



*Fundamentum Organisandi. Het orgel in de 15e eeuw, architectuur en ontwerp*  
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## CONCLUSIONS AND SUMMARY

### Conclusions

The question whether the present study has revealed the codes that lay at the basis of the design of organs and organ ensembles in the 15th century – with special attention to the relationship between the organ ensemble and the church interior – is answered in this volume in the affirmative. The hypothetical points of departure upon which it is based, that in the period concerned numerical, metrical and geometrical patterns gave rise to models for design, are likewise confirmed following examination of many organs and organ ensembles. Concerning the relationship between the organ ensemble and the church interior, the theory of *adjunction* provided satisfactory answers. These results offer entirely new insights into organ design as a specification on the scale of meso-architecture, but also into the architectonic design on the scale of macro-architecture.

Central to this was the design methodology current in the 15th century, which is presented here for the first time as a coherent system, confirmed by all available sources.

Intensive measurement and documentation of the organs and organ ensembles yielded information on the original design, its points of departure and their ultimate translation into the concrete object. Verification lies in the consistent relationship between design methodology and the translation to the distinction – ensuing from the design methodology and intended for practical use – between the *architectonic basic design*, the *draft drawing* and the *design drawing*. The significance of this for the interior design in a broader sense was exemplarily examined in the design of the winged altar retable, which in layout and execution displays close similarities with organ design.

The following conclusions and insights have resulted from the present study:

- A. In the fifteenth century, the design of objects on the scale of macro-, meso- and micro-architecture was based on a design methodology employing numerical, metrical and geometrical patterns and models.
- B. In contrast to views frequently upheld in the past and present, this design methodology did not give rise to complex geometrical figures, that could only be expressed in irrational numbers, as basis for the design, but to units that could be conveyed in whole numbers, which could subsequently be converted into concrete measurements.
- C. The utilization of the design methodology employing numerical, metrical and geometrical patterns and models is confirmed through the study of designs of organs and organ ensembles as objects of meso-architecture.

- D. The design assignment of the organ ensemble, as an object of meso-architecture in relation to the church interior, was primarily of an architectonic nature, realised through application of this design methodology; it had the character of a mutual addition (*adjunction*).
- E. The correctness of the theory of mutual addition in relation to the design of the organ is confirmed by the study. It is also plausible for other interior fittings, a matter deserving further investigation.
- F. The design specification was directed towards the outward aspect of the organ ensemble and its rapport with the church interior.
- G. The design methodology was applied to organ design throughout (Latin) Europe in the 15th century, independently of local or regional form traditions and style concepts.
- H. The design methodology did not serve a specific ideal as regards form, but was of an instrumental nature.
- I. The adopted research method yielded an understanding of the structure of the organ design, the underlying pattern and the utilization of the module, and, in a practical sense, the units of measurement derived from it.
- J. This information provided insight into the original design of the organs and organ ensembles that were studied, and their relationship with the architectonic surroundings.
- K. Lack of correspondence between the design methodological characteristics of the organ ensemble and the interior is a signal that the organ was not built for the church in question.
- L. From comparison with other interior fittings on the scale of meso-architecture (winged altar retables) it can be inferred that the principles on which the organ design was based were also valid for the further interior arrangements of the church.
- M. The study provided a new comprehension of the structure of the organ front. This was a composition of '(pipe) flats' of approximately equal width, whose height was proportionally interrelated.
- N. The iconography increases understanding of the diversity in layout and realization of 15th-century organ design.
- O. The study led to the conclusion that the organ design was produced by experts schooled in the design methodology.
- P. The design methodology was applied to organ design into the 18th century, irrespective of the style concepts of the period.
- Q. The influence of organ design of the 15th century extends into the 20th century.

