Kaja Tooming's doctoral dissertation is an excellent example of practice-based design research guided by the strategy of Productive Science and Poetics. It offers many practical insights into the aesthetic and acoustic qualities of hand-tuft d fibre art and design, and it presents a philosophical reflection on the nature of emotional expression in all art and design.

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The School of Design and Crafts H K (Högskolan för Design och Konsthantverk) at the Göteborg University

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For Liisa, Kaisa, and Richard

"Philosophy is said to begin in wonder and end in understanding.
Art departs from what has been understood and ends in wonder."

– John Dewey, *Art as Experience*

Abstract

Title: Toward a Poetics of Fibre Art and Design: Aesthetic and Acoustic Qualities of Hand-tufted Materials in Interior Spatial Design
Language: English
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This inquiry explores the aesthetic and acoustic qualities of fibre art and design. The goal is to understand how the manner of hand tufting, the selection of fibre materials, and the creation of two- and three-dimensional forms can work together to solve problems of interior design. The strategy of the inquiry is "productive science" or "poetics." The strength of this approach is the combination of analysis and synthesis. It begins with analysis of the functional elements of fibre art. This includes a description and explanation of the technique of hand tufting as well as scientific and technical studies of the aesthetic and acoustic properties of a variety of fibre materials. It then proceeds to consider the problem of creative artistic synthesis by focusing on the integration of all of the functional elements that are involved in creating works of fibre art and design. The centrepiece of this research is the creation of an ensemble of three fibre art works for the Jonsereds herrgård, a manor house of historical importance in Göteborg, Sweden. One work is a large fibre art hanging installed on the central wall of the grand dining room of the Manor. The other works are two fibre art sculptures, also sited in the dining room. These are innovative examples of fibre art as a functional design art. The inquiry concludes with a refl ction on the nature of unity in art and design. One of the central claims of this research is that *perception, meaning*, and *emotional expression* work together in creating the unity or wholeness of the products of art and design. The discussion develops this idea through consideration of the work of Maurice Merleau-Ponty, Roland Barthes, and John Dewey. This leads to a discussion of the *intelligibility* of emotional expression and the criterion of the *compelling correctness* of an artist's decisions in creating a work of art or design.

Contents

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Someone wrote in the guest book of one of my exhibitions many years ago, “Believe in what you are doing, and all the world will be yours!” The comment surprised me at the time, but it also helped me to realize that motivation comes from within. If one faces a challenge with curiosity and determination, a pathway will open. This thought has guided me through all of the years of my study and research in Sweden. However, there is a further truth that I appreciate more with every year that passes: no one moves forward alone. I am fortunate to have had the support and encouragement of many excellent people, all of whom I want to thank and none of whom I will forget.

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Introduction

This inquiry began, as all research should, with personal curiosity and a desire to better understand a matter that, on first consideration, may seem obvious or even inconsequential in ordinary experience. It began when, as a practicing artist and designer, I became fascinated with the surface character of my medium. Fibre artists are well aware of the beauty of their materials and of the forms that they create. They have an instinctive love and intuitive understanding of the medium. Wonderful as it is, however, the medium – and the practice of fibre art and design itself – is also puzzling. At least it was to me, as I began to look more closely and objectively.

Fibres and their formation in works of art have emotional appeal that seems to touch something basic in human nature – this much is obvious and perhaps only a cliché. However, the more closely I looked, the more puzzled I became about the sources of appeal in fibres, the possibilities of fibre forms, and, finally, the practical possibilities for the use of fibre art in daily life. The aesthetic value of fibre art as art is well recognized. But how fibre art could serve other purposes than artistic expression or "self-expression" – how aesthetic purpose could be joined with practical purposes – is somewhat vague and intuitive. Perhaps it is no more than a hope in the minds of some fibre artists who feel the need for some other justification for their art. To me, this was not enough. If the practice of fibre art was to become, in some sense or in some way, part of the emerging field of new design thinking, there would have to be serious, focused inquiry into the nature of fibre art and its potential as an art of design.

The inquiry began simply enough. I began to observe the materials and the technique of hand tufting more carefully than I had as a practicing artist and designer. I began to observe with a degree of objectivity that was unencumbered with the pressure and practical demands of producing specific works of fibre art. Looking back, I can say that I began to move from what John Dewey calls the "common sense" inquiries of practice into formal inquiry. This is what Richard Buchanan, developing Dewey's concept of "formal inquiry," calls the design inquiry of productive science and poetics. I will explain this idea further in a little while, but for now it is enough to say that I was observing from a new perspective, the perspective of design research.

My observations were not entirely or even largely passive. I experimented with the hand-tuft technique and with a wide variety of fibres, some familiar and others perhaps unfamiliar to many fibre artists. I began to produce small modules of work, and I observed how I worked and the qualities that emerged in these modules. And all through this phase, I thought about the practical, functional possibilities of what I was making. To be honest, I do not recall the precise moment when acoustics entered my thinking. All I remember is that I put aside the obvious functionalities of floor protection and so forth that are already known. I began to formulate the research question of my inquiry, focused on the aesthetic and acoustic properties of fibre art. Further, I began to think of fibre art works in context, in bigger contexts than the frame of a hanging. I began to think about environments and the idea of some kind of unity or wholeness in which the work of fibre art may participate. Coincident with these thoughts, I began to see the possibility of a dissertation structure, unfamiliar and vague though it was at the time.

Following this period of my work, I decided to mount an exhibition of work in order to observe how people reacted to the atmosphere created by my fibre art. Interestingly, some of the work that I presented in Kuressaare, Estonia, included earlier examples of my fibre art practice, before I had settled on the research question of my dissertation, the problem of acoustics. But I included many of the fibre modules and art works that I had recently produced and subjected to acoustic testing, and I displayed them in unusual ways: some were hung far away from walls, allowing people to move around to the "backside" of the work; other works were presented on the floor, in a matrix of sand. However, I also showed an early sculpture that I had created, and I presented other work in more traditional formats of hanging. The response to this "Backside" exhibition was enthusiastic, and it added to my motivation to move forward.

After the "Backside" exhibition, I continued my studies with reading and writing in many subjects, including the nature of acoustics and acoustic research. This deepened my understanding and also served as preparation for my Fil. Licentiate examination, which I completed in 2005. The Fil. Licentiate (Filosofie Licentiate) is a degree granted in Swedish Universities for rigorous and substantial work beyond the Fil. Magister (Master of Arts or Fine Arts) but not yet with the full development signified by the Fil. Doktor degree (Doctor of Philosophy). In my case, the Fil. Licentiate examination completed what I regard as Phase I of my research, focused on the phenomenological observation of materials, the production and acoustic testing of fibre modules, and all of the preparation that I completed for the more advanced phase of my research.

After this, I began to consider Phase II of my research, where I faced two significant problems. The first problem was to identify the object or environment where I would develop the work that was to be the centrepiece of my research. After much consideration and reflection, and valuable consultation with many people, including Bengt-Ove Boström, Director of Jonsered Manor and Advisor on Quality Enhancement to the Vice Chancellor of Göteborg University, I decided that I would produce an ensemble of three works for the dining room of this charming and historically important building. This decision came out of consultation with the architect, Christer Liljewall, in charge of restoring the Jonsered Manor and with others.

The second problem was as difficult, if not more so. I had to decide not only how to conduct this phase of my work – preparing the ensemble of works for the larger environment and conducting suitable tests – but also how to analyze the work and, then, structure the argument of my dissertation. At first, I thought I would use a case study methodology, following Rolf Johansson and the practice of case studies described by researchers such as Robert Yin. At this time, however, I also had an opportunity to spend a semester at the School of Design at Carnegie Mellon University, where I participated in advanced seminars in "Interaction Design," "Design Methods," and "Design as Inquiry" offered by Professor Richard Buchanan. Through these seminars, extensive discussions with Professor Buchanan about my research, and discussion with other doctoral students at Carnegie Mellon, I began to understand the idea of strategies of inquiry in design and design research. In particular, I began to see how one of the strategies discussed by Buchanan – the strategy of Productive Science or Poetics – could be applied to my work, giving it deeper structure and significance. At this point, the structure of my dissertation became clear. Indeed, much of my earlier work as a fibre artist and designer as well as my research took on significant shape and meaning. I began to see how the many questions and ideas in my mind were connected, and how their development was coherent in a larger understanding of fibre art and design. The final substance and shape of my dissertation owes much to my visit to Carnegie

Mellon and my discussions over the years with Professor Buchanan.

This "archaeology" of my research would not be complete if I failed to explain the importance of philosophy in my work. From an early time in my life I have been motivated by a desire to produce creative artwork that possessed both sensitivity and emotional intensity. At the same time, however, I have been motivated by a desire to understand the things around me. The first motivation led me into art as a professional activity. The second motivation led me into further studies in a variety of subjects, into art theory and art history, and, ultimately, into philosophical readings. These motivations came together as the driving force behind my inquiry.

The idea expressed by John Dewey in the epigraph of this inquiry speaks well to the complex mixture of art and philosophy that a reader will find in my work: "Philosophy is said to begin in wonder and end in understanding. Art departs from what has been understood and ends in wonder." It is not for me to say whether the ensemble of works produced as the centrepiece of this inquiry are wonderful, but I can say that the philosophical foundations of Productive Science and Poetics and the philosophical problems of the unity of art and design and emotional expression are a central expression of what I have come to understand about fibre art and design through the inquiry.

This inquiry is an example of what I consider to be "practice-based research" in art and design. The term is somewhat vague and ambiguous, though it is currently popular in some countries, including Sweden. What the term means to me is that the inquiry began in the practical experience of my work as a fibre artist and designer. It continued through practical production and experimentation with the technique of hand tufting and fibre materials. And it has yielded results that have practical as well as theoretical value. It does not matter whether we call the research practice based or something else. It is a design inquiry and an example of design research.

While I hope that the reader will find many useful insights in this research, I would like to call attention to what I regard as the major accomplishments.

First is the account of the hand-tuft technique, growing out of my experience as a fibre artist and designer. While the technique is important for art, craft, and industrial production, there are few accounts of the technique in the literature and little detail. I hope I have overcome this gap to some degree by describing the technique in detail and assembling its history.

Second is the study of the aesthetic and acoustic properties of materials in fibre art and design. In particular, I believe that the acoustic testing of materials is a useful contribution to the literature upon which others can build. This will be useful for industry as well as for other fibre artists and designers who are interested in fibres and their properties.

Third is the creation of artistic and design works for the Jonsered Manor. The ensemble of works involved considerable effort, and I have tried to explain my method and process in as much detail as possible. I hope that the site-specific process will encourage others to follow a similar process of emersion in the environment for which their work is intended. Even when an exhibition space is occasional, it presents a site-specific challenge. An exhibition of my work, connected with the dissertation, was mounted at the Gallery Gröna Paletten in Stockholm in May and June 2007.

Fourth is the articulation of the strategy and methods of productive science or poetics. The name and historical lineage of this strategy may not be familiar to many design researchers, but the practice, I believe, will resonate both with artists and designers as well as researchers in the arts and design. By employing this strategy and presenting the details of its workings in the specific area of fibre arts and design, I hope that the illustration will give confidence to others as they seek to explain the nature of research in the arts and design. The community of researchers has struggled for many years to find useful models for their work. Productive Science or Poetics is a model that gives intellectual strength to such research, offering an alternative to other approaches.

Fifth is the exploration of unity or wholeness in art and design. The intelligibility of emotional expression – the compelling correctness of an artist or designer's decisions – offers an important criterion for assessing and explaining the success of some work and the disappointment of other work. In this matter, I believe it is useful to consider the work of John Dewey in Art as Experience as a good beginning point for understanding the principles of art and design. Dewey's work is not as well known as it should be in Sweden and the Scandinavian and Baltic countries. It is a hospitable approach to aesthetics that resonates with the artistic traditions and values of these countries.

part i

Beginnings of the Inquiry

ch ap ter 1

The Aesthetic Problem of Fibre Art and Design

Fibre art is often regarded as a form of fi e art, serving a purely aesthetic purpose in enhancing the quality of experience in our daily lives. When displayed in interior architectural spaces, fibre art may even be regarded as merely decorative, adding an element of interest or delight to spaces that would otherwise be dull. But the question arises whether fibre art may serve other purposes as well, purposes that are practical and utilitarian as well as aesthetic. Indeed, the concept of "aesthetics" has two meanings that suggest the possibility of a more complex interpretation of the value of fibre art. In one meaning, "aesthetics" refers to beauty, and there is a long tradition in Western culture of exploring the relationship of aesthetics and beauty. In another meaning, however, "aesthetics" refers to all aspects of sensation, including the sensations and perceptions associated with beauty but also other sensations of pleasure or pain ranging through all of our senses. One area of the aesthetics of fibre art that deserves further exploration is the area of acoustics or the quality of sound in interior spaces. Could fibre art serve a practical function in changing the quality of sound in interior spaces?

The problem of sound absorption – dampening noise and softening the sound qualities of interior spaces – has been addressed in a variety of ways by different professions. For example, architects have looked to construction materials for use in the walls, fl or and ceiling. They have also given some attention to materials used in furniture – materials placed on the underside of furniture or materials used in furniture coverings and upholstery. In addition to architects, interior designers and product designers have focused on the choice of furniture coverings and the creation of furniture. Finally, acoustic engineers have been called in for special kinds of projects (concert halls, conference and meeting rooms, etc.), but they are not usually available for most projects. In any case, they have tended to use unappealing materials in the form of panels attached to walls or suspended from the ceiling.

In all of these approaches, however, there are difficulties. Solutions are typically hidden from view or, when visible, they are not aesthetically pleasing. And if the solutions are aesthetically pleasing and are not hidden from view, they do not have a high quality of sound absorption. The selection of materials is more often random rather than based on any systematic analysis of acoustic properties. In short, there is limited understanding of the acoustic properties of materials and the research in this area is often inadequate. Where there is testing of acoustic properties, most of the materials are simply not adequate to solving the problem. In general, there is little testing of the acoustic properties of furniture fabrics, and there is relatively little conscious designing for better acoustics.

The fibre artist comes to the problem with a somewhat different perspective. He or she comes with the experience of various techniques or ways of weaving, an understanding of the technical possibilities of different fibre materials, and an awareness of the aesthetic potential for expressive work in both two- and three-dimensional forms. Indeed, this is the genesis of the research presented in the following pages. As a fibre artist, I have focused on the technique of hand-tufting, exploring this technique in a wide variety of materials in order to create forms such as wall hangings and carpets as well as sculptural forms that may be viewed from all sides. Because of my experience as a fibre artist and designer, I began to see an opportunity for combining practical utilitarian functions with expressive artistic functions. In particular, I began to see an opportunity for creating artistic forms that could change the quality of sound in interior spaces.

