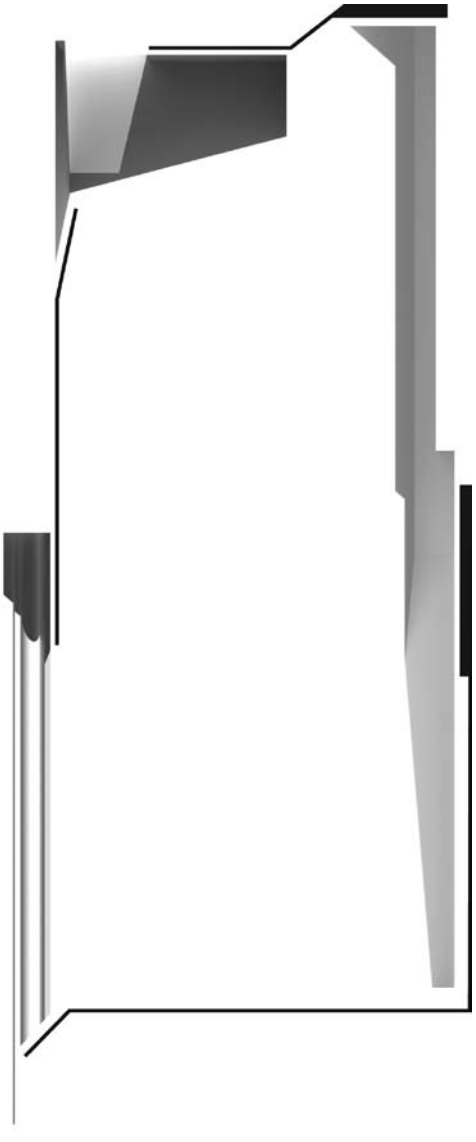
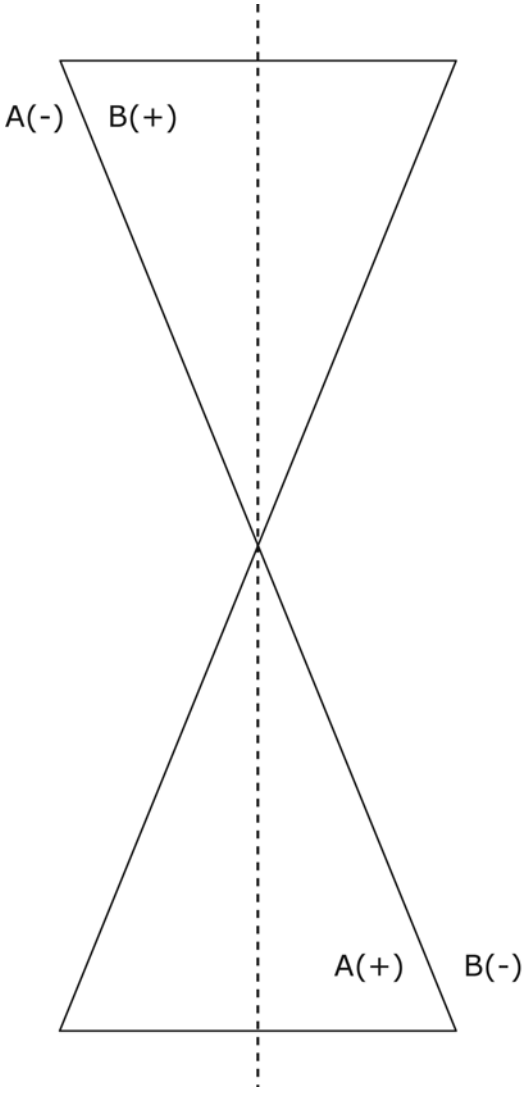




Dynamic Generation of Form

Claus Peder Pedersen
& Claudia Carbone

The material shown here constitutes part of a study of the dynamic generation of form in architecture. Some of the material has been developed in connection with my Danish PhD dissertation, entitled "Arkitekturens Dynamiske Formdannelser"[1] ("Dynamic Generation of Form in Architecture"), and is shown here in edited form. Other parts have been developed for an exhibition at Arkitekturgalleriet (Architecture Gallery) at the Danish Architecture Center, Copenhagen in collaboration with the architect Claudia Carbone, who has also helped to develop other parts of the material.[2] In addition, the architects Lars Bendrup, Vincent Grandgagnage, Annette Svaneklink Jakobsen and Maj Westberg have helped to develop the projects.