I have demonstrated that the planning of the furnishing of the church (in the 15th century but possibly also at an earlier stage) arose in a process that was in line with the design of the church. For this reason, considerable attention has been paid to the development of the design of the building, and particularly to its modular and metrical structure. In an ongoing process, interior fittings, including organs and retables, were subsequently designed. The relationship of these arrangements to the architecture – to the interior – was twofold. On the one hand the same modular and metrical data formed the basis, while the fitting in question was proportionally and numerically related to the architecture in a regular manner. On the other hand there was mention of an emphatic independence in respect to one another, expressed through the distinction between

macro- and meso-architecture and the way in which the objects were added to architectural parts of the interior without losing their autonomous character. This new approach to the relation between the interior and its fittings offers opportunities for further study of the church interior.

Although organ building in the 15th century was part of an intensive interchange between the various economic and cultural centres, many questions that arise here remain entirely unanswered. Some organ builders led a considerably ambulatory existence, which explains their presence in divergent places. The same is true, incidentally, for architects, who often offered their services beyond a regional level. The radius of their activities in the 15th century, however, hardly offers a satisfactory explanation for one of the most striking results of this study, namely that the architectural design methodology was applied to organ design throughout Latin Europe. The significance of this can be no other than that, from an early date, there was mention of a general and deep-rooted consensus on both the departure points and their practical application. This matter requires further research.

The fact that this architectural design methodology was still applied to the organ design of the 16th, 17th and 18th centuries likewise requires further investigation, particularly with regard to the relationship with concepts of style and form current in these periods.

The conclusion that organ design in the 15th century was essentially based on compositions of rational numbers throws a particular light on the discourse on the systematics of architectural proportion, in which until today much attention has been devoted – as a result of their occurrence in the geometrical theory of figures – to the irrational numbers. The results of my study confute (scarce) attempts to proclaim the golden section as the proportional principle of 15th-century organ design, attempts providing just as many proofs of the widespread application of proportional systematics based on whole numbers.

The study of 15th-century organ design also enables conclusions to be drawn concerning its significance for architectural design in a wider historical perspective.

A question requiring further research is whether the methodology apparently still current in the 18th century was still upheld in the 20th century, or that its evident advantages were rediscovered time and again. The methodology was applied so sophisticatedly in the 15th century that the impression arises that it was inherent to the conventions of style and form of the period. It can hardly be denied that its potential was explored to the full in order to realize certain intentions that could only be expressed in the form language of the Gothic era. The design methodology of the 15th century enabled the designer to attain a thorough command of all aspects of the design. But the fact that in the architecture and interior design of the 20th century - with its radical revision of design and form principles – design methodologies based on square grids were utilized, calls for research in a wider historical framework.

Marshall made her statement “every aspect of the Peter Gerritsz-organ requires a different Rosetta Stone” in relation to the study copy constructed in 2010-2011 of the organ built in 1479 for the Nicolaïkerk in Utrecht (see preface). The purpose of the copy was that it would contribute to the understanding of the secrets of the original instrument. My study contributes new insights with regard to the design principles on which it was based and the relationship between the organ’s design and the architecture of the church interior. These are relevant in the discourse on problems concerning the restora-

tion and resiting of both the organ in the Nicolaïkerk in Utrecht and that in Scheemda in the similarly named church. The historical importance – recognised worldwide – of the Utrecht instrument, and the unique position of the Scheemda organ in our heritage, demand decisions founded on multidisciplinary arguments. Following on from Marshall's plea, research into all the codes of these organs is required.

In this study we are confronted with a distance of more than six centuries from our subject. I am well aware that the overall picture is composed of gathered fragments. Not only has so much disappeared that could have shed another light on the subject, but our own vision of what we *can* see is coloured by the light in which we stand ourselves. Even at moments when I was physically closest to the subject, during measurement and documentation sessions, such data could only be collected in the form in which it has survived after centuries of use, alteration and restoration. Each observation required interpretation. Here my perception proved to be unconsciously limited by selection mechanisms that left certain aspects out of consideration. Having initially failed to notice essential information, I returned to some organs several times. Whatever the case may be, the result is a reconstruction of a past, which has been brought somewhat nearer, though much remains in the shadow of history.