However, this effort requires more than artistic intuition and sensibility. It also requires specific knowledge of the acoustic properties of various fibre materials, and this knowledge must be obtained through technical and scientific investigation. Furthermore, this knowledge, in itself, is not adequate to address the problem of sound absorption. It must be combined with an artist's knowledge of the manner of producing fibre works. That is, knowledge of the properties of materials must be combined with knowledge of the limits and potentialities of the proper techniques of weaving, because the manner of weaving is, itself, a factor in sound absorption. The integration of materials, technique, dimensional forms, and expressive purpose is what is required.

The nature of this problem calls for a new strategy or method of investigation. It cannot be a reductive method of merely analyzing various materials, because the artistic synthesis cannot be deduced from material properties alone. Nor can it be a theoretical method, where a “theory” of form and design is advanced and then “applied” to a practical problem, because artistic and design creation is not a problem of mere application of concepts. The practicing artist and designer must struggle with many factors, seeking their integration in a concrete product that is suited to a concrete situation of use. Theory arises in the course of the struggle, and it emerges in reflection and formal expression as the work progresses.

Such work is sometimes characterized as “practice-based research.” However, this loose and somewhat vague idea is better characterized as “inquiry,” because there is an ongoing inquiry in the work of the artist and designer, and the inquiry has form and structure in itself. In formal expression, for example, inquiry involves a problem statement, a hypothesis or initial idea, a sequence of development and exploration, and a final confirmation of the hypothesis and its statement as a principle or thesis. This is the pattern of the current book, divided into parts that address each of the issues of inquiry from a formal perspective. However, as expressed in design process, these stages are phases of analysis and synthesis in concrete production, with reflection on the implications and principles that emerge in the course of creative work. The analysis may involve, as it does in the current research, technical and scientific investigation of the acoustic properties of fibre materials. But it will also involve other aspects of analysis, such as careful observation of the aesthetic qualities of materials and discussion of the technique of hand-tufting. Furthermore, the method will also include issues of synthesis or form creation. In fact, the strength of the method is the integration of many *functional elements* in the activity of creating fibre art and design.

For the purpose of this research, we will characterize the general method of inquiry as “productive science” or “poetics,” based on the ancient Greek idea of a discipline of “poiesis” or “making.” As with most of the methods and strategies of intellectual investigation, the strategy of productive science may be traced to the ancient Greeks.[1] Aristotle was the first person to employ the method of productive science in the investigation of the human-made world. His inquiry is recorded in

1 See Richard Buchanan, “The Accomplishments of Design Methodology,” in *Handbook of Technology and Engineering Sciences*, ed. by Anthonie Meijers, Vol. 9 of *Handbook of the Philosophy of Science*, ed. by D.M. Gabbay, P. Thagard, and J. Woods (North Holland: Elsevier, forthcoming 2008).

the *Poetics*, a treatise on the art of tragedy and its place among all of the other arts, literary and non-literary. Many others who investigated the literary arts subsequently employed the method. This led, of course, to the common association of "poetics" with "poetry," even though Aristotle regarded poetics as a method with much wider application than poetry. However, the method of productive science or poetics was also employed in the investigation of many other arts, including the visual arts, music, and, by the twentieth century, the design arts. For example, the method was important at the Bauhaus and in the work of the designer Laszlo Moholy-Nagy. But it was also an important method for designers and design theorists holding quite different positions on the nature of design. For example, Herbert A. Simon, regarded as one of the most important design theorists of the twentieth century, wrote a book called *The Sciences of the Artificial*. As Richard Buchanan argues, this work follows the method and structure of Aristotle's *Poetics* and could be regarded as a modern variation of poetics and productive science, although Simon employed and positioned the approach well within the framework of his positivist philosophy and his vision of a design science.[2] Similarly, John Dewey's *Art as Experience* also employs a variation of poetics or productive science, positioned within the framework of his philosophy of pragmatism and his theory of logic and inquiry.

The method of productive science or poetics is practiced by common sense among many artists and designers, even though they seldom give the method its proper name or understand its origins and philosophical characterization. Indeed, one could argue that the experimental and exploratory method of many Swedish designers owes a great deal to the method of poetic inquiry, despite the lack of explicit recognition of the origins and history of the method. Thus, while the method of inquiry described and pursued in the current research may seem unfamiliar in some ways, it is also quite familiar in practical application. It is a method with considerable power for the practicing artist and designer, and it is very useful for the type of research undertaken in the current investigation.

2 Buchanan, "The Accomplishments of Design Methodology."

chapter 2

Approach to the Problem

General and Particular Hypotheses

Fibre art becomes an art of design when the purpose of creation is more than pure aesthetic expression. In this case, the work of fibre art no longer exists as an isolated object but becomes part of an environment, supporting and sustaining practical experience in the lives of human beings. For many people, the phrase "practical experience" is somewhat vague. It may mean no more than the often-disjointed fl w of perceptions and thoughts mixed with various motions – perhaps a movement of consciousness in doing the practical things of daily life but typically under conditions of distraction and interruption and without deeper coherence and unity. In the context of this research project, however, experience and practical experience have a more specific meaning, following ideas developed by John Dewey in *Art as Experience*. Rather than discuss experience in general, Dewey focuses on what he calls "an experience." An experience, he argues, has form and structure. It is a coherent interaction with the world, with a beginning, middle and end that embody the activity of a person and the conditions of the environment. It moves through resistance and struggle to a consummation in a completed piece of work, whether the "work" is practical, intellectual, or aesthetic. The work is not an object. Rather, it is an activity. And the activity has a mixture of practical actions (what he calls "overt doings"), intellectual dimensions (what he calls "thinking"), and emotion. The challenge of life, he suggests, is to fi d the coherence of an experience in everything that we do.

My work takes this idea of an experience as a beginning point. However, as a fibre artist, and particularly as a designer, I have found it important to develop Dewey's idea in a somewhat different direction than he did. I have found it important to focus on three considerations or three aspects of experience: *perception, meaning*, and *emotional expression*. Of course, Dewey discusses issues related to these three themes, but for the practicing artist and designer the role of perception is very signifi ant and deserves careful attention as the fi st step in one's interaction with the environment of daily living. Therefore, a major part of the early section of this research focuses on perception: the perception of materials, sound, and other features of the materials with which the designer must work. This is an analytic task and, in part, a scientific task. It is scientific in the sense that one must gather precise knowledge of the acoustic properties and potentialities of fibre materials if one is to seriously address the problem of enhancing the quality of sound in interior spaces. I have found phenomenology to provide an initial framework for such considerations and to be helpful in the observational method employed as part of the investigation. A theoretical foundation for this work comes from the phenomenologists Edmund Husserl and Maurice Merleau-Ponty.

Similarly, the role of meaning is also important for the fibre artist who conceives of his or her work as an art of design. Perception is important, but how we interpret perceptions and make meanings out of them is also important. In fact, the designer works in an environment that is rich in associated, traditional, historical, and cultural meanings. Any new work of design must engage and interact with such meanings if it is to be successful in supporting the experience of people in their concrete environment. For this reason, I have also found structuralism to be helpful, particularly in the form developed by Roland Barthes, who carried structural linguistics into areas that are not usually regarded as essentially linguistic. The idea that an environment possesses a deep structure of parts and relationships is very useful to the designer. It enables one to explore the details of placement of objects and artefacts in an interior space, and it also enables one to better understand how other meanings – social, cultural, and historical – enter into consideration in the activity of making meaningful experiences.

However, ideas about perception and meaning come together in John Dewey's concept of experience, but under a third consideration that is also critically important for the designer: emotion and expression. For Dewey, emotion is what unifies an experience, whether the experience is artistic and aesthetic or intellectual or practical. In short, if the designer is to be successful in supporting the practical experience of people living in interior spaces, he or she must explore the emotional and expressive aspects of their work. As Dewey would argue, emotion is not something separate from an experience – something added onto everything else. Rather, it is the heart of an experience – the unifying ”glue,” so to speak, of daily life.

The deepest hypothesis of my work is that *perception, meaning*, and *emotional expression work together in creating a unity or wholeness in the products of design and in the experience of the people supported by such products*. Exploring this hypothesis in the different stages of the following analysis and synthesis is what this research is really about. However, it is not suitable merely to assert this idea. It is necessary to see how it works out in the course of the research. It is necessary to see how fibre artists and designers arrive at solutions that support or refute the idea – and that is the work of research.

Beyond the general hypothesis of this research, there are also particular hypotheses that guide the work. Two hypotheses are important at the beginning. The fi st hypothesis concerns materials and their sound absorbing qualities.

1. Different fibres used in the hand-tuft echnique may have various qualities of sound absorption that are signifi ant for noise reduction.

If this proves to be true, then a further hypothesis comes into play.

2. The hand-tuft technique may be used to create products with an aesthetically pleasing quality that also help to solve the problem of sound absorption in interior spaces.

These hypotheses guide the two phases of my research. The fi st phase is the production and testing of samples of hand-tufted fibre materials, discussed in Part II. The second phase is the production and testing of hand-tufted fibre artefacts for a specific rchitectural space, the Jonsered Manor, discussed in Part III.

The Nature of Form and the Unity of Experience

Form is one of the key concepts of this research. However, form is an ambiguous concept with many meanings, and it can be confusing without a clear explanation of how the term is used in the present context. We will begin with a discussion of ancient usage in Plato and Aristotle and then move forward to a discussion of form in a modern context in the work of John Dewey and others whose ideas have a direct bearing on the current research.

For Plato, the form of a work of art “imitates” the rational structure of the cosmos.[3] The orderly relationship of parts to whole in a work of art is best understood as an analogy to the rational, orderly, and organic relationship of form and matter in the cosmos as a whole. In essence, form is a rational structure that orders the otherwise chaotic materials of which a work is created, and form represents or "participates" in the idea of beauty.

For Aristotle, too, the work of art is an "imitation," but it is an imitation of "nature" or "natural things," not of the rational structure of the cosmos. Of course, imitation does not mean merely copying nature. Instead, it means grasping the essence of the work of art *as if* it were a natural object, with different implications for the intelligibility of art and the quality of "necessity" in form that distinguishes Aristotle's view from that of Plato.[4] This leads to a quite different line of analysis, an analysis by the method of productive science or poetics.[5]

The analysis involves four considerations. First, unlike natural objects, the work of art does not have an internal principle of motion or genesis. It has an external principle. A human being creates the work by shaping materials into an organization or form that is directed toward some purpose or function. Aristotle calls this creative power, residing in the artist, the *effi ent* cause. Second, Aristotle distinguishes between the form and the matter of a work of art. The form is the unifying structure of a work of art that begins as an idea in the artist's mind and then is progressively realized or actualised through the creation and refi ement of the work. For example, the form of a tragedy is a unifying action with a beginning, middle, and end. It is important to emphasize that the form created by an artist – a form that organizes the material – actualizes the potentiality of its parts. However, artistic form is not the essential form of a natural object but the *perceptible* form, which is accidental to the essence of a natural object. That is, unlike natural form, an audience perceives the visual or sensory form of a work of art.

At this point, however, Aristotle makes a further distinction that is both startling and highly useful in understanding the work of art. He distinguishes two different senses of "matter." One is matter as the *material of the work of art* and

3 Plato, Phaedrus. *The Collected Dialogues of Plato: including letters*. Ed. by Edith Hamilton and Huntington Cairns. 1961, p. 475-525.

4 See Stephen Halliwell, *Aristotle's Poetics* (London: Duckworth, 1986). Halliwell offers an insightful discussion of the unity of art and the idea of necessity and probability, contrasting Aristotle and Plato.

5 Kenneth A. Telford, *Aristotle's Poetics*: *Translation and Analysis.* Chicago: Henry Regnery Company, 1961.

the other is matter as the *material of form*. Again, the example of tragedy serves to clarify the meaning. The matter of tragedy is certainly words, the text that carries the story of a tragedy. However, *the matter of the form* of tragedy is comprised of such things as character, thought, various incidents, and so forth. (We will discuss the signifi ance of this later as it applies to the work of fibre art, but for now we can merely suggest that perceptions, meanings, and emotions could be considered as the materials of form in fibre art.)

Finally, Aristotle sees form in close relationship to the function or effect of the work of art – regarded by Aristotle as the *final* cause of a work. The fi al cause or effect of a work of art is fundamentally emotional. That is, each work of art achieves a distinct emotional effect that is intimately related to form. Although Aristotle never discusses the concept of design, we may infer from his discussion of practical objects in other treatises that the fi al cause of design is not only emotional expression but also the fulfilment of some practical need.

The signifi ance of Aristotle's treatment of form is illustrated by contrast to another philosophic analysis of form. In *The Sense of Beauty*, the American philosopher George Santayana argues: "Unity would thus appear to be the virtue of forms; but a moment's refl ction will show us that unity cannot be absolute and be a form; form is an aggregation, it must have elements, and the manner in which the elements are combined constitutes the character of the form."[6] Instead of regarding form as an aggregation of materials – emerging as a result from the combination of parts – Aristotle sees form as the unifying idea that precedes the making of the work of art, an idea that is progressively realized in creation through embodiment in materials.

There are important similarities as well as signifi ant differences in the treatment of art by Aristotle and John Dewey. The most signifi ant difference, for our purpose, is that while Aristotle focuses on the work of art in itself, Dewey focuses on the *experience* of the work of art – hence, the title of Dewey's book, *Art as Experience*.[7] But Dewey's treatment of the experience of art has strong parallels with Aristotle's analysis of the work of art. For example, Dewey, too, emphasizes the role of the artist in making the work of art. He regards the artist as someone who is engaged in an act of thinking through the form and materials of his or her art. However, he also places considerable emphasis on the role of the audience in

6 George Santayana, *The Sense of Beauty: Being the Outline of Aesthetic Theory*. 1955, p. 61.
7 John Dewey, *Art as Experience*. 1958.

an act of reconstructive making – virtually remaking the work of art in personal experience. More important for our purpose, however, is Dewey's treatment of form and matter. Like Aristotle, Dewey sees form as an idea that is progressively realized in the act of creation or making. It has a structure of inception, development, and consummation that is strikingly similar to Aristotle's notion of dynamic form as having a beginning, middle, and end. Furthermore, where Aristotle distinguishes between the materials of the form and the materials of the work of art, Dewey also sees a similar distinction. For Dewey, the materials of experienced form are emotional qualities, signs and symbols, and over doings; the materials of art are, as one would expect, the usual raw materials that are discussed by others – e.g. words or paint or wood or stone, fibre, and so forth. Finally, Dewey regards emotion as the unifying aspect of any experience. Emotion is what unifi s a work of art and an experience of art.