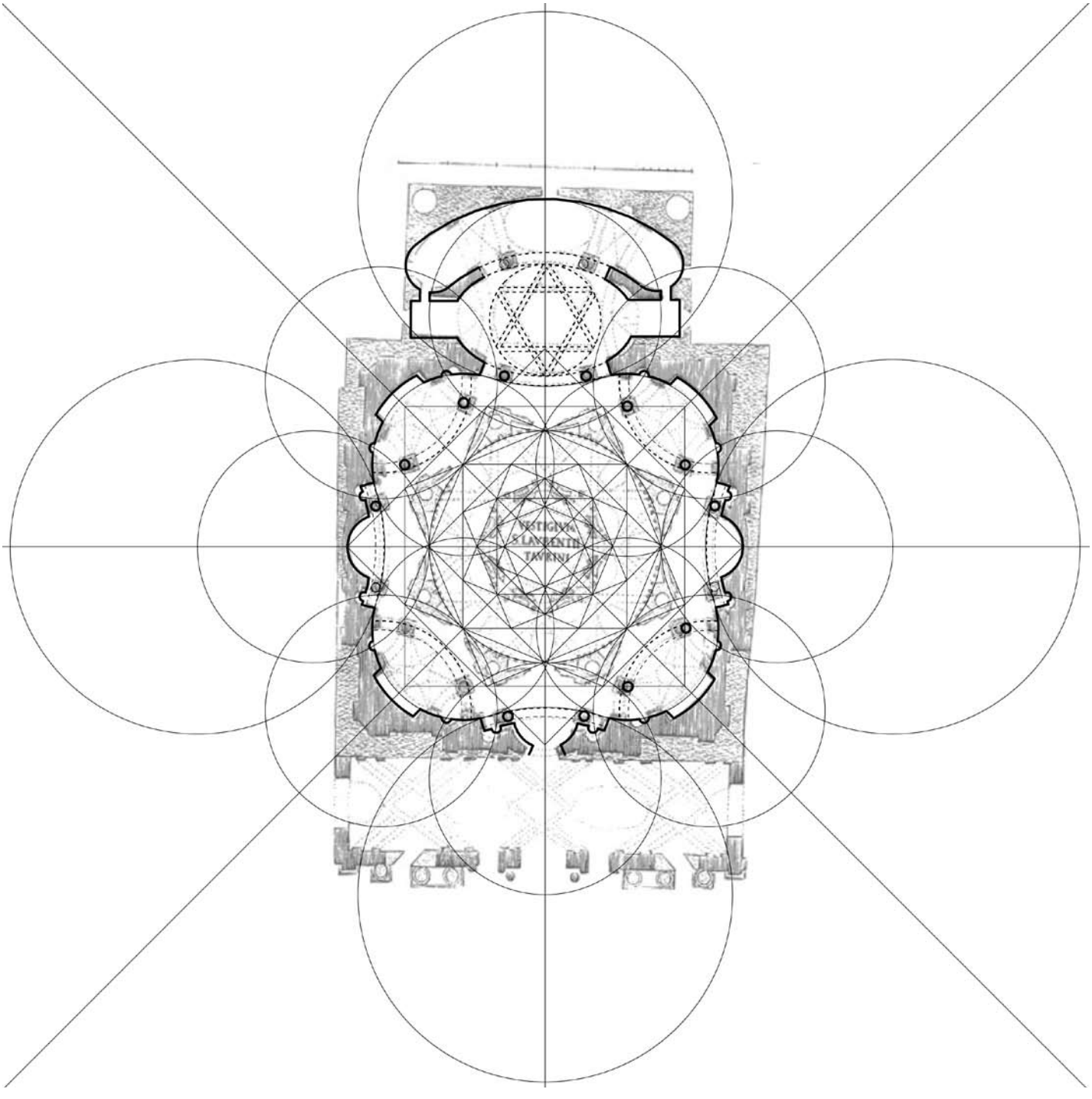
The research work shown here comprises a study of the formally-speaking complex generation of form in architecture. It has been given the title "Dynamic Generation of Form in Architecture". The concept "dynamic" can be defined (cf. Kasper Nefer Olsen) through reference to catastrophe theory, which operates