We therefore run the risk of underestimating the real significance of the organ culture of the 15th century, dismissing it merely as a 'preliminary' to later developments. Considering the central role played by the church in the spiritual, social and cultural life of the 15th century, the widespread dissemination and presence of organs in churches of diverse size and status constitutes a signal concerning the significance of the organ culture of that period, and this should not be underestimated. That this phenomenon was not limited to ecclesiastical and economical centres or rulers' courts appears, among other things, from the presence of organs in more remote territories such as Gotland, Rügen, Eiderstedt and the Eems-Dollard region. They form as many indications of an organ culture that was much more widespread than we can imagine, the remnants of which can offer no more than a limited reflection. Indeed, the history of the organ culture of the 15th century has yet to be written.

## Summary

### **Fundamentum Organisandi. The organ in the 15th century, its architecture and design.**

The issue of organ design in the 15th century is an almost unexplored field, particularly with regard to the relationship between the organ ensemble and the church interior. In order to study the subject, knowledge was required of the utilized design methodology. A coherent picture of the architectonic design methodology of the 15th century, taking all sources into account, has until today not been available. Likewise absent was an up-to-date overview of all surviving organs and organ ensembles of the period, and those known from illustrations. Since an understanding of the design methodology and the availability of comprehensive source material were conditions *sine qua non* for research on the subject, their acquisition formed a substantial part of the study. In the present volume a new and coherent picture of the design methodology is presented, and an overview of organs and organ ensembles up to ca. 1530 which is as complete as possible.

The crux of the research concerned the decipherment of the codes upon which the design of organs and organ ensembles in the 15th century was founded, with special attention to the relationship between the organ ensemble and the church interior. In Krewerd I discovered a metrical and proportional relationship between the organ ensemble and the architecture. This put my research onto the track of the design principles at its basis.

In order to verify this, the sources on design methodology were studied and prevailing standpoints on them critically reviewed. All sources (including Villard de Honnecourt, Lorenz Lechler, Matthäus Roriczer and Arnaut van Zwolle) were compared. It emerged that the design methodology current in the 15th century was based on a square grid and was essentially modular.

With regard to mutual proportions, these were established by means of rational (= whole) numbers. This is founded on the number theory of Late Antiquity. Numbers, compound numbers, and proportions expressed in whole numbers, were considered to be exponents of a universal harmony originating in God's creation. By utilizing this number theory, the designer could give expression to his role as recreator. There was also a role for certain geometrical figures, which played their part in formatting the design. Interpretations expressed in irrational numbers did not stand their ground, except in detailing; in practice, however, such elements could be replicated full-scale.

In defining the design of a church building, the internal width of the choir was determinative. The measuring unit (*werkvoet*) that was applied formed the binding module for the entire design. It could be organised in large units (*demarcations*) or divided into smaller ones (*parts*). From initial observations in Krewerd it emerged that the dimensions of the organ ensemble were derived from the measurements of the church, a fact confirmed by further research of the collected data of many other organs and organ ensembles.

The design methodology enabled the designer to realize design specifications in diverse architectonic scale domains. These are distinguished in terms of macro-, meso-

and micro-architecture. The (church) building and its interior belong to the scale domain of macro-architecture, while most interior fittings, including the organ ensemble, belong to that of meso-architecture. The Gothic form language of the era was applied not only in specifications in the scale domain of macro-architecture, but in smaller scale domains too when dealing with details.

The research addressed the question on which design methodological parameters organ design was grounded. The organ ensembles to be studied were scrutinized according to the following thesis: numerical, metrical and geometrical patterns gave rise in the 15th century to models for the design of the organ ensemble in the 15th century in its architectural context. An important issue was the nature of the relationship between the organ ensemble as an object of meso-architecture and the interior on the scale of macro-architecture. This was studied from the perspective of the theory of *adjunction*, on the assumption that the organ ensemble (by reason of the corresponding measurements) was added to the architectonic element (wall, pillar, portal etc.) for which it was intended, thus reinforcing the structural and formal qualities of the two without loss of their autonomy.