For Dewey, works of art are signs of a unifi d, collective life; they are "marvellous" aids in the creation of such a life. Objects of art are many languages, and they communicate because they are expressive. The "remaking of the material of experience in the act of expression" is not an isolated event confi ed to the artist and a perceiver. It is also a "remaking of the experience of the community in the direction of greater order and unity."[8] For Dewey, an artist's work lives only in communication when it operates in the experience of others.

There are important similarities, but also some differences, in the treatment of art and the act of expression by Dewey and the French painter Henri Matisse. For Matisse, the goal of art is expression, but expression is not simply a gesture or the passion revealed in a human face.[9] It is the entire organization of pictorial elements, unifi d in the composition of a work. Composition – the unique form of each painting – emerges over time as the artist explores the essential pictorial means for this or that painting, ultimately yielding a work that is harmonious in its entirety. Expression is both the act of artistic creation and the result of creation, and this is very similar to Dewey's understanding of expression. For example, Dewey argues that aesthetic emotion is "native emotion transformed through the objective material to which it has committed its development and consummation."[10] For Dewey, art is not nature, but rather is "nature transformed by entering

8 Dewey 1958, p. 81.

9 Henri Matisse, Notes of a Painter, in *Theories of Modern Art: A Source Book by Artists and Critics*, ed. by Herschel B. Chipp. 1968, p. 130-137.

10 Dewey, p. 79.

into new relationships where it evokes a new emotional response."[11]

Evoking emotional response is an important consideration when seeking the unity of experience. However, the issue of where emotion is located and how it is evoked is easily misunderstood. Is emotion in the work of art? And if it is not in the work of art, how is it evoked in human beings? A very insightful discussion of this issue by the composer Roger Sessions may help to throw some light on what is a difficult matter that is open to quite different aesthetical theories. Like Dewey and Matisse, Sessions focuses attention on the artist as he or she works with materials and shapes them into an expressive form. However, instead of a direct expression of emotion, Sessions argues that form in music expresses "gestures of the spirit" that energize emotion in the audience.[12] This idea is relevant to works of the visual arts and design. What it suggests is that such works do not directly express emotion but rather that their texture, lines, colour, and form are best regarded as "gestures of the spirit." Such gestures – and fibre art is easily regarded as gestural in its essence – energize the emotions that are latent and potential in human beings. In short, evoking emotion means energizing what is potential in human beings in a concrete environment.

Of course, there is a further implication of Sessions' ideas for the current research. While we are not directly concerned with music, as such, we are concerned with the quality of sound in interior spaces. The value of Sessions' ideas for this research is the implication that sound, even if it is not in the formal shape of music, may contribute to or detract from the unity of emotion in experience. Indeed, his idea that music does not directly express emotion but rather expresses gestures of the spirit that energize emotion suggests that sound itself is an element that can subtly support the quality of unity and expression that is sought in the second phase of the current research.

We will continue the discussion of the unities of form in chapter 10, where we will discuss the results of our research in the context of principles of unity or form and experience in the work of Maurice Merleau-Ponty, Roland Barthes, and John Dewey.

11 Dewey, p. 79.
12 Roger Sessions, *The Composer and His Message.* Humanities 101, October 1963. The University of Chicago Press: Chicago, [p. 101–134.]

Experience in Architectural Spaces

It is useful to return to the concrete architectural environment within which the ensemble of fibre art works created in this research are conceived. Our goal is to understand the problems that architectural spaces present to the fibre artist and designer, but to see the situation from the perspective of the discipline of architecture, perception research, and acoustic science.

The concept of "spatiality" is central to architecture, but perception research has added some concepts that help to elaborate this concept, suggesting different dimensions, so to speak, of spatial experience. For example, research has shown that the brightness of surfaces (e.g. walls, fl or, and ceiling) influences our judgment of space. Similarly, other factors such as room size, ceiling height, windows and other openings, shielding, furnishings and lighting also affect the experience of space within architectural structures. In fact, according to Küller, the colour researcher Garling has proven that "street rooms" – for example, the spaces between buildings – actually lose their "spatiality" when their size grows larger or when there is less "closure."

For the architect, there are two kinds of rooms: interior and exterior. One of the characteristic differences between these two kinds of rooms is their scale. But another characteristic is the degree of permanence or transience. In the morning hours, a street room can be a narrow path between sheds and stands. In the evening, the whole market can be disassembled and hauled away, yielding an open, airy alleyway that we may not even recognize. In interior spaces, however, we believe that permanence is an essential feature of a room. From antiquity, architecture has been defi ed as permanent – and such things as tents and work sheds rarely count as architecture, though they may be regarded as works of design.

Examples of interior rooms, where continual changes are made, are museums and exhibition premises. Those that belong to more offi ally permanent interior rooms are offices, hotels and hospitals. The private rooms in residences can be both temporary and permanent. A person could move from one residence to a totally other residence and bring along his personal order of things that makes one recognize the place: "Aha, Grant lives here!"

It is commonly recognized that when people enter a room they seldom react to a specific feature before assessing the total surrounding environment. For this reason, we can begin to understand that the visual and other perceptual elements of a room have far deeper influence on people than has previously been understood. This should, of course, be taken into consideration in the design, colour scheme, lighting, and sound qualities of the environment. Such matters place greater demand for a more nuanced theoretical model of interior spaces, suggesting the need for more sophisticated experimental research.

In this regard, it is useful to observe that textile artefacts have three main functions in a room. They insulate – that is, they help to regulate such things as temperature and climate, the movement of air, and the quality of light and sound. They offer a degree of privacy. They protect against mechanical wear. And they provide a degree of aesthetic stimulation, pleasure, and even delight, affecting our sense of sight, hearing, and even touch, since the textures and surfaces of fabrics offer a wide array of aesthetic sensations. However, the use of textiles in a room is very context dependent.

While the research in this project focuses considerable attention on the acoustic element of fibre art – as discussed earlier, this is a seriously neglected area of investigation – it is also important to note that the senses of sight and touch are deeply implicated in any design solution based on fibre art products. This will become quite evident as the investigation proceeds. Nonetheless, the acoustic problem is complicated and requires careful attention.

In this project, acoustics is important both when measuring the sound dampening properties of the material samples and when understanding the acoustic function in the formation of a spatial gestalt. A survey of technical considerations is necessary for a proper orientation. Unless otherwise noted, this survey mainly follows Lennart Karlén (1983).

General requirements on sound quality in different room types may be found, for instance, in SBN 80, directions from the Board of Public Building and Spris. Usually, the requirements regulate the maximum permitted sound level in house installations and the longest reverberation time in furnished unmanned rooms.[13]

The demands put on the design of the room with regard to acoustics depend upon the primary function of the room. Karlén distinguishes two main types of acoustic ambitions concerning rooms: those in which the acoustic contact is essential and those in which more or less acoustic seclusion is of primary importance. To the category of rooms whose acoustic contact is primary belong, for example, boardrooms, classrooms and auditoriums. To the category of rooms whose acoustic seclusion is primary belong, for example, large offices, telephone exchanges, and editorial rooms. An overall measure of the effect of the room's

13 L. Karlén. *Akustik i rum och byggnader*. 1983 p. 8.

sound absorbing surface is the reverberation time. In rooms for oral communication, there exists, for each room size, an optimal room dampening. The addition of sound absorbents rightly placed can offer a favourable balance between sound intensity and vibration in a room that formerly had poor acoustics.[14] Room furnishings in the form of furniture, textiles, fittings, and so forth influence the sound fi ld in the room and consequently the audible experience of the room. For example, the room acquires an absorbent surface through porous furniture surfaces, which lessens echoes and cuts the reverberation time.[15]

With few exceptions, the acoustic influence of furnishings upon a room is left to chance. One of those exceptions is in a space such as a concert hall, where chairs or other seating are usually designed so that the sound would be experienced identically whether the chairs are empty or not, and the effect of their sound absorption is included as part of the integral planning of the room. Other rooms where furnishings play a crucial role are, for example, auditoriums, opera halls, theatres, motion-picture theatres and music studios, where the sound has a fundamental function. Even in office landscapes, the furniture's sound dampening effect has been given some attention.[16] But if the furniture's dampening effect is not suffici nt, what would then be the solution? Most commonly, the alternative is to mount acoustic plates on the ceiling or even on the walls.

In acoustic matters, there is still uncertainty about how the quality of sound affects spatial experience. Is spatial experience affected in any way by sound impressions? For example, can a room be delimited but still be experienced as extending its limits (unbounded) with regard to acoustics? Can a square room be experienced as round? According to Karlén, the room and its furnishings can have a high degree of influence on the experience of sound and, in turn, on the experience of spatiality.[17]

The acoustic properties of furnishings in public environments, schools and workplaces have a clear practical function. Today, however, there are scarcely any accounts of these properties from furniture manufacturers. There are four fundamental acoustic functions for furniture and furnishings: self-generating sound radiation, sound absorbing, sound diffusion, and sound dampening through shielding.[18]

14 Karlén, 1983 p. 62.
15 Ibid., p. 80.
16 Ibid., p. 80.
17 Ibid., p. 80.
18 Ibid., p. 80-81.

After extensive investigation, as will be discussed later, I have not found any research on the hand-tuft technique itself. My search for information on the Internet, inter alia, is a confi mation of this. However, in a related matter, a research project on acoustic dampening textile was initiated in the autumn of 2006 at the Swedish School of Textile in Borås, Sweden. Margareta Zetterblom begins with a knitted dampening textile in 100% wool.[19] Even professor Ulla Bodin, from the Swedish School of Textile, has developed and tested a knitted acoustic dampening textile, but in contrast to Zetterblom, her material is a three-dimensional knitted material in synthetic fiber.[20]

Concerning measurements of the sound dampening properties (sound absorption measurements), these are usually evaluated, according to Hans Jonasson, in accordance with EN ISO 11 654. A few new defi itions have been included in this standard. These are the practical sound absorption factor and a weighed sound absorption factor. According to Jonasson, the practical sound absorption factor is calculated for every octave band following the 1/3-octave band values determined in accordance with ISO 354.[21]

A Final Note

Fibre art has a rich tradition of expression in Scandinavian and Baltic cultures and in most cultures around the world. However, the transformation of fibre art into an art of design in the modern sense of design requires the artist and designer to move into new territory, supported by appropriate research and a new method of inquiry that enables the integration of many factors in fi al design solutions without losing the expressive emotional force that makes fibre art valuable in human culture. To reduce fibre art to technical considerations is not enough. There must be a sophisticated vision of analysis, certainly, but there must also be a vision of synthesis and emotional expression to match.

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19 See Margareta Zetterblom's Master Thesis "Silence – en akustiskt dämpande textil" Borås, 2004.

20 Account, according to Ulla Bodin.

21 H. Jonasson, Print-out 2002-02-30, p. 13.

chapter 3

Strategy and Methods of Research

The central practical question behind this research is what properties or characteristics do hand-tufted artefacts have that would be signifi ant for interior spatial design, allowing both acoustic absorption as well as aesthetic expression. This is partly a technical question, but it is also an artistic question that requires care in exploration.

Productive Science or Poetics

Before discussing the particular methods employed in this inquiry, it is important to understand the broader perspective on method that the investigation represents. This research is an inquiry in the tradition of *productive science or poetics* – a method fi st employed by Aristotle to study human-made-things and subsequently employed in many variations in Western culture, including the work of artists such as Henri Matisse and the composer Roger Sessions, designers such as Moholy-Nagy, and philosophers such as John Dewey, with Dewey's *Art as Experience* as an excellent example. Dewey's defi ition of inquiry serves to explain the approach followed in this research: "Inquiry is the directed or controlled transformation of an indeterminate situation into a determinately unifi d one."[22] In the context of this research, the goal of the method is to resolve a problem in practice and theory and advance our understanding of design.

The method begins with an analysis of the *functional elements* of the problem and then moves forward with a synthesis of those elements in a concrete work or product, with refl ction on the principles that guide the solution. Typically, the functional elements identifi d in this method are (1) the manner or technique

22 John Dewey, *Logic: The Theory of Inquiry*. 1938, p. 117.

of production, (2) the matter, means or materials of the work, (3) the form of the work, and (4) the function or purpose of the work. This is a method that is highly suited to practice-based design research, and in a sense it could also be regarded as a form of refl ction-in-practice, following Donald A. Schön's ideas in *The Reflective Practitioner*. This method explains the organization of the following chapters.

The chapters in Part II focus on analysis of the manner of production and the material of fibre art. Chapter 4 addresses the manner of producing fibre art in this research. It presents a brief history of the hand-tuft technique and discusses the strengths and limitations of this way of creating works of fibre art and design. Chapters 5, 6, and 7 address the nature and properties of the materials employed in this research. The chapters are based on the creation and testing of samples of hand tuft ng. The samples are small modules that *begin to take on form* but not the fully developed form that is eventually required for artistic production. Chapter 5 focuses on the "shootability" of fibre materials in the hand-tuft technique of weaving. Chapter 6 focuses on the aesthetic qualities of the fibre materials and the material samples produced with the hand-tuft technique. It illustrates the phenomenological method of observation. Chapter 7 deals with the acoustic properties of different fibre materials, tested through the methods of acoustic science and analysis.

The chapters in Part III focus on the synthesis of manner, matter, form and purpose in fibre art, with special emphasis on form and purpose. Chapter 8 reports on the exhibition "Backside," which presented samples of hand tufting to the general public in order to assess responses to the aesthetic qualities of the samples. Chapter 9 addresses the problem of form and synthesis, based partly on the results of testing described in earlier chapters but also on solving the artistic or design problem of creating artefacts that function effectively in a real-life situation of use. The focus is on the creation of hand-tufted artefacts, placing them in a suitable interior space, and assessing their acoustic and aesthetic qualities in the wholeness of that space. In this research, the interior space is a large dining room in the *Jonsereds herrgård*. This space is known for its charm and aesthetic quality, but it is also known as a space with difficult acoustic problems. The chapter documents the creation of three design works – a large wall hanging and two fibre sculptures – and the testing of acoustic qualities in the room before and after the works are installed.

The chapters in Part IV focus on principles and conclusions. Chapter 10 is a refl ction on the principles that guide artistic creation and how the pieces created in the fi al phase of this research may bring unity to the experience of the space, solving both acoustic and aesthetic problems. It explores different ideas about the unity of experience in the work of Maurice Merleau-Ponty, Roland Barthes, and John Dewey. The focus is on fi ding the elements or aspects of unity that the artist and designer may consider in creating works such as those reported in this research. Chapter 11 presents the conclusions and a summary of the results and fi dings reached in the research.