> … with a distinction between static and dynamic systems, defined by the more or less well-developed ability of any given system to react or even communicate with its environment.[3]

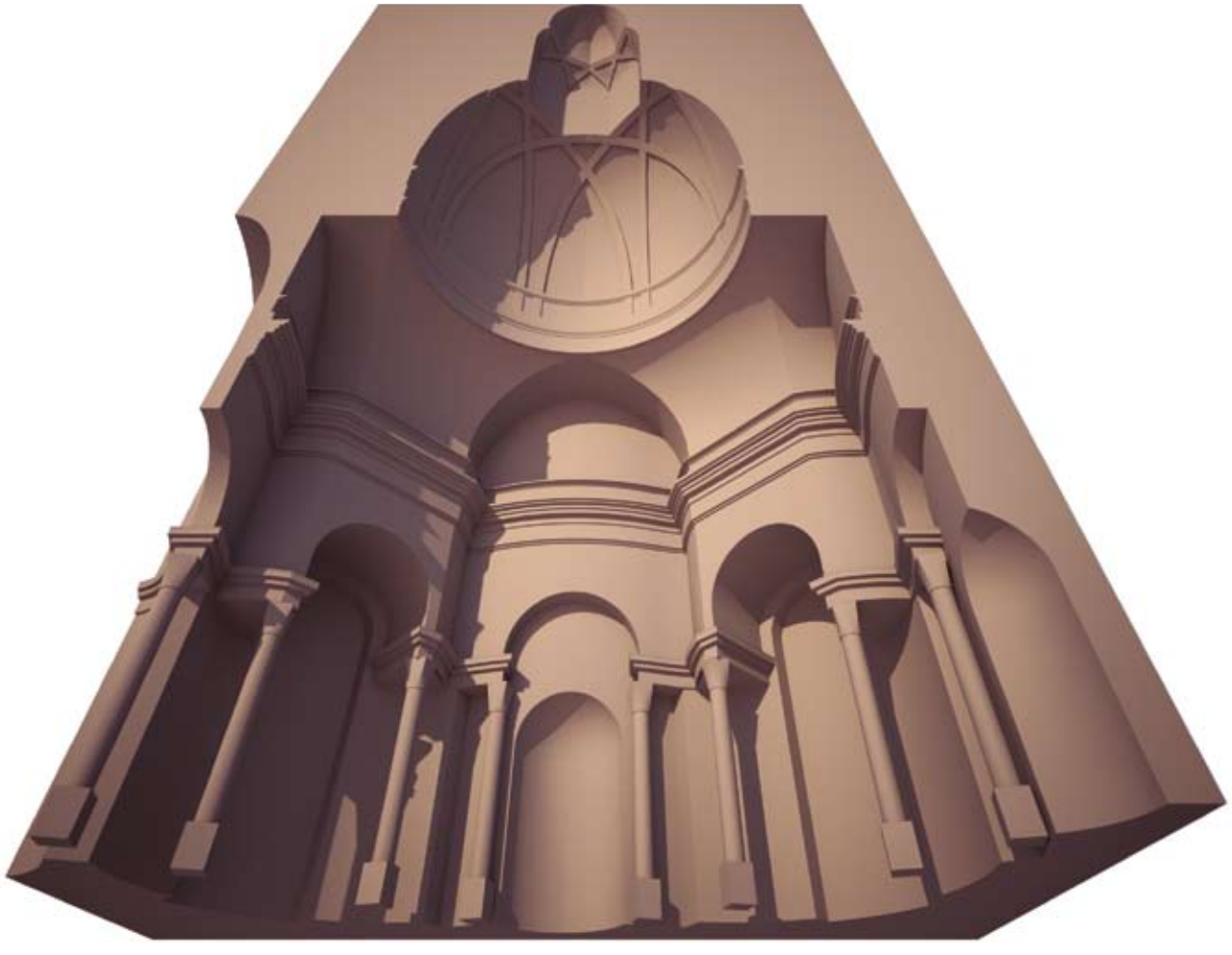
The study focuses on the complex plastic generation of form that arises in a dynamic exchange between geometry and drawing conventions. It seeks to develop an architectural research methodology based on methods of working and analytical tools associated with the architectonic drawing. For the same reason, the work is based on a dual approach contrasting formal architectural analyses with architectonic development work.

