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# A DIFFERENTIATION OF THE NOTION OF RESISTANCE, BASED ON TWO WAYS OF OPERATIONALIZING TEXTILES IN ARCHITECTURE

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## ABSTRACT

An emerging field of design research deals with the operationalization of materials. In this paper, we present and analyse two approaches to operationalizing textiles in architecture. In our analysis, we focus on how differences in operational design expose different kinds of resistance in textiles. Anna Vallgård and Cecilie Bendixen define a material's resistance as what gives us access to knowledge about it (2009). We argue that it is fruitful to compare these two approaches in order to shed light on how to produce sufficient and suitable resistance when operationalizing textiles. As a conclusion we suggest four types of resistance: a *material resistance*, a *technique-driven resistance*, a *design space resistance* and a *programmable resistance*.

## INTRODUCTION

Design research methodology is the subject of an on-going academic debate and continuous development. In addition to the outcomes related to its specific content (answering the research questions), another outcome of research projects in design research is thus a

contribution to this methodological debate and development.

An example of such a contribution is a paper from the 2009 NORDES conference where Anna Vallgård and Cecilie Bendixen argue that “there is a material side of design that we cannot address through studies of use and social practice – the properties and potentials of materials, forms, and structures must be explored through another kind of study” (Vallgård & Bendixen 2009). They call this kind of studies *operationalizations* of materials, and as examples of such studies, they use their respective PhD projects. Bendixen's PhD is about how textiles should be formed and placed in a space in order to have an acoustic damping effect on the space, while Vallgård's PhD is about how the computer can be combined with more traditional materials to create what she calls “computational composites” (Ibid.).

Even though they do not refer to the concept of *operationalization*, Mette Ramsgard Thomsen and Martin Tamke argue for “three modes of material evidence” as critical strategy to frame and evaluate material research: “the *design probe*, *material prototype* and the *demonstrator*” (Ramsgard Thomsen & Tamke 2009). These three modes can be seen as three ways of *operationalizing* materials. Ramsgard Thomsen & Tamke explain: “The *design probe* [is] a design-led investigation allowing speculative inquiry and theorisation and setting out of design criteria, the *material prototype* [is] a material-led investigation allowing exploratory testing, of craft and material behaviour, and the *demonstrator* [is] an application-led investigation allowing interfacing with real world problems and constraints” (Ibid.).

How materials (hereunder textiles) are approached depends on the stakeholder (Vallgård 2009); this is

visible in the two presented approaches to operationalizing textiles in architecture. The first case, carried out by a textile engineer, consists of experiments of how textiles can be integrated in architecture students' material repertoire through model making with textiles. The second case, carried out by an architect, proposes textile thinking as an architectural strategy and language to further develop the potentials of media facades.

First, we will each present the two cases, detailing their respective motivation, background and experiments, focusing particularly on the resistance produced by the experiments. We then compare them in terms of how motivation, background and operational design expose different kinds of resistance in textiles. As a conclusion we suggest four types of resistance: *a material resistance, a technique-driven resistance, a design space resistance and a programmatic resistance.*

### CASE 1: A TEXTILE ENGINEER'S APPROACH TO OPERATIONALIZING TEXTILES IN ARCHITECTURE

This case is a textile engineer's PhD project, dealing with the material practice of architects: how textiles are currently part of this practice, and how they could be part of it in the future. The motivation for the project comes from an observed tension between on one side the revival of the use of textiles in architecture and on the other side a swinging in the other direction. This tension is also mentioned in literature, for instance by (Krüger 2009) and (Quinn 2010). In the project, material practice means how architects approach materials in their daily work: how they work with, choose and apply materials.

The specific focus in this paper is two experiments, which investigated how textiles' resistance can be exposed to architecture students through model making in order to create new ideas for how textiles can be used. The experiments are examples of *operationalizations* of textiles, and introduce a meta-perspective to the notion of *operationalization* as textiles' resistance is anticipated and staged for exploration to others.

#### EXPERIMENTS AND RESISTANCE

In the two experiments, spaces were modelled using a three-dimensional sketching kit consisting of textiles, cardboard support and tools for giving form to and joining these materials. In each experiment, which lasted 1,5 - 2 hours, the sketching kit consisted of different textiles, support and tools, and more importantly, the instructions given differed. I will now describe the specificities of the two experiments, which both focused on the light effects (functional and aesthetic) that can be created with textiles.