The overall strategy of poetic inquiry employed in this research explains the organization of chapters and provides guidance for a variety of particular methods and techniques employed at various stages of the research. However, it is important to note that the strategy of poetic inquiry is also consistent with what is known as "practice-based research." Indeed, the strategy of poetic inquiry encourages both empirical observation as well as experimentation, and experimentation or practical investigation is the essence of practice-based research.

Practice-based Research

This research project is *practice based*, which here means that the materials to be studied are produced in the process of research. In order to attempt expanding the boundaries of artistic expression delimited by what the hand-tuft technique has to offer, practical tests have been carried out. It has been important to practically test more unknown but market obtainable thread materials in order to become acquainted with their usability. In what degree the post-treatment of the weave has affected the properties of the hand-tufted material has also been studied. The choice of which combinations to produce in the material samples is founded primarily on experience-based knowledge of what could be aesthetically interesting. Therefore, the choice has been directed by a strategy with the aim of offering a group of samples that are representative of possible variations and provide good possibilities for comparison. The chosen material samples have also been *observed* and described in regard to the material's aesthetic qualities from a *phenomenological* perspective. The identifi ation of differences among the samples' aesthetic/technical properties has been decisive for which samples were to be tested acoustically. The acoustic tests have been accomplished by means of a method used in acoustics, viz. through the *pipe method*. [23] A more justifi d method for room situations is the *room method*, depicted in ISO 354.[24] An alternative and cheaper

23 H. Jonasson, Ingenjörsakustik. Print-out 2002-02-30, p.12.

24 According to Hans Jonasson, sound researcher and department director at SP Sveriges Provnings- och Forskningsinstitut. See H. Jonasson, Ingenjörsakustik . Print-out 2002-02-30.

testing method, being precise and easy to handle, is the *pipe method*, mostly used for comparing various materials.[25] These limitations reside in the testing of small surfaces and only in the perpendicular incidence. With a pipe diameter of 10 cm, one can measure the absorption factor up to around 1800 Hz. At even higher frequencies, the pipe diameter must be further reduced. For more complicated situations, where the sound in reality falls in from all directions at once, the room method is nevertheless suggested.[26] I carry out tests through the *room method* in the spatial design context.[27] As in the process of producing material samples, the design and creation will be guided by both an aesthetic aspiration and a strategy for obtaining examples that represent possible variations and provide good possibilities for comparison. The aim is for the hand-tufted material to be a part of a whole, which simultaneously puts focus on the material's signifi ance and making it available for analysis.

25 Jonasson, 2002 p. 12.
26 Ibid, p.13.
27 See p. 102–103 for more detailed information.

part ii

Analysis: Manner and Material

chapter 4

The Hand-tuft Technique

> Artefacts, rugs, tapestry and rug elements in hand-tuft technique are like the weed of the sea, a swirly material with threads in constant motion. There is no need for wind for experiencing life in these long-threaded "beings."

Due to their diverse and interesting qualities, hand-tufted products have attracted attention in many parts of the world, and the hand-tuft technique is finding wider and wider application. International design and furniture fairs, exhibitions, and well established furniture stores: all have shown an increasing interest in hand-tufted artefacts.[28]

Historical Background

Hand-tuft technique (hand-tufting) designates the modern weaving technique by which thread is shot into a vertically suspended backing by means of a hand-steered machine that is driven by compressed air.[29] *Thread* designates a thinner or thicker elongated material consisting of one or more fibres, regardless whether it is spun, twined or produced in some other way.[30] Fibre designates a thread-like formation, whatever its origin, which alone or in a composition constitutes a thread. The word "hand-tuft technique" has no entry in the Swedish NE Diction-

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28 For example, most of the presented rugs at the international furniture fair, "Salone Internationale del Mobile" in Milan 2003 and 2004, were hand-tufted.

29 My own formulation of this concept. See picture nr. 1. I have written an article about the hand-tuft technique "Käsintuftaus. Haastava ja jännittävä tekniikka" in *Suomalaisen Käsityön Lehti Taito* 2/97, p. 38–39.

30 *Yarn* is the more common term in this context, but since "yarn" only designates spun or twined material, I have chosen to use "thread" with a special definition.

ary. Probably the concept is too new and its history too short. The word "hand-tuft technique" originates from German or English. Despite the fact that pictures of hand-tufted products are included in many contemporary design and furnishing books, as well as exhibition catalogs, there is very little written about the technique itself.[31] There are a few articles in newspapers and in popular and specialized periodicals that attempt to describe the technique in a general way, but there is little detailed information.[32] There are no books that provide thorough and detailed information. Even companies that manufacture hand-tufted products such as rugs provide little or nothing about the history of the technique and its development. Nonetheless, there are scattered short explanations in various company catalogues. For example, Oliver Treutlein has written:

> "Tufting has its origins in the early settler years in the USA and is a method of making textile materials by punching soft, voluminous pile yarn into a backing material with a sewing needle. Even today, alongside industrial mass production, exclusive individual carpets are still made by the hand-tufting method."[33]

According to Pia Eldin, the word "tuft" has an English origin, and it designated an old handicraft practiced by the American settlers around the beginning of the 17th century.[34] However, there is a difference between the hand-tuft technique and the so-called "pile weave" technique or the particular form of pile weave technique known in Scandinavia as the "Rya" technique. According to Jean Wilson, "Pile weaves have ends of yarn, cut or looped, rising above a flat background weave to create surface interest. Technically, this is a compound weave that has a basic weft woven as the ground, plus a supplementary weft that forms the pile or raised surface. The pile yarns are an addition to the ground weave – they are integral part of the weave. Surface texture is created by bringing these yarns up from the ground weave."[35]

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31 For example, see Christopher Farr and Matthew Bourne et. al, *Contemporary Rugs: Art and Design*. 2002. See even *Dish: International Design for the Home*. Ed. Julie Müller Stahl. 2005 p. 36–39; and C. Martin, *The Surface Texture Book*. 2005 p.17.

32 For example Lindén Ivarsson, A-K, Ryamattans återkomst.// *Göteborgs-Posten* 2000-03-25.

33 Oliver Treutleins company catalogue. Treutlein commenced his company O.T., *Oliver Treutlein* year 1985.

34 P. Eldin, *Från enris till flossa: En bok om handvävda mattor i Sverige*. 1986 p. 54.

35 Jean Wilson, *The Pile Weaves: Twenty-six Techniques and How to do Them*. 1974, p. 9–10.

According to Eldin, loops of thick, twined wool yarn were sewn fast onto heavy backing. Since the 1930's, tufting has, according to Eldin, been converted to an industrial technique, but can be carried out by hand with a special tool as well as through industrial manufacturing.[36] According to her, the rugs, like pile rugs, can be tufted in "whole flo s, relief, loops or chenilles – which provides fringes on both sides."[37] It is confusing that Eldin does not distinguish between tuft and hand-tuft. However, in a book by the Danish author Inge Alifrangis one fi ds: "Actually it is about the old Smyrna technique (in Denmark also known as the Aladdin-needle technique), through which one sews fast loops of wool onto weaved bottom in a pattern of choice."[38]

Modern hand tufting is only a few decades old.[39] Originally, it was the procedure used to repair large industrially manufactured rugs. According to Rolf Brenner, the mobile machine employed in hand tufting, the so-called "pistol," gradually developed into a handicraft tool.[40] The Hofmann Company in Germany was one of the fi st to manufacture hand-tuft machines in the 1970's.[41] At their inception, the hand-tuft machines were rather simple and had meager options for different thread lengths. This resulted in limited possibilities for expression. Today's hand-tuft achines can provide the user a choice of eight different thread lengths. Hofmann began manufacturing a more advanced hand-tuft machine at the beginning of the 1990's. Today, other companies are also manufacturing hand-tuft machines. The machines' functions are the same, but they have various constructions, their usage being more or less comfortable.[42]

One line of development in the technique has today resulted in the prospect of using robot-tufting machines. The process is controlled by the intermediacy of computer processing and the workmanship element of the work disappears. Computer controlled manufacturing is still not as widespread as the manually con-

36 Eldin, 1986 p. 54.
37 Ibid., p. 54.
38 I. Alifrangis, *Det danske ægte tæppe: Danish handmade Rugs and Carpets*. 1996.
39 According to Rolf Brenner, the hand-tuft technique is "not more than around 40 years old". See Carlsson, A, Konstnären befrias när datorn håller sig på mattan.// *e.Magasin* Nr. 5 1996.
40 Rolf Brenner has long experience of producing hand-tufted rugs. He can be regarded as Sweden's *Grand Old Man* in the trade. He has helped start many hand-tuft studios and has lead courses.
41 See www.hofmann-handtuft.de
42 I have used the modern hand-tuft machine from *Hofmann* myself in my works and work samples.

trolled machine. Wilcom Pty Ltd in Australia has been one of the pioneers. HITEX is the Swedish equivalent, which started its business in the middle of the 1990's and calls its process "Hitex Robot Handtuft".[43] One of the fi st individuals who began using the computer controlled hand-tuft technique was Rolf Brenner, a German resident of Sweden working in Håkanhult.[44] Rolf Brenner was also one of the fi st in Sweden to start a hand-tuft workshop of his own. Since 1980 he has created a host of hand-tufted rugs for various interior environments both in Sweden and abroad. In 1996 he launched a computer-controlled system. He described the system in this way: "three motors steer the pistols' movements horizontally, vertically and toward the weave. The fault of precision is no more than 1/100 mm, which is needed for placing the stitches precisely next to each other, which is needed when changing colours, for example."[45] Such accuracy, according to Brenner, is not achievable by the human hand. Other advantages are, according to him, doubling of speed of the weaving process, greater precision of pattern creation according to the blueprint, and achieving greater smoothness of the surface.[46] However, the technique results in jaggedness, caused by the pattern being transferred in "pixelized" form, as if partitioned in small squares, and by the machine moving in small steps instead of continuous motion. Slanting or curved lines become jagged.

Kasthalls fabrik was the fi st textile company in Sweden to start the production of hand-tufted fabrics.[47] Kasthall has also started using a robotized tufting machine. Since the 1990's an increasing number of hand-tufting studios have been established in Sweden. One example is Eldblå on Gotland, run by textile designer Karin Kloth.[48] Rugs from this studio are tufted in wool, linen and silk. The School of Design and Crafts (HDK) at Göteborg University purchased its fi st two modern hand-tuft machines from Hofmann in 1991 and began using them in education.[49] The technique of hand tufting has not gained as much ground in the rest of the Nordic countries as it has in Sweden.

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43 See www.hitex.se
44 See Carlsson, A, Konstnären befrias när datorn håller sig på mattan.// *e.Magasin* Nr. 5 1996. Telephone interview with Rolf Brenner 2005-04-18, 15 o'clock. See www.designbrenner.se.
45 Carlsson, A, 1996.
46 A tape recorded interview with Rolf Brenner 1998-10-08.
47 For more information about Kasthall, see www.kasthall.se
48 See www.eldbla.se. Rolf Brenner helped start the studio.
49 Former professor in Textile Art, Hans Krondahl, bought them for an auxiliary course 1991/92.

Today, there are hand-tuft studios in various parts of the world. Substantial production is found in the Netherlands and Germany. There are many hand-tuft studios in Asia, many with European ownership interests. The technique is well known in the United States.

The technique of hand tufting has been compared to the technique of pile weaves (rya rugs, etc.), and, in terms of appearance, the visual impression is similar. Having a front side with long dense standing threads being either cut or uncut (loops) is a feature that hand-tufted materials have in common with pile weaves. The type of technical fabrication utilized, assisted with various tools, is what differentiates them. Pile weaves (for example, rya rugs) are woven on horizontal looms, while hand-tufted fabrics are built upon a backing stretched upon a vertical frame. Pile weaves are woven row by row, and the "backing" and fringe are created simultaneously. But since hand-tufted work is built upon an already existing backing, it is possible to work over the whole surface at once.

Compared to the short history of the technique of hand tufting, the history of rya rugs reaches back several thousand years.[50] According to Sirelius, the oldest historic source is of "the usage of rya rugs in Scandinavia in the convent of Vadstena in a manuscript from 1451-52" in a context where bedclothes are mentioned.[51] I will not explore the history of rya (and flo s) in greater length, despite the fact that they have been the source of inspiration in establishing the technique of hand tufting. The technique of hand tufting has developed further in another direction not common to the rya technique in terms of technical fabrication.

It is impossible and speculative to try to determine exactly when and with which event the story of the hand-tuft technique began. However, one can state that the modern history of the hand-tuft technique began with the manufacturing of the modern hand-tuft achine in the 1980's.

50 See V. Sylwan, *Svenska ryor*. Stockholm 1934 och Sirelius, U. T., *Finlands ryor*. Stockholm 1925.

51 Sirelius, 1925 p. 6.

Picture nr. 1. Hand-tuft echnique

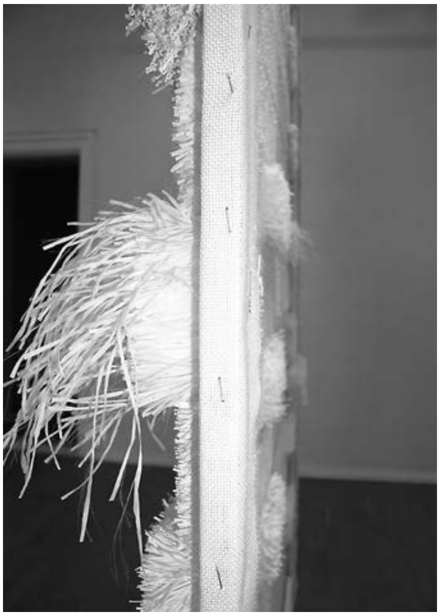
Description of Technical Possibilities and Limitations

The technique of hand-tufting offers the user a much higher degree of liberty compared to techniques developed on so-called "regular" looms or through the assistance of computer-steered tuft machines. The hand-tuft machine can be used like a brush in the hand. The direction and length of the "brush stroke" depends upon the user's personal "handwriting" and bestows upon the work its distinctive character.[52] Creating and weaving are achieved in the same stroke.[53] Having the possibility to glance over the whole surface at once, being able to control the process, and being able to treat the backing as a canvas on which one has the possibility of drawing strokes of colours here and there provides far better conditions for ongoing work. There is no need to weave row by row, but instead direction can be chosen freely and spontaneously. The great advantage of the technique is the liberating possibility of treating the form as something in growth.

52 See picture nr. 1.

53 Compare this with the robotized tuft machine, with which, according to Elisabeth Brenner, the creative work lies in the design and not in the tufting itself. Carlsson, A, Konstnären befrias när datorn håller sig på mattan.// *e.Magasin* Nr. 5 1996.

Picture nr. 2. "Uncut" threads



Picture nr. 3. Side view of the "uncut" threads.