Analyses of individual buildings reveal a variety of different ways of organising architectonic space. These architectonic principles of organisation and enquires form the basis of the design projects. Analysis and design thus explore an architectonic enquiry from two different angles, and there is an exchange between them. The analysis clarifies architectonic questions, which are tested in the design work. The projects analysed are more or less direct sources of inspiration for the design work, resulting in independent projects. In turn, these projects reflect back on the analytical part by clarifying the standpoint and focus which the analyses seek to identify.

This methodology is inspired by the work Peter Eisenman did in the early 1970s (without taking over Eisenman's



San Lorenzo – geometric analysis



San Lorenzo – analytic rendering

critical decompositional project). This work is based on a series of detailed formal analyses of the buildings of the Italian modernist Giuseppe Terragni, revealing the underlying geometry and architectonic syntax. The analyses form a basis for Eisenman's architectonic projects known as *House I–IV*.[4] The projects are founded on Terragni's idiom, but transcend it in a series of systematic structural transformations of plans and elevations.

Analysis and project can be understood independently and separately in Eisenman's work. However, if they are read together several dimensions can be added. Eisenman's architectonic project inscribes itself in an historic tradition of architecture, and the analysis of the already existing works provides a perspective of the architectonic intention expressed in the projects. As a result, they constitute an interesting option for a form of architectural research that involves architectonic development work.

The analytical work

The analytical part studies a series of selected examples from various periods of architectural history. There are examples taken from Italian Baroque architecture, where basic geometric shapes are combined into a plastic, complex architecture. There are also examples taken from the circle of modernist architects who, like Häring, Scharoun and Aalto, sought to develop a formally contextual functionalism. And finally there are examples taken from the so-called "blob" architects, who develop a plastic architectonic idiom inspired by the computer's geometric capacities.

If anything links these vary varied architects, it is a more or less articulated wish to transcend or challenge existing geometric principles of organisation in architecture in favour of a more complex form of expression. Baroque architects transcend the ideas of Renaissance architects concerning structured and legible clarity fixed in simple geometric configurations and relations. The strictly geometric structure does not disappear, but it is expanded into more complex structures. Modernist architects like Häring deliberately take a stance in opposition to the white functionalism of Bauhaus. Häring objects to its linking of functional rationalism and an abstract Cubist design world. Instead, he claims that functional architecture must be contextual and specific, and therefore that it must also be varied in form in keeping with its context.[5] The blob architects formulate a challenge to Euclidian geometry. They claim that architecture can be based on a topological design universe which can be "informed" using animation and design software.[6]

However, the focus of the study is not primarily directed at the theoretical and ideological ideas that characterise these three periods of architecture. Instead, the study is more concerned with specific examples that can be analysed formally and geometrically. The study analyzes a total of six examples.[7] Excerpts from one example – Guarino Guarini's church *San Lorenzo* in Turin – are shown here. *San Lorenzo's* complex plan is based on two simple geometric structures consisting of squares and circles. The two geometries are additively inscribed in one another. The church's dynamic Baroque space is formed in the interface between these two geometries. The circles are circumscribed and linked into continuous lines – or fixed as independent, intersecting figures. The centres of some circles are placed in the interior of the church, making it expand from a central point of focus. Others are placed outside the interior of the church, exerting pressure on this interior from outside, and forming a space that pulsates between expansion and contraction.

Guarini's architecture is based on a complex order. The underlying simple geometric principle of organisation and the ortographic projection drawing are used flexibly and dynamically. The individual elements of the church – groundplan, dome and lantern – are developed independently but linked by the geometric principle of organisation and connected in section to a complex, plastic space.

Design work

The design work is developed in dialogue with the analytical work. It continues the dynamic exchange between geometry and architectonic drawing conventions in new architectural expressions without trying to reproduce the idiom of the analysis examples. Two examples of design work are shown here – a model and a spatial installation. The model and the installation isolate different aspects of the analysis work, and develop them in their pure form.