In Experiment 1, fourteen second-year architecture students at UTS (University of Technology, Sydney) worked in four groups. The point of departure for the experiment was an on-going assignment regarding the

design of a building skin for the UTS tower building. They were introduced to two specific textiles (silicone coated woven glass fibre fabric and coated polyester mesh) for building skins. For inspiration, they were also shown reference projects where these textiles were used. They were then asked to make a sketch model of a textile skin for the UTS tower building using the following materials: a cardboard 'corner' (the two sides each measuring approx. 50 x 70 cm), a piece of woven black polyester fabric (approx. 60 x 90 cm), 2 pairs of scissors (to cut fabric), 1 cutter (to cut cardboard), metal wire (to create structure underneath fabric) and a staple gun (1 for two groups, to attach the textile and possibly the wire to the cardboard) (Figure 1). The polyester fabric had an open plain weave structure, imitating the coated polyester mesh introduced to the students.



Figure 1 Left: Materials available to the students. Right: Model created by one of the four groups.

In Experiment 2, eleven third- and fourth-year spatial design students at UTS worked in four groups. The students were given a cardboard "room" of dimensions approximately 35 x 35 x 35 cm (see Figure 2, left). Three square pieces of translucent textile were also given to each group. As a limitation, they were told that the textile only could be attached to the ceiling, and that the room was an office. The students created spatial configurations with the textiles, and took photographs of these configurations, holding the room up to a light source. After some time, the limitations were loosened and in addition to attaching the textile to the ceiling, the students could cut the textile (Figure 2). Finally, the first textile, woven grey polyester chiffon (non-elastic, 38g/m<sup>2</sup>) was replaced by meshed lycra chiffon (elastic, 65g/m<sup>2</sup>) in a darker shade of grey. At this point, the room's scenario was changed to an exhibition space.



Figure 2 Left: A student group taking a photograph of their model. Right: A photograph of a model.

The choice of textiles was based on the three principles of textiles and daylight defined by Boutrup and Riisberg – the importance of density, number of layers and distance between layers of textile (Boutrup & Riisberg 2010). These principles were introduced at the beginning of the workshop.

The two experiments revealed that when seeking to expose textiles' resistance to architecture students, three strategies were used: the textiles are used to materialize,

illustrate, or develop a concept. While the first two strategies use pre-existing ideas – respectively immaterialized (such as an idea) or materialized (such as an existing building or a sketch) – as point of departure, the third strategy uses textiles as a tool to develop new ideas. In this third strategy, the resistance of the textiles seems suitable and sufficient, while in the first two strategies, their resistance is in a certain sense avoided. In the third strategy, textiles provide a *material resistance* as architectural strategy to create new ideas.

The two experiments also show that constraints and clear progression (as in Experiment 2) result in a deeper exploration of the textiles and their effect on daylight. These constraints can also be seen as resistance. Rather than *material resistance*, a *programmatic resistance* is created by the framing of the experiment. While in Experiment 1, the brief or framing was relatively open, in Experiment 2 the brief was more closed, presenting a higher degree of *programmatic resistance* to the students.

## CASE 2: AN ARCHITECT'S APPROACH TO OPERATIONALIZING TEXTILES IN ARCHITECTURE

The second case introduces the textile-driven notion of *textilisation of light* as an architectural strategy and language to develop further potentials of media facades.

The concept is motivated by an emergent call for an integration of [media] screens embedded into the architectural material instead of “propel the surface into a sign” (Perrella 1998) and “running the risk of dematerialising the architecture that supports” (Van Berkel 2012). Following on Ito’s idea of a “fabric” (Ito 2001) Haeusler argues for a “sort of media-clothing” (Haeusler 2009). This material-driven approach to architecture is backed up by Spuybroek, who argues: “Architectural design is not about having ideas but about having techniques: techniques that operate on a material level” (Spuybroek 2008). Spuybroek builds on Semper’s *Principle of Dressing* and *Order of the Four Elements* (Semper 1860). However the concern of Spuybroek is “Semper’s materiality, not his materials” (2008) and he states that “it is not interesting what materials are”, but “much more how certain materials act” (Ibid.). How textiles can be operationalized is also of interest for Garcia who identifies how textile reasoning has encouraged the “thinking and doing” (Garcia 2006) of architects in various ways.

The question remains, however, how textile thinking can be operationalized or framed in design experiments to seek resistance from the actual subject matter, its techniques, tectonics and from the possibilities rendered by this new design space?