A clear limitation lies in the machine's capacity to handle diverse thread lengths, which determine the material's (volume's) height. The hand-tuft machine VML 16 offers the technical possibility to "tuft" eight different heights, from 16 mm to 45 mm.[54] An auxiliary effect can be achieved if the machine does not cut as it should – due to solitary long "uncut" threads, the height of the volume is expanded.[55] The result can be aesthetical alluring, but from a technical standpoint, it is a failure. The cause for the thread not being cut properly is found in the thread material itself. The knife of the hand-tuft machine cannot handle certain materials and this is an additional limitation of the technique.[56] A minor variation of thread length can also be brought about by the agency of an "incorrect" wheel, viz. one that does not match the needle at hand. But the difference between the lengths is not as great as in the foregoing example.

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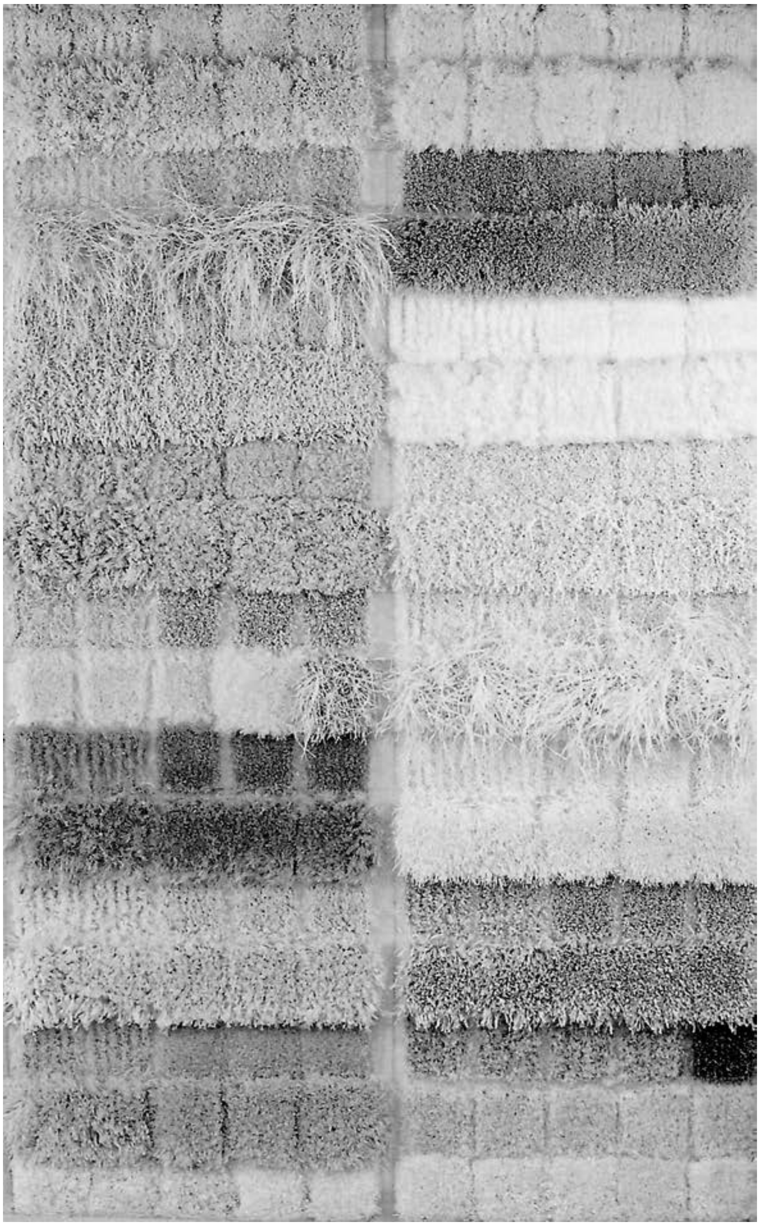
54 Information can be found at Hofmann's web site www.hofmann-handtuft.de.
55 See Picture nr. 2 and 3.
56 See Appendix 3.

Picture nr. 4. Kaja Tooming *Celebration* 1999, 61 x 61 cm

Hand tufting is accomplished from the backside of the backing. Since the hand-tuft machine shoots thread through the backing, no knots are created. Instead, the threads are fi ed with glue that is brushed on the backside while the weave is still stretched on the frame. The edges are glued back if needed after the dismounting. The gluing, usually done with water-based PVA-glue, is most important for rugs lying on the fl or. Hand tufting from a single side is most common, but it is also possible to tuft double-sided, even if it excludes gluing as well as demanding of the weaver a higher level of experience and skill in mastering the technique.[57]

The technical means set limits upon usable materials. What one is able to achieve depends heavily upon the properties of the thread material. This is the reason why it has been important to conduct an introductory study of the "shootability" of the selected thread material.

57 For an example of a double-sided work, see Picture nr. 4. Kaja Tooming, *Celebration* 1999. See also p. 174.



Picture nr. 5. Kaja Tooming, *Backside* 2003. Photo: Bengt Kvist

chapter 5

"Shootability" of the Thread Material

For the purpose of this investigation I have selected and tested eighteen different thread materials.[58] The criteria of selection were the different characteristics of the material, i.e. differences in the threads' physical properties. I have chosen to test some of the most common thread materials, such as wool, cotton and linen, as well as some other more unusual and, in the world of tufting, rarer materials, such as paper thread with raw silk fibre, polyurethane treated ramie, viscose treated silk, etc.[59]

The appropriate amount of threads, shot simultaneously through the bottom weave, differ according to the thread dimensions and thread materials. It was important to determine for each material the appropriate amount of threads, since the volume's density of thread [trådtäthet] affects the quality of the tufting. Testing the shootability was also important, i.e. how adequately the machine shoots the thread through the backing. Some of the threads are arduous or even impossible to shoot. Information and evaluation of the shootability of the tested materials can be found in the chart in Appendix 3.[60]

Each thread material was sample-tufted on a 71 mm by 71 mm surface. The amount of threads shot at the same time through the backing varied from two to eighteen. All samples were hand-tufted along straight lines in order to retain the same style in all samples. The materials shown to be easy or possible to shoot were hand-tufted with two different yarn lengths – 18 mm and 40 mm. Materials shown to be easy to handle were also tufted double-sided, viz. on both sides of the backing. I have used a scale from one to five to specify the shootability.

58 See Appendix 3.
59 See Picture nr. 5. See also p. 176.
60 My judgment is based upon my experience with handling the technique. I have more than ten years of practical work experience with the technique of hand tufting.

Wool is the most common material and one of the easiest to use in hand tufting. During the last few years linen has been increasingly utilized as well, but not yet as much as wool. Linen is a more difficult thread material than wool for the machine to cut. Occasionally, wool and linen threads are used together, and they can then be shot through the backing together simultaneously or apart, one at a time. There are many other fibres, for example ramie (woven ribbon), raw silk and Chenille silk, all of which are just as suitable technically, but despite this, are not utilized as much as wool.

Viscose treated linen (Japanese thread nr. 3) and polyurethane treated silk (Japanese thread nr. 20) were totally impossible to tuft.[61] In these cases the machine could tuft neither one nor more threads. This can mean that otherwise easily manageable materials could be impossible to use after being specially treated. Viscose treated cotton (Japanese thread nr. 5) was, for example, very hard to use, while non-treated cotton was easier to hand-tuft.[62] Furthermore, a specially treated silk (Japanese thread nr. 6) was difficult to tuft t greater lengths (40 mm).[63]

The appropriate amount of threads being shot through the backing depends also upon the physical properties of the thread material, in which the structure and thickness of the thread are decisive. Properties of the thread material depend upon the properties of the fibres composing the thread: mechanical properties – where, among other things, length, thickness and "strength" of the individual fibre are of importance.

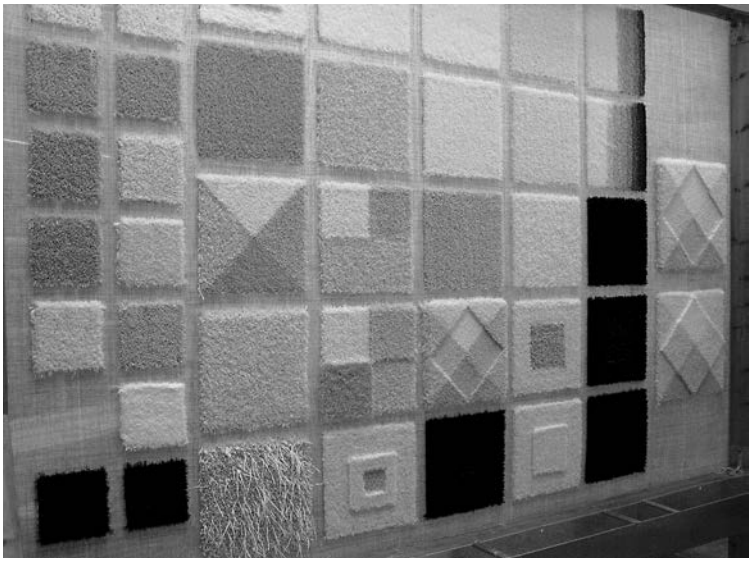
The "thicker" the thread material, the fewer are the threads that can simultaneously be shot through the backing. This is the case regardless whether the thread material is round or flat (for example, woven ribbon). I have, for example, only managed to hand-tuft two threads of polyurethane treated thread (Japanese thread nr.19), three threads of woven ramie ribbon (Japanese thread nr. 17) and in the case of viscose treated silk (Japanese thread nr. 7) three or four threads, depending upon the height of the volume and/or double-sidedness.[64] The material's inner structure (the fibres' interrelationship) influences the "strength" of the thread material and thus also the "shootability." It is therefore important to fi d the right amount of threads for each thread material.

61 See Appendix 3, column I row 13 and column II row 5.
62 See Appendix 3, column II row 3.
63 See Appendix 3, column II row 4.
64 See Appendix 3, column I row 7, column II row 13 and 14, and column I row 13 and 14.

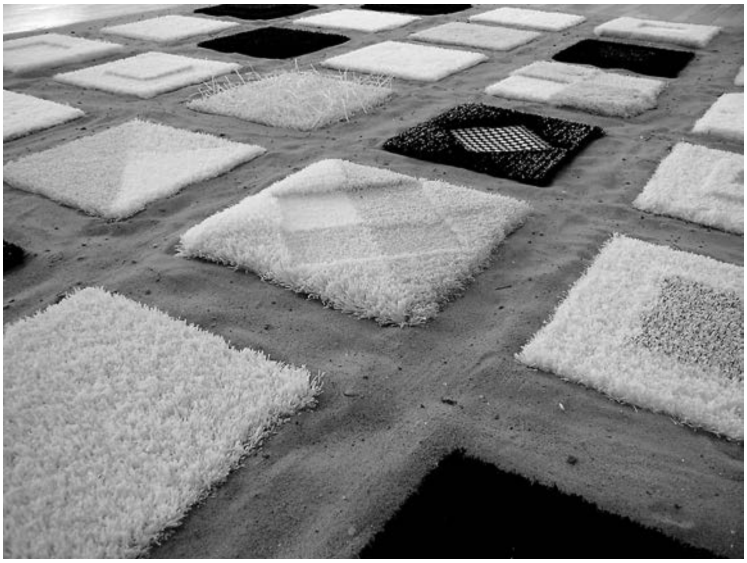
The thinner the individual thread, the more threads are suitable to be shot together for assembling the volume's density. I have, for example, used 18 threads for linen 35 and for Narva cotton.[65] The machine has difficulty cutting a larger amount of threads, but a lesser amount of threads does not build-up the volume well enough. For some materials, the shootability differs also at various heights. For example, the cotton thread was considerably more difficult to tuft at a height of 40 mm than 18 mm.[66] In this case, I presume that the thread's softness was decisive for the difference.

On the basis of the result of the introductory study of the "shootability," I have selected appropriate thread materials for the ongoing work. I selected those threads whose samples were most expressive and those representing the most divergent characteristics. Approximately twenty samples at the size of 30 x 30 cm and three samples at the size of 40 x 40 cm were made.[67] The purpose was to clarify the differences between various surface structures and the interplay between different materials from an aesthetic perspective.[68]

65 See Appendix 3, column II row 11 and 12, column I row 5 and 6.
66 See Appendix 3, column I. Compare row 5 with row 6.
67 See Picture nr. 4.
68 These material samples were part of the exhibition *Backside* year 2003 at the Town Hall Gallery in Kuressaare, Estonia. See Picture nr. 6 and 7.



Picture nr. 6 Hand-tuft amples on frame. Photo: Kaja Tooming



Picture nr. 7 Floor installation with hand-tufted rug elements and sand, *Town Hall Gallery* in Kuressaare, 2003. Photo: Kaja Tooming

Fibres used in the research. Photo: Bengt Kvist

chapter 6

Observations of the Material

Observations of the Material's Aesthetic Qualities

In an effort to better understand the aesthetic qualities of the materials employed in this research, I have used a method drawn from phenomenology. In accord with this method, I have attempted to describe the material in a spontaneous fashion and in as plain a language as possible. The goal is, in a phrase that is characteristic of phenomenology, to arrive "to the things themselves." This involves trying to observe phenomena from diverse points of view.

In the first stage I described the material's character, colour, form, light and shade. Interpretations are developed in the second stage, which lays a foundation for, and deepens the understanding of, the character of the material. My goal has been to comprehend the phenomena as they are presented in direct experience, without theoretical and historical constructions. According to Husserl's theory of intention, things are always experienced as something; they already have meaning.[69]

The observed material samples were also those tested acoustically. The sizes of the samples were adapted for the acoustic testing equipment and all samples have, therefore, circular backings with a diameter of 10 cm. However, the total "volume" of the samples vary. The exact dimensions depend upon the yarn's length and the threads' behavior.[70] Volume designates the size and shape of the hand-tufted material. This concept has been developed in the current work in order to describe the

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69 See even Jan Bengtsson, *Sammanflätningar: Husserls och Merleau-Pontys fenomenologi*. 2001, p. 28-29.

70 The terms used for the samples in chapter 2 signify the thread length and if the backing is glued or unglued: long-threaded (L), unglued long-threaded (OL), short-threaded (K), unglued short-threaded double-sided (OKD), unglued long-threaded double-sided (OLD). See figures 1, 2, 3, 4 and 5.

character of the hand-tufted material, because the material does not have a clearly defi ed surface. Rather, it has a "depth" which reaches down to the backing from the surface above. It is a depth that can be compared to the volume of more or less clear water. Visibility depth designates here the maximum depth, which can be observed down into the volume of the hand-tufted material.