The model is based on an hourglass figure that is used both spatially and figuratively in various designs. Spatially the hourglass can be described as a double cone. It has two spaces with a reciprocal relationship. These two spaces are turned or twisted into each other across the reference point

formed by the waist of the hourglass. Above this reference point the outside of one of the cones is transformed into the inside of the other – and vice versa. This twisting between two spaces is a source of inspiration for the spatial characteristics of the model. However, the hourglass is also used more obviously, as a figurative prototype for the elements of the model. The hourglass can be illustrated as a closed X-shaped plane figure. The two diagonally crossing sides form an axis of symmetry through the middle of the figure. The hourglass-shaped plane figure is repeated, transformed and reshaped in the design of the model. It is used as a geometric prototype that determines the design of the individual components of the model. But it is also used as a regulating geometry that coordinates and determines the relations between the parts of the model.

The hourglass figures are coordinated by an overall geometric framework consisting of a rectangular volume that is quadratic in plan. This volume cannot be read directly in the model. The orthogonal lines of the rectangular volume form the basis of the diagonal lines of the hourglass figures. And this is utilised in both plane and elevation. At the same time, it also helps directly to delimit the model. Basically, the model consists of three elements: a wall, ribs and a fluid figure. Each of these three elements is defined in its own way by the hourglass-shaped prototype; but they are linked by the rectangular volume delimiting the elements and providing them with comparable sizes and proportions.

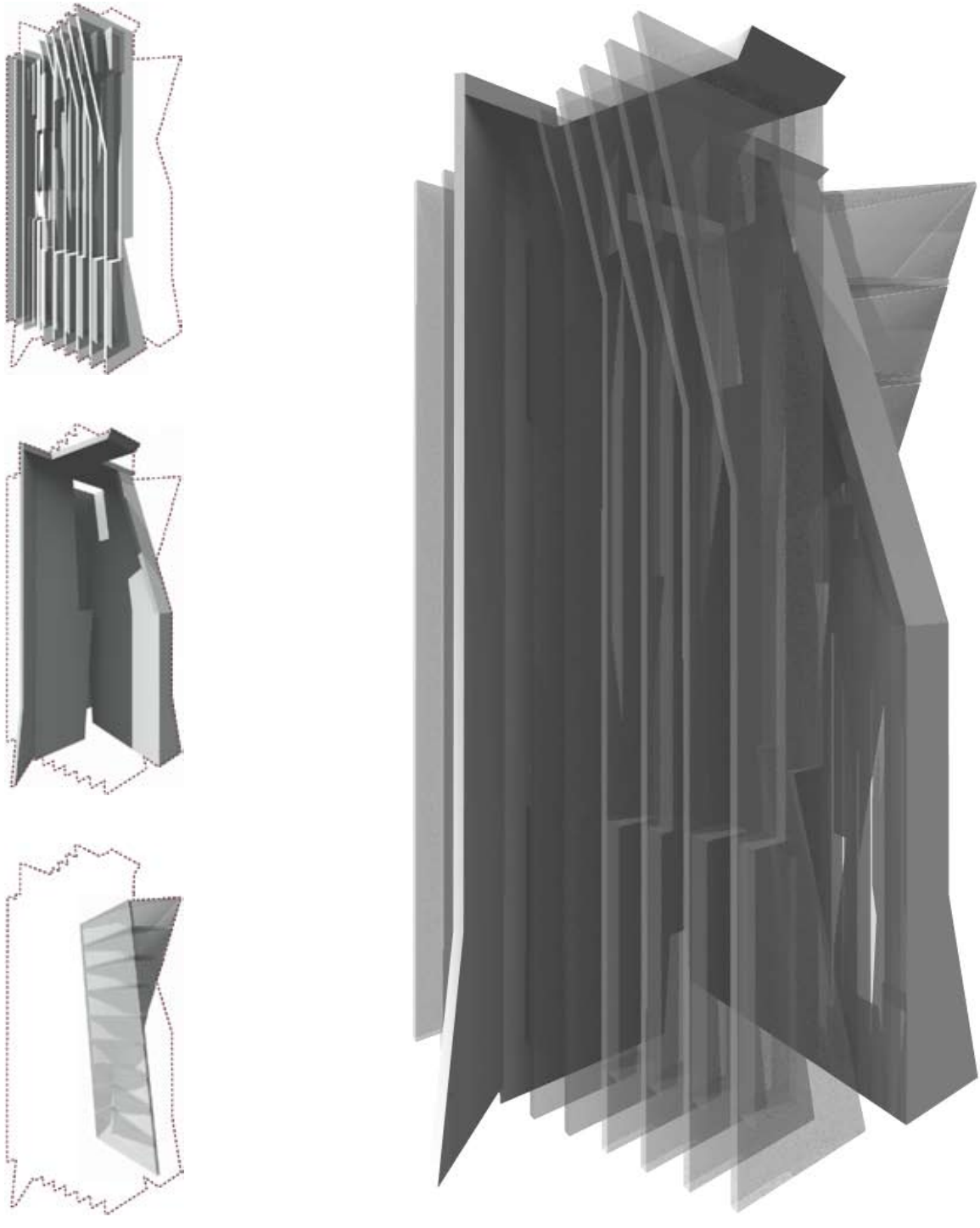
The installation continues a number of the characteristic features of the model. The spatial reversal of the hourglass is continued – although not as a figurative prototype. The installation consists of a series of columns which continue the sequential development from the model's ribs.