The source material for this study consisted of organ ensembles and organ cases up to ca. 1530 that are substantially preserved in a fixed position in the church, surviving fragments of organs and organ ensembles, organ galleries, organ shutters and original design drawings. In addition, depictions were examined of organs and organ ensembles no longer in existence; in this category intensive inquiry led to surprising discoveries.

Substantially preserved organs and organ ensembles functioned as primary sources, which through measurement and documentation provided information about the parameters upon which the design was based. Mutual comparison was made possible with the help of a specially developed *width diagram*. The results are presented here in graphs in which all instruments are represented in a uniform manner.

The organ ensemble comprised a gallery and an organ placed upon it. The gallery stretched over the entire width of the church, or consisted of a balcony installed against the wall, of which the most common form is described as a *swallow's nest*. The balustrade of the gallery largely impeded the view of the lower part of the organ case from the church below, so that the gallery and organ front were seen as one composition. In the upper organ case the front pipes were arranged in 'flats'. The Rugwerk was initially an integrated part of the gallery balustrade, later gaining more autonomy as a piece of furniture in its own right. In order to harmonize the transition from ensemble to architecture, use was made of contour painting, lending profile to the ensemble against the wall.

It is thanks to Michael Praetorius (1619) that we have the characteristic term of the *swallow's nest*, and likewise the authentic proportional distinction between organs of different sizes: a "Ganß Werck", a "Halbes Werck" and a "Viertelwerck".

Most of the organs were provided with shutters, often painted with sacred imagery. Depictions of the Coming of Christ in the world were widespread, with the Annunciation as the most common theme. The saints to whom the church was dedicated also played a role in the choice of subject matter. In the absence of shutters, curtains could also be used to conceal the organ.

The organ ensemble did not occupy a standard, specific position in the church interior. In principle any location could be considered, assuming it was accessible and there was sufficient space for the bellows. The actual position of the organ ensemble was pri-

marily determined by architectonic considerations, by reason of the relation with a specific architectural element (portal, pillar, screen etc.).

Mainly executed as flat cases, the organs display many similarities - partly through the presence of painted shutters - with contemporary winged retables. This analogy with the organ (case) was too conspicuous to be disregarded, and led to formal, design methodological and design technical comparison.

The design assignment concerned the outward aspect of the organ ensemble and its rapport with the church interior. It was an architectonic assignment, both on the scale of meso-architecture with regard to the ensemble, and on that of macro-architecture as regards the rapport with the architectonic element in the church interior.

The interpretation of the design assignment (and its realization and concrete appearance) was determined by local/regional expertise, facilities and circumstances. By reason of the corresponding form language, objects in all architectonic scale domains were created by designers of diverse backgrounds (architects, master masons, goldsmiths, carpenters, and other craftsman).

In the design process there was mention of a complex of roles and responsibilities, methods and techniques, views and interpretations. A distinction is made between the design in a *broader* sense and that in a *narrower* one. In the design in the *broader* sense, the process was directed towards the fulfilment of the conditional aspects. In the design in the *narrower* sense, the result of this was translated to models, drawings, descriptions and suchlike for the purpose of elaboration and ultimate realization. In all phases of the process the design methodology proved to fulfil a role as a "development platform".

Four representative (and in time and place divergent) churches and organ ensembles were exemplarily investigated, namely Sion (cat. 54), Utrecht Nicolaïkerk (cat. 63), Carpentras (cat. 10) and Krewerd (cat. 24). They were placed in a historical context, the role of principals and designers was examined, and the design principles upon which the design was based were analysed. The results enabled the development of the design to be reconstructed. Its modular nature proved to be a factor of significance in the transition from design to execution. The realization of the organ ensemble was ultimately based on metrical information derived from the module.

In these instances the application of numerical, metrical and geometrical patterns and models is proven. What is more, the relationship between the building and the organ ensemble was found to be characterized by the principle of *adjunction*. These results were confirmed by analysis of various other (researched) organ ensembles included in the source material.

The *design drawing* for Carpentras (cat. 10) is representative for the period of research. It corresponds in technical terms to the many preserved drawings of designs in all architectonic scale domains.