Because the material's aesthetic qualities have central importance for the project as a whole, I will provide an example of the method of description by focusing on two samples, selected with the aim of providing examples that are characteristically as divergent from one another as possible: fi e and long-threaded cotton and polyurethane treated rayon.[71]

The samples have been observed at different points of time with various types of natural lighting (cloudy or sunny), and also with blended light from various light sources (incandescent, fluorescent, and natural). By rotating the samples, light comes in from different angles. I have held the samples in my hand, placed them before me on a table, and stepped back a meter or so in order to observe from various distances – from close range, through the agency of a magnifying glass, and up to a maximum of three meters.

71 See Picture nr. 8. Fine and Long-threaded Cotton. (Material nr. 1 in the acoustic investigation). The cotton thread is manufactured at Narva Krenholm in Estonia. Narva Krenholm is owned by Borås Wäfveri. The term for this thread is 54/2. See Picture nr. 9. Polyurethane Treated Rayon. (Material nr. 6 in the acoustic investigation). The polyurethane treated rayon is manufacture in Japan and is marketed by Nakachuu Co., Ltd. Polyurethane treated rayon has been termed by the latter as Rayon 100% picot (twisted yarn) poly-urethane sizing (un-dye-able).

Picture nr. 8 Fine and Long-threaded Cotton. Photo: Bengt Kvist

Fine and Long-threaded Cotton

Description. The thread is thin, with a diameter of about 0.3 mm.[72] It is composed of two very thin twined threads with a notably loose s-spun. The surface of the thread is a bit uneven; very short fibres stick out from the surface. The fibre has the form of a spiral twisted tube. The two twined fibres in turn consist of very short fibres with a length of approximately 10 mm.

The fringe is very malleable and soft. The volume is very dense; the threads stand compactly together; the surface is almost impenetrable. The transition of density from bottom to top is even, without major variation. But the more the material is "formed," large variation occurs, since the threads then place themselves in diverse directions. The threads hook or attach into each other due to the very small fibres sticking out from the surface. One does not see down to the backing and the volume appears to be impenetrable.

72 See Picture nr. 8.

The thin threads, even when the volume has been "formed," point mainly orthogonally from the backing. The surface of the thread looks a bit uneven, with very short fibres sticking out.

The thread is pale, bleached white with an evident cold hue that is without nuance. The thread is completely matte and light dampening; it "sucks" in the light and evens out all directed light. "Flat" shadows are almost created, whose boundaries are so blurred that the shadow becomes almost invisible.

Interpretation. The cotton material is alluring, like a soft- oated plush animal or like a soft and supple baby skin. It is also similar to soft moss, or at times similar to tousled hair. Experiencing the material's character and its softness creates an association with a small plush animal. The visual experience of the material suggests its softness. When one handles it, the visual experience is confi med. Sinking into soft moss is not an unpleasant experience. When moss is trampled upon, it rises again. Even this material can easily be depressed, but unlike moss it does not rise again by itself. The material can look like tousled hair or like a whirlwind, depending upon how one plays with the structure of the surface.

The properties of the fibre are those that determine if the material is experienced as soft or hard. The stark contrast between the softness (the soft volume) and the pale white cold hue makes the experience of the material both refreshing and warming, both luxurious and cosy.

The white colour offers a "sterile" impression coupled with few distinctive nuances and the material looks colder than the fibre when viewed by itself. An interesting contrast emerges between the material's character – its soft surface – and the "chalk white" colour. It is a contrast between contradictory meanings.

The longer the threads are, the more malleable the material becomes. This means that the threads are easily depressed and the height of the surface is partially or totally recessed. This gives the impression that the thread is "enslaved" and cannot hold itself upright without the support of its neighbours, the other threads. This gives an impression of an underlying surface supporting or creating the direction of the threads. The volume of the material can lose its tonicity and look depressed, but this also makes it possible to intentionally play with and change the form. One can interact with the material and affect the surface.

Reflections and conclusions. That the observed material has a soft quality, is malleable, is light dampening (the light creates almost invisible "flattened" shadows), and looks like a plush animal or like soft moss are some of the conclusions I could draw from my observations. They are important properties for the experience of the material from an aesthetic point of view. Due to the yarn's softness, the longer the material, the more malleable it becomes. And the volume is easily wholly or partially depressed. But unlike moss, it does not rise by itself. The material is characterized by this "non-autonomous" thread, which cannot stand upright by itself. The properties of the thread are what make the material appear soft. The white colour brings about the "sterile" impression and the material is experienced as colder than the fibre itself. The stark contrast between softness (the soft surface) and the pale cold white hue can be experienced as both refreshing and warming. It contributes to a composite impression of the material as luxurious in a homey and cosy manner.

Picture nr. 9 Polyurethane Treated Rayon. Photo: Bengt Kvist

Polyurethane Treated Rayon

Description. The thread is a woven (2 mm wide) ribbon, edged with small "loops."[73] The loop forms a half-circle with an approximate 2 mm radius, com-

73 See Picture nr. 9.

prised of a smaller band, which is an integral part of the primary woven ribbon. The ribbon is woven with a thread composed of many long thin shiny fibres. The thread is uneven in its structure. It is treated with polyurethane, which gives a matte and somewhat rough surface, accumulated most densely in the middle of the ribbon and in the loops. The shiny surface is visible mostly along the edges of the ribbon.

The hand-tufted surface is uneven and the volume gives the impression of movement. The volume has a rather stable form. It is simultaneously dense and airy. The threads stand packed together, but the "loops" create space between them. The transition of density between the bottom and surface is irregular. As the density decreases, it disperses towards the surface, while it appears to be impenetrable deep down. The backing is not visible. The threads hook into each other, but keep their distance from each other by way of the loops.

The colour ranges from a cold white hue to a warmer light creamy white without luster. The contrasts emerge most clearly with directed lighting. The cold white hue almost completely disappears in diffused light (light without direction) and the impression then is dominated by the light creamy matte appearance. The material shows "dramatic" shadows in a directed light, with sharp transitions between the illuminated material and the dark empty spaces. The thread's uneven, stable and illuminated surface contrasts with the dark spaces between the threads.

Interpretation. With the volume giving an impression of movement, I have a hard time focusing. When I try to follow the path taken by a thread, my gaze gets lost in the endless labyrinths of vacant space. The vacant space looks fragile, while the material presents itself as stable and sturdy. Something happens between the threads and the threads' vacancy, where the light is refl cted and creates shadows. A mood is created there.

The observed material is alive, expressive, and incongruous with exclusivity and elegance. Up close, it looks like delicate snowflakes ready to fall on the ground. There is so much elegance in the "movement." Actually, the material is standing still, yet it gives a defi ite impression of movement.

The material looks like an animal with curly fur, with elegance and luster, like young ladies dressed up for a ball. The material looks like a "marine plant" in movement or like a living coral. It is like an irresistibly inviting "coral forest" with infi ite labyrinths, where I can be easily mislead by so many directions. I can "sink" into it without actually drowning.

The material is at the same time both light-refl cting and light-dampening – it both "sucks in" and refl cts the light. The light creates dramatic shadows in directed light, where the direction and intensity of the light become decisive. The stronger the light source, the harsher the shadows and greater the contrasts created. It amplifi s the experience of the material having a living, elegant and multi-dimensional essence.

The material is very rich in contrasts and gives the impression of being both soft and hard, both vigorous and fragile.

The material gives the impression of being prickly: prickly like a porcupine but at the same time soft, like a dog's fur. The threads hook or fasten into each other owing to protruding loops. At the same time, these help the threads to keep their distance from each other. The loops make the material airy, giving the impression that the volume is penetrable and impenetrable at the same time. As a labyrinth causes curiosity, so does the material upon closer inspection.

Reflections and conclusions. One of the conclusions that I could reach from observation is that the uneven thread structure gives the impression of a moving volume. The apparent movement is due to the material's way of refl cting light that partly "sucks in" and partly refl cts light. The material has a cold hue with warm nuances depending upon the way the light falls. The thread's partially matte and partially glossy surface fi ds its most full expression in directed light.

The material is not very malleable, but keeps its stable form very well. The volume is dense, but airy. The "loops" create columns of air between the threads, which are standing close to each other. The transition of density from the bottom to the surface is uneven. The volume grows less dense near the surface, but thickens and becomes impenetrable deep down, and through which the backing is not visible. The threads' interrelations have great import for the experience of the volume: they hook themselves into each other due to the protruding loops. At the same time, the loops contribute to keeping the threads' distance from each other. Since the threads are not standing straight up but are winding, air columns stretch downwards between the threads in twists and turns which the eye cannot follow. This makes the surface visually both impenetrable and penetrable. It is like a labyrinth, where one easily looses orientation. The light, which creates living and playful shadows, amplifi s the visual aesthetic and dramatic experience of the material's character and can have both a soothing and riveting effect upon the character of the material.

Conclusions

Length, thickness and structure of fibre and thread, as well as the thread density, have great importance for the material's character and for creating a soothing and dramatic experience. The manner of how one peers into the volume depends upon the properties of the thread material – both the way the thread is composed by its fibres and the properties of the fibres.

The visibility depth is a characteristic aspect of the material, which is also why the quality of light is important for experiencing the volume.

chapter 7

Acoustic Qualities of the Material

Sound Absorption Tests

Before discussing the acoustic qualities of the material, we will begin with some definitions. *Sound* is defined in *Sound Absorption Technology* as "a vibratory disturbance in the pressure and density of a fluid or in the elastic strain in a solid, with frequencies in the approximate range between 20 and 20,000 cycles per second, and capable of being detected by the organs of hearing."[74] Sound absorption means to dampen or take up or take in sound within a material. It involves several factors.

1. *Density* – the relation of mass to volume.
2. *Thickness* – as used in this research it refers to the length or height of the thread.
3. *Structure of the thread* – acoustic research commonly focuses on porosity, but in the contexts in this research the structure of the thread is more relevant. As used in this research it refers to the relation of the fibres in themselves and taken together in compositional form.
4. *Treatment of the backing* – whether the backing is glued or unglued after weaving.
5. *Placement in the room* – where the material is placed in an environmental space.

Among these factors, density and thickness have received attention in acoustic testing. And, of course, there has been some consideration of placement in a room. However, there are no recognized materials with good sound absorption characteristics that one may also explore for aesthetically pleasing results.

74 Uno Ingard, *Sound Absorption Technology*. 1994, p. B-1.

The goal has been to test material samples that are comparable and, at the same time, representative of the wealth of possibilities afforded by the technique of hand-tufting. The following questions have guided the research: Does the fibre structure of thread signifi antly affect the absorption factor? Does gluing the backing affect the absorption factor?

The tufting samples were chosen to enable a comparison between thread materials of different fibre structures, which explains why all of the thread materials chosen were sampled in equal tufting heights (40 mm). Since the thickness or height of the thread material could also play a role, additional samples of certain thread materials were chosen in order to compare between high (40 mm), low (18 mm) and double-sided (80 mm) tufted materials. A few further samples were taken from some thread materials in order to compare between glued and unglued tufted samples.[75]

The sound absorption tests were carried out at the SP Swedish National Testing and Research Institute.[76] The measurements were implemented through the pipe method, i.e. according to the "standing wave method." The method may be described as follows:

> "A loud speaker at one end of a pipe produces a plane wave. The sample mounted at the other end of the pipe reflects the sound wave and a standing wave is produced in the pipe. With the assistance of two microphones in the pipe and a two channel FFT analyzer, the samples' sound absorption can be determined in perpendicular incidence."[77]

Single-sided samples were oriented so that their fringes were directed toward the sound source. Measurement uncertainty "is estimated to be less than 0.05 units of the absorption factor specifi d with a coverage factor of 2.[78]

All samples had a circular backing with a diameter of 10 cm. The size of the

75 Meeting at the Swedish National Testing and Research Institute 2003-06-04 with Hans G. Johansson, PhD, Director of Acoustics, Håkan Andersson, Civil Engineer in Acoustics and Joachim Stadig, Engineer in Acoustics.

76 Report from SP, Swedish National Testing and Research Institute 2003-06-17, Reference P302599. Test runs were carried out 2003-06-12 and 2003-06-16. These measurement results have also been presented at Futureground, DRS International Conference 2004, at Melbourne, Australia 2004-11-20. See Appendix 1.

77 ISO 10534-2. Report from SP, Swedish National Testing and Research Institute 2003-06-17, page 5.

78 Report from SP, Swedish National Testing and Research Institute 2003-06-17, page 5.

samples was adapted to fit the acoustic test equipment. The designations used for the samples indicate the thread's length and whether the backing is glued or unglued: long-threaded (L), unglued long-threaded (OL), short-threaded (K), unglued short-threaded double-sided (OKD), unglued long-threaded double-sided (OLD).[79]

Sound Absorption Tests

There are two primary properties of the sound absorbing material:

1. Values: the sound absorption factor.
2. Physical properties: form-density, the material's thickness (or height of the volume), the fibres' and/or the threads' interrelationship; the structure of the volume and the structure of the thread/fibre, etc.

The sound absorption properties were tested in two different ways: placing the samples directly against the wall, or placing them 5 cm from the wall, since the gap of air between the object and the wall could have great signifi ance for the sound absorption.

The most interesting audible frequency interval from an acoustic point of view in an interior setting is the interval between 630 and 1250 Hz.[80] Therefore, a high absorption factor in this frequency interval is especially desirable, and the measuring is therefore focused on this.

In all, tufted samples with 17 different thread materials were tested. Additionally, untufted backing was also tested. Sound absorption measurements were performed on these thread materials: wool, cotton, linen, raw silk, viscose treated silk, ramie, polyurethane treated rayon, viscose treated cotton, viscose treated paper thread, viscose treated ramie, paper thread with raw silk fibre, Chenille cotton, and viscose treated linen.[81] Linen and wool were tested with two different thread dimensions. Thread materials of ramie and viscose treated silk were tested with different widths.

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79 See figure 1, 2, 3, 4 and 5. In SP, the term "yarn length" is used for what is here called "thread length".

80 According to Hans G. Jonasson and Håkan Andersson.

81 See figure 1. Report from SP, SP, Swedish National Testing and Research Institute 2003-06-17. Henceforth, I will give the terms in parentheses as used in the report and figures (the graphs).

RAPPORT

utfärdad av ackrediterat laboratorium/REPORT issued by an Accredited Laboratory

SWEDAC ACKREDITERING 1002

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Handläggare, enhet/*Handled by, department*	Datum/*Date*	Beteckning/*Reference*	Sida/*Page*
Håkan Andersson, Akustik Tel: +46 (0)33 16 54 23 Email: hakan.andersson@sp.se	2003-06-17	P302599	1 (5)

Bestämning av ljudabsorption med rörmetoden
(5 bilagor)

Mätobjekt Tuftade textilprover numrerade enligt tabell nedan.