The model hints at a tectonic form in the way that the various elements are joined, mounted and framed. In the installation this theme is developed into an actual structure. Each column consists of four hinged segments. The hinged joints are flexible, so the profile of the column can be adjusted and fixed using a system of wires.[8] This makes it possible to develop a movement through the series of columns, which contrast and span the space in which they are placed. The installation is contextual. It changes the space, modifies its context, and influences the bodies that move through it. The model does not inscribe itself in the same way in the space in which it is placed. Its size (the dimensions correspond roughly to a door aperture) creates a physical relation; but at the same time it is primarily spanned by the geometric self-referential relations. The model retains (hence the name) a vaguely referential relation. It hints at a scale that cannot be fixed. This ambiguity is supported by a minimum of articulation of joints and profiles, the absence of recognisable building elements, and industrially manufactured materials with smooth, undifferentiated surfaces.

The model and installation are developed in a mutual dialogue. They develop closely related spatial themes derived from the analysis examples. They further this experience through various reflections on the practice and forms of representation of architecture. Within this field of potential, the aim of this study has been to produce an analytical and artistic development project which on the one hand offers its services to a research-based discussion of dynamic generation of form in architecture, and on the other retains a simultaneous autonomy as an architectonic expression.

Notes

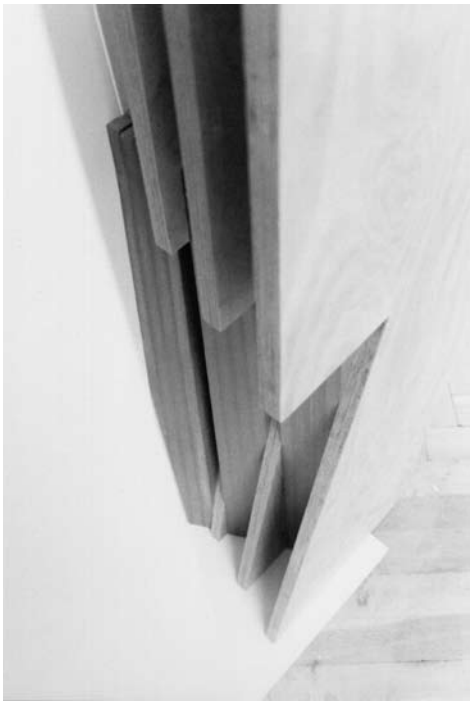
1. See my PhD dissertation Arkitekturens Dynamiske Formdannelser, Claus Peder Pedersen, Århus 1998.
2. Udspænding. Arkitekturgalleriet [11]. Claudia Carbone & Claus Peder Pedersen. Catalogue. Copenhagen, 1999.
3. Labyrint – für freie Geister. Kasper Nefer Olsen. Copenhagen, 1993. P. 14.
4. Terragni's Casa del Fascio is analysed in "From Object to Relationship II: Giuseppe Terragni" Perspecta 13/14, The Yale Architectural Journal. Cambridge, 1971. Pp 36–75.
5. See Kunst- und Strukturprobleme des Bauens. Hugo Häring i Schriften, Entwürfe, Bauten Ed. Heinrich Lautrebach and Jürgen Joedicke. Stuttgart, 1965 (original text 1931).
6. See for instance "Performance Anxiety?" Jeffrey Kipnis 2G no. 16 2000/IV.
7. The examples are: Francesco Borromini's "San Carlo alle Quattro Fontane", Guarino Guarini's "San Lorenzo", Hans Scharoun's "Geschwister Scholl Gymnasium", Friedrich Kiesler's "Endless House", Enric Miralle's "Centro de Gimnasia Ritmica y Deportiva" and Foreign Office Architects "Yokohama Port Terminal".
8. A wire system makes it possible to extend and fix one of the four joints of the columns in any position. This makes the column a triple-jointed hinge structure which is statically stable (provided that the column is anchored at top and bottom).