The production of design drawings was preceded by drafts, in which the modular character of the ultimate design was determined. In this phase, the (*architectonic*) *basic design* and the *draft drawing* can be distinguished. Despite the fact that such drawings for organ design do not survive, their utilization can be assumed on historical grounds and by reason of examples (including retable design). The results of the instances studied were such that - as an ultimate verification - it was possible to reconstruct the original design drawings.

The creation of a new organ ensemble often coincided with building or rebuilding operations in the church, or was a consequence of subsequent refurbishing.

The dimensions of the organ ensemble, established on architectonic grounds, were in principle at odds with the natural width of the instrument. This was apparently solved by applying a formula according to which the longest front pipe (expressed in feet) was related to the width of the organ case. If the largest pipe was 4' long, the width of the case was ca. 6'. Where the largest pipe had a length of 6', the case was ca. 8' wide, and for an 8' pipe ca. 10' etc. In the earliest phase of the design process (resulting in an *architectonic basic design*) this formula enabled the designer to connect the requirements of the instrument with the measurements – expressed in the *werkvoet* – of the church. Any discrepancies between the desired width of the instrument and the architectonic dimensions were compensated by the width and position of the stanchions in the front.

In the studied cases we meet various persons known to us as designers: Peter Maggenberg (Sion), Jacob van de Borch (Utrecht) and Blaise Léquyer (Capentras). The *architectonic basic design* must be attributed to the architect/workmaster. The production of the *design drawing* belonged to the competences of carpenters, although architects and master masons were also eligible. It cannot be excluded, moreover, that some organ makers also had the required architectonic design skills.

While design drawings did not include measurements, they sometimes gave an indication of scale, while metrical information was probably supplied separately.

For the examples researched, contracts no longer exist. From organ contracts surviving elsewhere it can be ascertained that there was no mention of an unequivocal procedure for putting the instruments out to tender. The design and sometimes even the (already constructed) organ case were put at the maker's disposal by the principal. In some instances the organ maker and the carpenter were commissioned simultaneously, or the organ builder acted as main contractor. Painters responsible for decorating the shutters were contracted separately.

Organ design in the 15th century was the result of a long development. The pursuit of symmetry in the instrument's appearance was made possible by the invention of the rollerboard. The solution seen in the 14th-century organ in Norrlanda (cat. 38) represents the transition from the asymmetrical positive to the symmetry of the double-towered front common in the 15th century, as at Sion (cat. 54). Characteristic of the upper case is a subdivision in more or less equal widths – the 'flats'. In accordance with the differing lengths of the pipework they accommodate, the heights of the flats are proportionally related to one another. The composition of the organ front consists of symmetrical arrangements of flats. The positioning of the stanchions on or next to the demarcation lines forming the basis of the design, and the choice of mitre-shaped or increasing or decreasing pipe lengths in the flats, created a subtle rhythm in the upper organ front.

The flat constituted the formative element in the structure of the upper organ case. Flats of differing widths and heights were combined in three-, five-, seven- and even nine-part structures in various formations.

In the course of the 15th century both *Rugwerk* and *Bovenwerk* were introduced, with the necessary consequences for the layout. The organ at Perpignan (cat. 46) is exemplary for a fully developed instrument comprising several 'storeys' of monumental dimensions.

The design of the organ included expressions of symbolic and allegorical significance. They concerned the union of the heavenly with the earthly liturgy, and were manifest in number symbolism, themes of the shutter paintings, or the presence of angel figures. In

contrast, typically profane elements – like the so-called *Rohraffen* – recalled the secular origins of the organ.

The utilization of the design methodology in the 15th century can be traced from Sweden to Spain and from Wales to eastern Germany. In organ design, at least, it was still employed after this period, as can be seen in a number of instances dating from the 16th, 17th and 18th centuries. The influence of 15th-century organ design on that of 19th-century neo-Gothicism is evident, and was encouraged by influential writers. In the 20th century, by way of reinterpretation, 15th-century organ design was yet again to provide an example.

*Translation: Stephen Taylor*