1	Bomull 54/2 (Narva Krenholm)
2	Lin 16 (Bockens Lingarn 4/4 BL)
3	Wild raw silk (silk 100 %) reeled by hand, unbleach ab. 3000 denier, (Japansk garn nr. 27)
4	Silk 100 %, viscose sizing bleach, (Japansk garn nr. 7)
5	Ramie 100 %, knitted tape, (Japansk garn nr. 17)
6	Rayon 100 % picot (twisted yarn) poly-urethane sizing (un-dye-able), (Japansk garn nr. 19)
7	Cotton 100 %, viscose sizing bleach, (Japansk garn nr. 4)
8	Silk 100 %, viscose sizing bleach, (Japansk garn nr. 16)
9	Paper yarn (cellulose 100 %) viscose-sizing, white (dye-able), (Japansk garn nr. 23)
10	Ramie 100%, Lea 7/2 viscose sizing, unbleach, (Japansk garn nr. 29)
11	Paper yarn (cellulose 100 %) + raw silk 28 denierx3 (twisted, dye-able), (Japansk garn nr. 22)
12	Chenille, bomull
13	Ull 100% (Brage), Nm. 7/2, Tex 280
14	Lin 35
15	Ramie 100 % knitted tape, (Japansk garn nr. 18)
16	Ull 100% (Mora), Nm. 20/2, Tex 100
17	Linen 100%, viscose sizing unbleach, (Japansk garn nr. 3)
18	Bottenväv ESTEX 263 grey, constr. 60/80, (Schilgen GmbH & Co)

Proverna fanns i utförande med limmad och olimmad botten, märkta i resultattabellen med L resp. OL. Prover med dubbelsidig tuftning var olimmade och är märkta med D i resultattabellen.

Proverna var tuftade med två olika garnlängder, 18 mm resp 40 mm.

Mätdatum 2003-06-12, 2003-06-16

SP, Sveriges Provnings- och Forskningsinstitut, Box 857, 501 15 BORÅS, Tel 033-16 50 00, Telefax 033-13 55 02, E-mail info@sp.se, Org.nr 556464-6874

Ackrediterat laboratorium utses av Styrelsen för ackreditering och teknisk kontroll (SWEDAC) enligt lag. Verksamheten vid de svenska ackrediterade laboratorierna uppfyller kraven enligt SS-EN 45001 (1989), SS-EN 45002 (1989) och ISO/IEC Guide 25 (1990:E). Denna rapport får endast återges i sin helhet, om inte SWEDAC och SP i förväg skriftligen godkänt annat.

Figure 1. Report from SP, Swedish National Testing and Research Institute 2003-06-17, Reference P302599

Test Results

Test against wall, 18 mm thread length

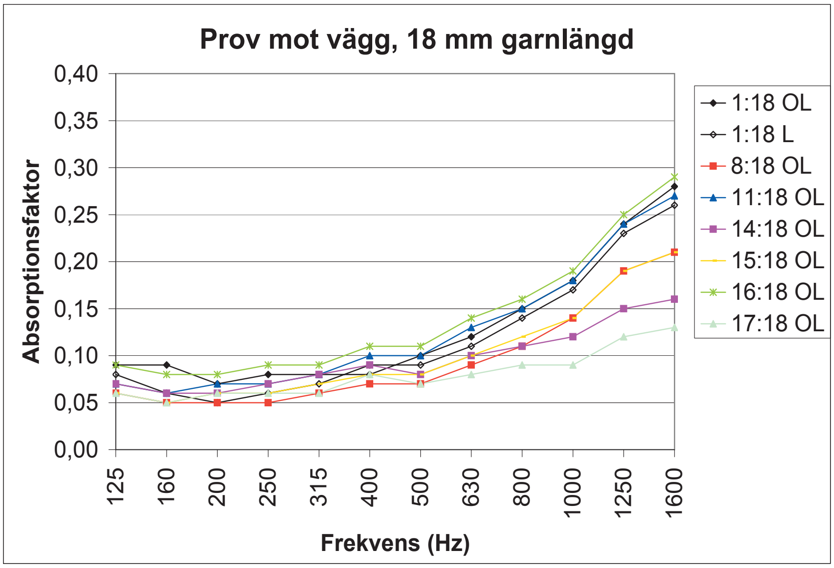


Figure 2. Test against wall, 18 mm thread length

Eight material samples with thread lengths of 18 mm were tested, placed directly against a wall. Since the fi st test showed insignifi ant differences between glued and unglued backings, only unglued samples were subsequently tested. The following materials were tested: cotton (1:18 OL and 1:18 L) with both glued and unglued backings, viscose treated silk (8:18 OL), paper thread with raw silk (11:18 OL), linen (14:18 OL), woven ramie ribbon (15:18 OL), wool (16:18 OL), and viscose treated linen (17:18 OL).[82]

All samples showed a very low absorption factor. The absorption factor was, for all samples, highest at the frequency of 1600 Hz. The maximum absorption factor was under 0.3 (out of 1.0) for all samples. This demonstrates that samples with thread lengths of 18 mm, placed directly against a wall, have irrelevant signifi ance for sound absorption. Therefore, the testing of these samples was terminated.

82 See Figure 2.

Test against wall, 40 mm thread length

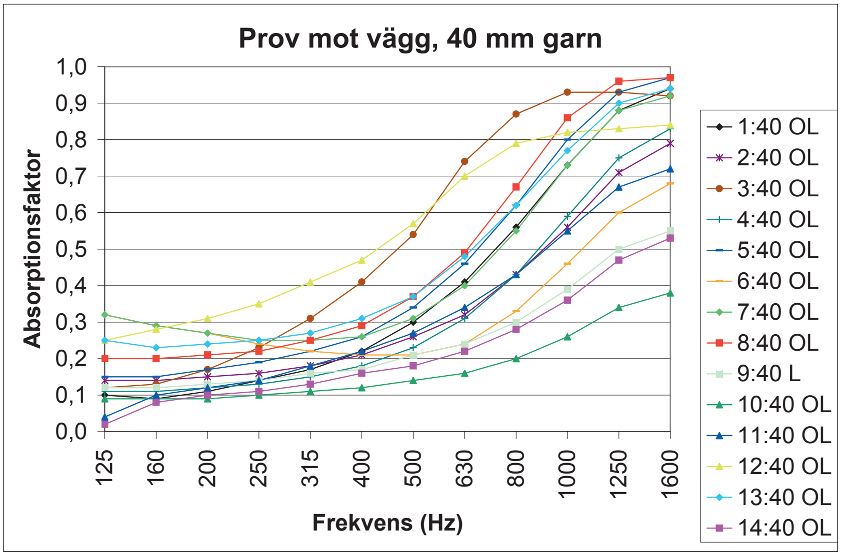


Figure 3. Test against wall, 40 mm thread length

Fourteen material samples with thread lengths of 40 mm were tested, placed directly against a wall. All samples had unglued backings with the exception of one sample with viscose treated paper thread (9:40 L). The following materials were tested: cotton (1:40 OL), linen (2:40 OL), raw silk (3:40 OL), viscose treated silk (4:40 OL), woven ramie ribbon (5:40 OL), polyurethane treated rayon (6:40 OL), viscose treated cotton (7:40 OL), viscose treated silk (8:40 OL), viscose treated paper thread (9:40 L), viscose treated ramie (10:40 OL), paper thread with raw silk (11:40 OL), Chenille cotton (12:40 OL), wool (13:40 OL), and linen (14:40 OL).[83]

Samples tested against the wall with thread lengths of 40 mm demonstrated very low values up to 630 Hz, but grew most rapidly above 630 Hz. Still, the absorption factor was consistently low, and only two samples had values over 0.5: Chenille cotton (12:40 OL) and raw silk (3:40 OL).[84] Thirteen of fourteen samples had the best results (the exception being raw silk, which dropped somewhat)

83 See Figure 3.
84 See Figure 3.

in the frequency interval of 1250-1600 Hz, in which six out of fourteen thread materials demonstrated very high values with an absorption factor over 0.9. The highest levels were attained by the viscose treated silk (8:40 OL) and woven ramie ribbon (5:40 OL) samples, which both attained 0.97 at 1600 Hz. Also wool (13:40 OL), raw silk (3:40 OL), cotton (1:40 OL) and viscose treated cotton (7:40 OL) attained values over 0.9. Raw silk showed a signifi antly higher absorption factor compared to the other materials already at frequencies just above 600 Hz, and eventually reached 0.9 in the vicinity of 900 Hz. The viscose treated ramie (10:40 OL) showed the lowest values, where the maximum absorption factor was under 0.4 in the whole frequency range. Linen (14:40 OL) and viscose treated paper thread (9:40 L) showed the next lowest values, whose absorption factors never exceeded 0.55.

Test 5 cm from wall 40 mm thread length on unglued backing, as well as untufted backing

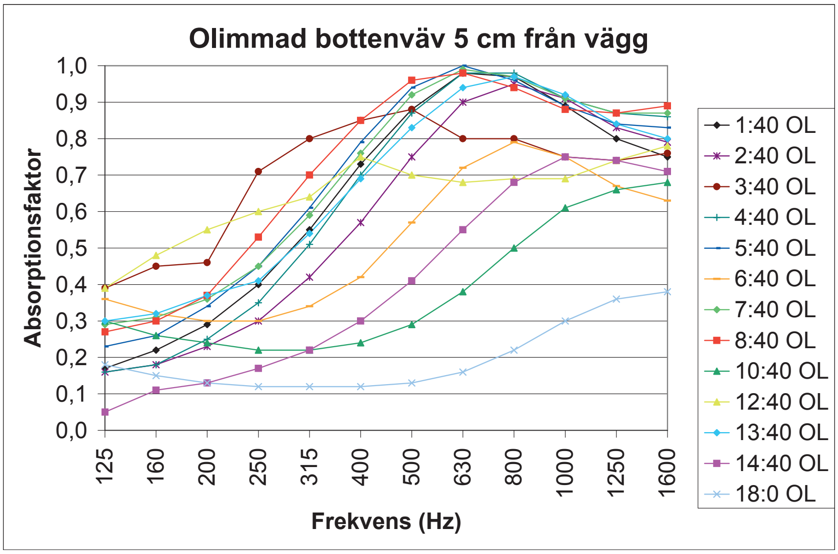


Figure 4. 40 mm thread length on unglued backing, as well as untufted backing, 5 cm from wall

Thirteen material samples with unglued backings were tested, placed 5 cm from the wall: cotton (1:40 OL), linen (2:40 OL), raw silk (3:40 OL), viscose treated silk (4:40 OL), woven ramie ribbon (5:40 OL), polyurethane treated rayon (6:40 OL), viscose treated cotton (7:40 OL), viscose treated silk (8:40 OL), viscose treated ramie (10:40 OL), Chenille cotton (12:40 OL), wool (13:40 OL), linen (14:40 OL) and ESTEX 263 backing (18:0 OL).[85]

The absorption factor of over half the samples began growing rapidly already at the frequency of 200 Hz. Already at 400 Hz, eight materials had attained the factor of 0.7, and at 500 Hz the values of seven materials had risen above 0.8 or 0.9. In the case of Chenille cotton (12:40 OL), its absorption factor sunk from 0.75 to 0.70. At the frequency of 630 Hz, seven materials had absorption factors above 0.9 out of 1.0, which is an excellent result. One sample attained the ideal absorption factor result of 1.0, namely woven ramie ribbon (5:40 OL). Viscose treated cotton (7:40 OL) also came very close to the ideal value with the absorption factor of 0.99. Not far off were viscose treated silk (8:40 OL), along with cotton (1:40 OL) and viscose treated silk (nr. 4) with the values of 0.98. All of the last mentioned materials had absorption factors above 0.90 up to the frequency of 1000 Hz and then sank somewhat, but still not dropping below 0.75 at the frequency of 1600 Hz. Two additional materials attained absorption factors above 0.90 past and above 630 Hz, but eventually the absorption factor sank to a greater extent than the other materials mentioned. These materials were wool (13:40 OL) and linen (2:40 OL). Raw silk (3:40 OL) attained the most even absorption factor curve: between frequencies 250 and 1600 Hz the absorption factor laid steadily between 0.70 and 0.88. Chenille cotton (nr.12) also showed a even absorption factor curve, which rose steadily from 0.40 to 0.77 over the course of the frequency range, with its maximum at 1600 Hz. Ten samples with unglued backing showed a stable rising curve for ten samples. For seven of these, the absorption factor reached its peak in the frequency interval 500-1000 Hz.

The ESTEX 263 backing (18:0 OL) obtained a very low absorption factor, which did not rise over 0.3 until reaching 1000 Hz, but still had not reached 0.4 at the frequency of 1600 Hz. Viscose treated ramie (10:40 OL) too had a very low absorption factor: under 0.5 until 800 Hz, reaching its highest value of 0.68 at 1600 Hz. The absorption factor of linen 35 (14:40 OL) remained below 0.55 until 630 Hz, and reached a maximum value of 0.75 at the frequency of 1000 Hz.

85 See Figure 4.

Test 5 cm from wall 40 mm thread length on glued backing, as well as untufted glued backing, 5 cm from wall

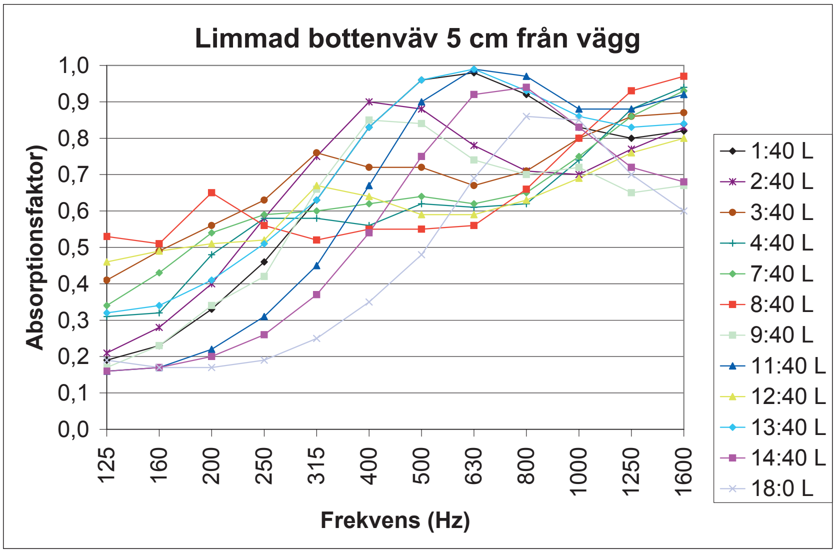


Figure 5. 40 mm thread length on glued backing, as well as untufted glued backing, 5 cm from wall

Twelve material samples with glued backing placed 5 cm from the wall were tested: cotton (1:40 L), linen (2:40 L), raw silk (3:40 L), viscose treated silk (4:40 L), viscose treated cotton (7:40 L), viscose treated silk (8:40 L), viscose treated paper thread (9:40 L), paper thread with raw silk (11:40 L), Chenille cotton (12:40 L), wool (13:40 L), linen (14:40 L) and the glued untufted backing ESTEX 263 (18:0 L).[86]

The highest absorption factor values, between 0.98 and 0.99 were demonstrated by wool (13:40 L), linen 35 (14:40 L) and cotton (1:40 L) at the frequency of 630 Hz. Linen 35 (14:40 L) demonstrated an absorption factor of over 0.90 between the frequencies of 630 and 800 Hz. On the other hand, Linen 16 had its fi st peak at the frequency of 400 Hz with an absorption factor 0.76 and then sunk to 0.67 at 630 Hz, but thereafter began to rise again where it reached 0.87 at 1600 Hz.

