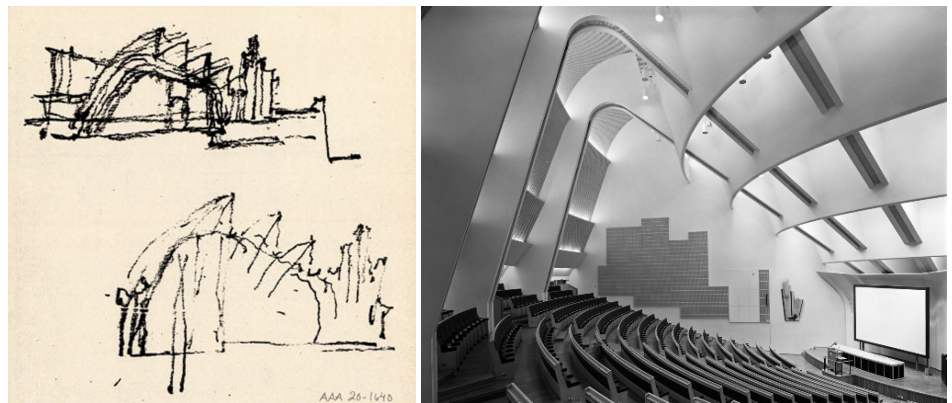
**Figure 41. Northern part of Riola Church.** Photo by Author, c. 2019

In the south, Aalto adopts an even subtler way to hint at the sloping site and shape a new topography. Right in the enlarged space between the curved surface and the frame, a ramp resembling the winding road to the site is introduced, which the visitor takes either upward to the choir, or downward to the hexagonal chapel near the altar. Continuing the outdoor slope indoors, the church is turned into a valley where visitors aggregate, thus echoing the Tuscan valley scape seen until entering, which still lingers on their impression. (Fig.41)

Each frame is bathed in the domain of light generated by the curved surface while together raising the latter beautifully and powerfully like the goddess columns on the Acropolis do. The surface attaches to them in the north, then increasingly attracted or striving to the sun with widening distance, as if a hillside plant growing in a slanting upward direction, with laden flowers amid orderly leaves, an epitome of a world admits collaboration but no hierarchy, no less rational than natural. (Fig.42)

*Another example of the "thick partition" close to that in Riola*

This "thick partition" juicy in air, sunlight, and tension saw a very similar approach in the Lecture Hall on the Otaniemi Campus of Helsinki University of Technology, only the fanning distribution of frames differing from the parallel, tapering one. So there creates a converging space for lecturing, whose sloping trend turned into amphitheatrical seats on the outside, a hub or sanctuary for the campus. (Alvar, A. F. & Alvar, A. A. & Alvar, A. M. 2008, 88, Fig.43)



**Figure 42. Sketches by Aalto for Riola Church Design.** Drawings from Alvar Aalto Foundation  
**Figure 43. Aalto University, Main auditorium.** Martti Kapanen, Alvar Aalto Museum, c. 1956

## Conclusion

Some scholars assert that Aalto was modern architecture's earliest dissent and reformer.

*Aalto, arguably the earliest dissent and reformer of modern architecture, long overlooked and misunderstood until his constantly used composite system and "thick partition" are revealed*

*Denying the structure-envelope dichotomy, Aalto structured not for material efficiency or ideal authenticity, but for a poetic sense making featuring ambiguity*

It was Aalto's overly dazzling sensual sculptural surfaces in his pursuit of plausible "ambiguity" that obscured his rational thinking, and he has long been classified as "irrational" and "a-tectonic". Ironically, such restructuring and transcendence of clear-cut characteristics of modern architecture became proofs of his guilt of being "not rational enough."

As a composite system, the surface-frame system has been a constant in Aalto's architectural career. The "thick partition" including different elements develops into a dialogue among others. Finally, they get into an intertwined system, which is rare at that time where the separation of structure and enclosure was politically correct.

Based on this, Aalto fully explores the possibilities of its tectonic expression, incorporating the control of space and light and weaving a web of meaning, with multiple layers of symbols presented through the manipulation of surfaces and frames. As we can convincingly see, Aalto has achieved an ambiguous constructive presentation in a rational structural manner. Furthermore, the "thick partition" prototype is not limited to the church.

Although this system is highly relevant to the rational construction of structures, Aalto does not take it further in terms of structural efficiency, nor does he present the structural elements for their own sake, but is highly subservient to the expression of space and meaning. This poses an obstacle to revealing Aalto's rational design approach but constitutes a unique feature of Aalto's constructive presentation: the poetic gradually stands out against the ambiguous expression. Beneath the well-known "humanizing form" and "warm material expression" throbs Aalto's sharpness and radicalness.

Furthermore, denying the structure-envelope dichotomy is Aalto's first step to transcending modernity. He had developed his ideas, from as small as certain religious functions to as big as the role of architecture in society. Aalto went out of "Form follows function" to question the one-to-one relationship.

Aalto rewrites almost all clear-cut tenets of modern architecture to the extent that structure differs from non-structure yet without noticeable difference or predestined priority in expression. Meanwhile, the served and servant spaces are also presented purposely, but not in the way we are used to, as the often negatively-treated latter becomes the lead role. Aalto blended and blurred the various forms and systems typical of modern architectural vocabulary, but his ways are unlike the unclassifiable forms of pre-modern architecture. The skin-skeleton dichotomy of modern architecture, namely envelope structure, received a gentle counteraction from Aalto: isn't there anything besides the lead role for the space to play? The space may also be used to divide itself, be questioned beyond fixed form on different occasions that may even rethink the human-centeredness -- could each element, from the dividing wall, the furniture to lighting, has its own space beside human? Is the religious space really another thing from the secular? Right in this sense, we may feel that Aalto the Atheist still left some specific room beyond human reach, though probably not literally religious.

Wandering all over the world while rooted in a far corner, Aalto had never baptized himself a fully modernist. Though he delved therein once upon a time, he soon found his complex reaction to modernism. Hence, both inheriting and critical led to a restructuring of the tenets to the extent of ambiguity. Furthermore, to this day, there are still parts of his work that we as contemporary people cannot fully understand, but which can be deeply resonated. In this sense, we can say Aalto is a contemporary master.

## Acknowledgements

Authors may acknowledge contributions to the presented research or credit illustrations here. Also, authors may provide information in this section on how the research is funded, for example through research foundation, university, authority, organization or spare time research.

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