### EXPERIMENTS AND RESISTANCE

In the experiment the *design probe* links programmatic considerations (24H-potential, using the potential of light not “only” at night, but also during the day) with the development of tectonic solutions embedding the

media screen into the architectural material. Textile loops are transformed into digital bricks, providing a *programmatic resistance* to this specific “idea, which [is] materialized” (Vallgård & Bendixen 2009).

According to Ramsgard & Tamke the *material prototype* “answers and develops the design criteria of the design probe and allows exploratory testing of craft and material behaviour” (2009). In *textilisation of light* the *material prototype* focuses on how to integrate LEDs (light-emitting diodes) into a woven construction, testing and evaluating the conductivity of the material. Weaving as a technique defines the premise or *technique-driven resistance* for the organisation of the LEDs. Following this premise the construction is woven, interlacing the textile’s conductive side with its non-conductive side and placing LEDs at the intersections (see also conceptual sketch, figure 3: *Design probe*). The *material prototype* argues for the development of a new weaving technique, which is magnified and horizontally layered to provide applicability on an architectural scale, at day and at night. At daytime the metal-coated side of the textile reflects sunlight, while its other side absorbs the light and the structure as a whole provides shade. At night it “materializes” the light and “only” reveals the LEDs from the periphery. Architectural criteria are linked with technological and textile-led ones, suggesting new possibilities for the integration of LEDs in architecture. This new connection frames the *design space resistance*.

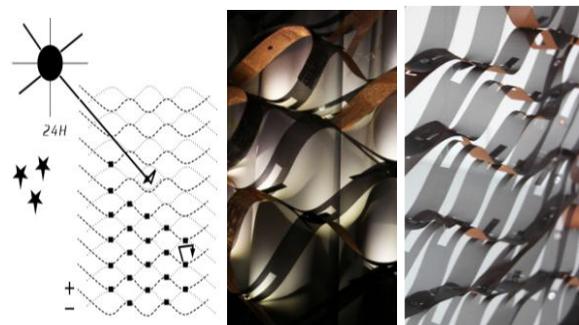


Figure 3 Left: Concept sketch of *Design probe*. Middle: *Material prototype*, night condition: Textile loops are transformed into digital bricks. Right: *Material prototype*, day condition.

## A DIFFERENTIATION OF THE NOTION OF RESISTANCE

As previously mentioned, Vallgård & Bendixen define a material’s resistance as what gives us access to knowledge about it (2009). They use the example of a ruler used to measure a table as an example to illustrate this: the edges of the table provided the necessary resistance to measure its length. This raises the following question: What is the resistance that gives us access to knowledge about textiles, and how they can be used in architecture, in the two described cases?

While in the first case described here, the resistance is linked to how textiles can be made accessible to textile novices, the second case deals with the resistance that

occurs as textile thinking is linked to another technology, namely LEDs. We agree with Vallgård & Bendixen that textiles have a low immediate resistance, but we also suggest that when they are operationalized in a new practice (as in the first case) or with another technology (as in the second case), different types of resistance are exposed, which all give us access to knowledge about textiles and how they can be used in architecture.

Based on the two presented cases, we suggest a differentiation into four types of resistance: a *material resistance*, a *technique-driven resistance*, a *design space resistance* and a *programmatically resistance*. *Material resistance* is the resistance created by the subject matter, in both cases the textiles themselves. The *technique-driven resistance* evolves from the choice of specific techniques, and is exposed in the second case by the choice of weaving as a way of organizing the LEDs. The *design space resistance* is developed when the goal of the experiment is to expand the design space, as in the second case. The *programmatically resistance* frames of the experiment. In the first case, this resistance is defined by the instructions given to the participating students, and in the second case, this resistance is established by the programmatic choice of embedding the media screen in a material while also exploring the 24-hour potential of the facade.

## CONCLUSION

In this paper, we have presented and analysed two ways of operationalizing textiles in architecture in order to shed more light on how to produce sufficient and suitable resistance when operationalizing textiles.

We have argued that the operational design depends on the researcher's background and motivation, providing different kinds of resistance.

We suggest that there is a multitude of ways in which materials can be operationalized and that two of them are presented in the two cases discussed here: Operationalization through the researcher's own experiments with a material, and through the researcher's staging of a material with others.

Finally we propose a differentiation of the term resistance into four types of resistance: a *material resistance*, a *technique-driven resistance*, a *design space resistance* and a *programmatically resistance*.

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