Model – three elements: ribs, wall, fluid element

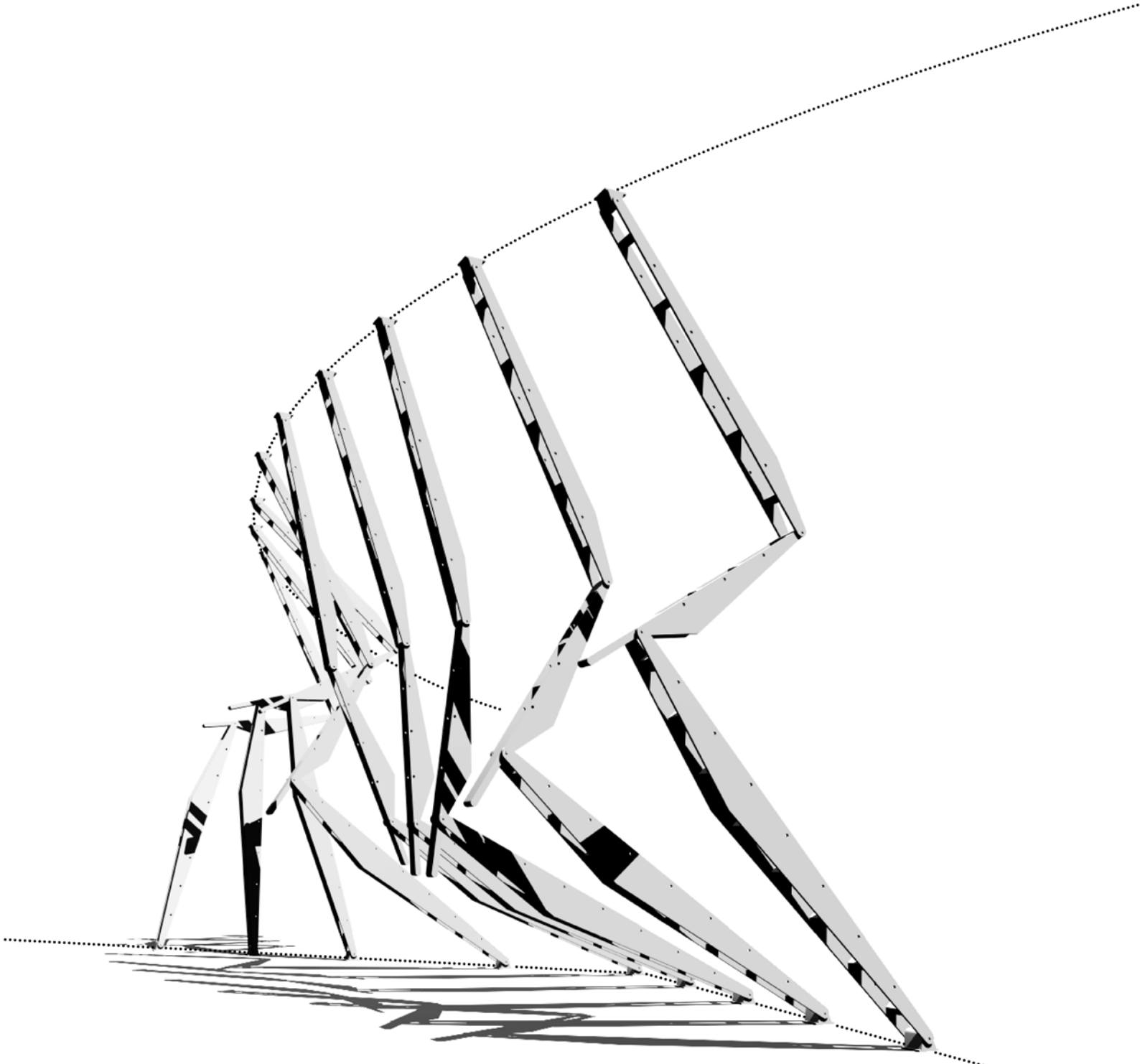
Model – fluid element

Model – ribs

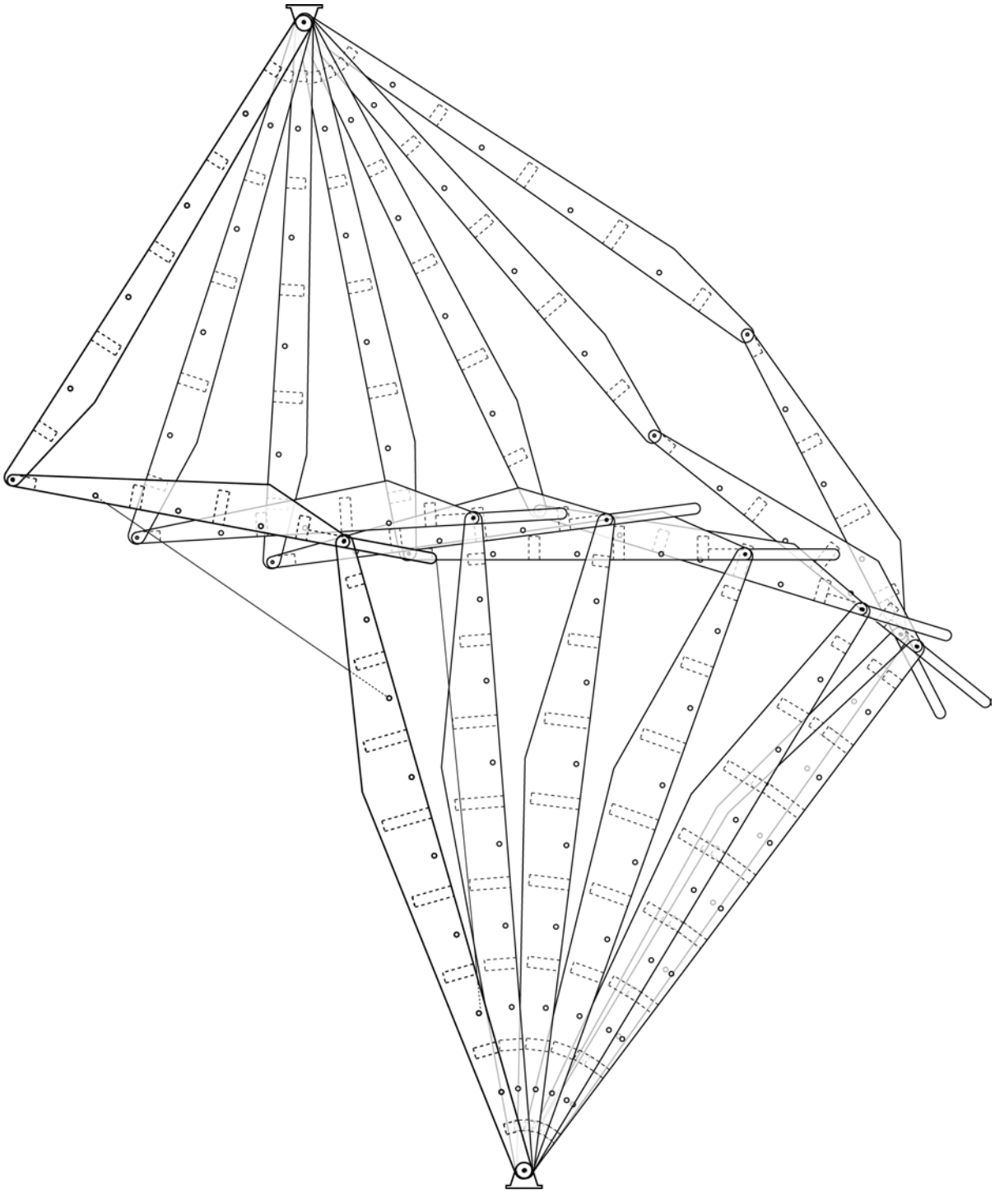


Model – details

Installation – Arkitekturgalleriet, The Danish Architecture Center, Copenhagen.



Installation – movement



Installation – varying profiles

Installation – Aarhus School of Architecture