86 See Figure 5.

Four materials had a low absorption factors between 500 and 800 Hz, but near 1600 Hz they rose over 0.90. These samples were the viscose treated silk (8:40 L), viscose treated silk (4:40 L), viscose treated cotton (7:40 L) and paper thread with raw silk fibre (11:40 L).

The Chenille cotton (12:40 L) demonstrated the most stable rise of value, measuring 0.46 at the lowest frequency of 125 Hz and 0.80 at the highest frequency of 1600 Hz. Even viscose treated silk (8:40 L) and raw silk (3:40 L) demonstrated a steady curve over the whole frequency interval between 125 and 1600 Hz.

The ESTEX 263 backing attained a very low absorption factor until 500 Hz, after which it rose quickly until 800 Hz. The backing attained its highest absorption factor of 0.85 to 0.87 between the frequencies of 800 to 1000 Hz, after which the value plunged again to 0.60 at 1600 Hz.

Test of double-sided weave 5 cm from the wall

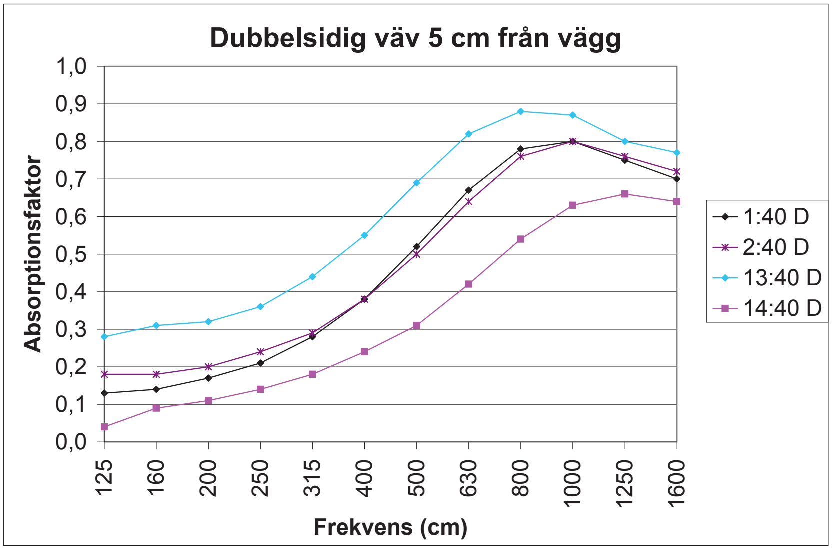


Figure 6. Double-sided weave 5 cm from the wall

Four double-sided material samples were tested, placed 5 cm from a wall: cotton (1:40 D), linen (2:40 D), wool (13:40 D) and linen (14:40 D).[87]

From among the double-sided samples, wool (13:40 D) attained the highest value over a larger frequency interval, with the highest absorption factor of 0.88 between the frequencies of 630-1250 Hz. The lowest value was obtained by linen 35 (14:40 D), which attained its highest absorption factor of 0.63 to 0.66 between the frequencies of 1000 and 1600 Hz. However, linen 16 (2:40 D) attained an absorption factor of 0.75 to 0.80 between the frequencies of 800 and 1250 Hz. Almost the same result was reached by the double-sided cotton. The highest level for double-sided samples came to be 0.88.

Analysis

All samples, with thread lengths of both 18 mm and 40 mm, placed directly against a wall, attained very low values in frequencies under 500 Hz. The values of 18 mm thread length samples did not rise much either at higher frequencies. However, samples with thread lengths of 40 mm, compared with those of 18 mm, attained much higher values at the higher frequencies. For example viscose treated silk (8:40 OL), which attained 0.97, the highest value among all 40 mm thread samples against a wall, attained an absorption factor of 0.21 at a thread length of 18 mm (8:18 OL). Cotton (1:40 OL), which also attained a very high absorption factor (0.94) at high frequencies when tested with 40 mm thread length, attained a very low value (0.28) when tested with 18 mm thread length (1:18 OL). Paper thread with raw silk fibre (11:18 OL) also attained a very low value (0.27) at an 18 mm thread length and a considerably higher one at 40 mm (11:40 OL) with an absorption factor of 0.72. The absorption factor was two to four times higher for all samples with a 40 mm height compared to the same material with an 18 mm height. The fi st sample tests showed that one or two samples with an 18 mm thread length ("low" level) are suffic nt for the comparison with those with a 40 mm thread length ("high" level).

Samples with the unglued backing 5 cm from the wall exhibited considerably more high results for various thread materials than the tests with glued backing 5 cm from the wall or against the wall, in the most interesting frequency interval 630-1250 Hz.[88] It is very unusual for a material to demonstrate the ideal absorp-

87 See Figure 6.
88 Compare Figure 4 and 5.

tion factor result of 1.00, as the woven ramie ribbon (5:40 OL) had accomplished.[89] Compared to this test result of this material sample placed 5 cm from the wall (5:40 OL), the sample placed against the wall did not demonstrate such a high value at the frequency of 630 Hz with the inconsiderable absorption factor of only 0.46. Thus, at the frequency of 630 Hz, the sample placed 5 cm from the wall (5:40 OL) had a factor double that of when the sample was placed against the wall. However, the difference was not as large at the frequency of 1600 Hz, where both had high absorption factors – 0.97 without an air gap, and 0.83 with a 5 cm spacing from the wall.

Even other samples placed 5 cm from the wall had very high absorption factors, proximate to the ideal value, at the frequency of 630 Hz: viscose treated cotton (7:40 OL), viscose treated silk (nr. 8:40 OL and 4:40 OL) and cotton (1:40 OL).[90] Against a wall, these materials had low absorption factors (under 0.5) at the frequency of 630 Hz.[91] At the frequency of 1600 Hz the values were in similar fashion less than half. However, in comparison, the samples 5 cm from the wall had double the absorption factors at 630 Hz.[92] An identical pattern applied also to wool (13:40 OL). Linen (2:40 OL) was the only material at the frequency of 1600 Hz that obtained the same value (0.79) for both the sample against wall and the sample placed 5 cm from the wall.[93] However, the differences were considerable at 630 Hz, where the values of the samples placed against the wall were three times lower.

Five out of eight materials with unglued backings attained higher absorption values than glued backings. Two materials, wool (13:40 L) and linen (14:40 L), attained a bit higher results with glued backings than with unglued.[94] Cotton (1:40 OL and 1:40 L) attained equally high values (0.98) at 630 Hz for both glued and unglued samples.[95] The value of the glued sample rose earlier and afterwards sank in less regard than the unglued. The untufted unglued backing (18:0 OL) obtained very low values, while the untufted glued backing (18:0 L) showed a very high absorption factor, which peaked (0.86) at the frequency of 800 Hz.[96]

89 See Figure 4.
90 See Figure 4.
91 See Figure 3.
92 Compare Figure 3 and 4.
93 Compare Figure 3 and 4.
94 Compare Figure 4 and 5.
95 See Figure 4 and 5.
96 See Figure 4 and 5.

The double-sided material's pile height is twice as high as the single-sided, but the density is halved. They also demonstrate lower values compared to the single-sided, and do not exceed 0.82.[97] The maximum values for all double-sided samples were obtained between 800 and 1250 Hz.[98] Wool (13:40 OL) attained its maximum value, 0.88, at 800 Hz.[99] The single-sided sample of the same material (13:40 OL) placed 5 cm from the wall also demonstrated its maximum value at 800 Hz, however the value turned out to be 0.97.[100] Consequently, the results differ from each other, showing that the double-sided samples demonstrate values that are a bit lower. However, the difference is not considerable. Out of four double-sided samples, wool attained the best result.

It is of general opinion that wool material is one of the best suited for sound absorption. My results tell the same story. All the same, my tests also showed that another thread material, viscose treated ramie (5:40 OL), had even better absorption values.[101] Among samples with unglued backings, viscose treated cotton (7:40OL), viscose treated silk (8:40 OL and 4:40 OL) and cotton (1:40 OL) attained better results than wool (13:40 OL).[102] Among samples with glued backings, wool (13:40 L) obtained the same results as paper thread with raw silk fibre (11:40 L).[103] The absorption factor for cotton (1:40 L and 1:40 OL) with both glued and unglued backing was almost as high as wool.[104]

Conclusions

Several material samples would reach the ultimate ideal level or come very close to the ideal level.[105] This demonstrates that hand-tufted material can have very good sound absorption properties. Threads standing densely side-by-side should be of importance. The pile's height and the thread material were signifi ant for the absorption factor. The gluing of the backing also affects the absorption factor.

97 Compare Figure 4 and 6.
98 See Figure 6.
99 See Figure 6.
100 See Figure 4.
101 See Figure 4.
102 See Figure 4.
103 See Figure 5.
104 See Figure 4 and 5.
105 See Figure 3. Report from SP, Swedish National Testing and Research Institute 2003-06-17.

Materials with low absorption factors and with unglued backing showed much better results with glued backing. However, materials with very high absorption factors with unglued backing generated lower factor results with glued backing.

Materials with unglued backings were generally shown to have a higher absorption factor than those with glued backing in the frequency interval of 500-1250. (The expected result was the following: materials with higher density should show a higher absorption factor, and a glued backing would affect the density and the material's tightness so that glued samples would show higher values than unglued).[106] Samples with glued backings placed against the wall showed very low absorption factors at all frequencies. Samples with unglued backings against the wall also showed very low absorption factors up to 630 Hz, but the factor results rose considerably at very high frequencies (between 1250-1600 Hz).

Generally, the samples with unglued backings and a thread length of 18 mm gave very low absorption factors, which did not grow considerably with higher frequencies, while some material samples with 40 mm showed very high absorption factors at very high frequencies.[107]

Conclusions from acoustic testing of selected samples:

1. Treatment of the backing affects the absorption factor. The absorption factor of unglued materials, with an otherwise lower absorption factor, is increased after treatment. Conversely, the absorption factor of materials, with an otherwise higher absorption factor when glued, is decreased after treatment.
2. Thickness (height) of the pile has great signifi ance for the absorption factor. A longer thread means a thicker pile, which ultimately results in a higher absorption factor.

106 Compare Figure 2 and 3. Figure 2 includes samples with unglued backing and Figure 3 with glued backing.
107 See Figure 3 and 4.

part iii

Synthesis: Form and Purpose

Picture nr. 10. The *Backside* exhibition at the Town Hall Gallery in Kuressaare, 2003.

Picture nr. 11 The view of the room: Backside's back side and reliefs.

chapter 8

The *Backside* Exhibition

The exhibition *Backside* was planned as a pilot study for Phase Two of my research in order to investigate the importance of hand-tufted materials in the concrete context of a room. It was the beginning of a movement in the research toward synthesis, gathering impressions from those who attended the exhibition and shared their experiences.

Picture nr. 12. Floor installation with hand-tuftet rug elements and sand. Detail.
Photo: Kaja Tooming.

The purpose of the Backside exhibition was to demonstrate the quality of the hand-tufted elements and show possible variations of presentation with aesthetic qualities taken into consideration. Specifi ally, the purpose was to show how "peculiar placing creates a concrete meaning" and is an important part of the whole, i.e. part of the room's unifi d configu ation.[108] The units in Barthes' theory of structural activity correspond to my hand-tufted elements. According to Barthes, such a unit is insignifi ant in itself, yet a small change in its placement results in a change in the overall configu ation.[109] This conclusion is useful from both aesthetic and functional points of view. From the viewpoint of the whole, the positioning of every hand-tufted element was important for creating the atmosphere of the room. Furthermore, the interplay between the hand-tufted rug elements (in various forms and composed of various fibres) and the light played a large role. The exhibition was built upon the works I had created over several years – from hand-tufted pictorial weaves, large and small, to sculpturing and fl or installation – where individual hand-tufted elements were joined together with sand.[110]

I employed a survey questionnaire at the exhibition in order to learn how people experienced the hand-tufted artefacts in a spatial context. The questionnaire was formulated in three languages: Estonian, Swedish and English.[111] A total of 102 people answered the questionnaire. Of these, 66 answered in Estonian, 25 in Swedish, and 5 in English. The nine questions posed were few and very basic so that the visitors would have the time and energy to reply then and there. The questionnaire had questions:

1. Do you know about the hand-tuft echnique?
2. Which of the various exposure possibilities are felt as most interesting to you?
a) Large rugs on walls (work number 7 and 11)
b) Compositions on canvas (work 2 and 6)
c) Compositions in the room, that is, away from the wall (work number 1 and 5)
d) Installations on the fl or (work number 8)
e) 3-d form in the room (work number 13)

108 See Barthes' theory on structuralistic activity on p.113–115.
109 See page 114.
110 See pictures nr. 4–7 and 13–18.
111 The time of the exhibition in the middle of summer was planned with the many international tourists in mind visiting Kuressaare, the most established spa resort in Estonia.

3. Is there anything that has surprised you in the exhibition? Which thing?
4. Is there anything that has irritated you in the exhibition? Why?
5. How do you experience the atmosphere in the exhibition?
6. Which of the materials or material compositions at the exhibition have made the largest impression on you? Please elaborate and indicate the index number of the work.
7. How do you feel about the possibilities of using combinations of materials such as combining textile and metal, for example?
8. Which of the aesthetic solutions would you preferably use in a room as solutions to acoustical sound problems, if you knew that works in the hand-tuft technique grant large sound-reducing effects? Please elaborate and indicate the index number of the work.
9. Additional observations or suggestions.

Since the questions were simply stated, it was difficult to pursue a deeper analysis of the replies or draw decisive conclusions. However, I could draw some interesting conclusions about the aesthetic qualities of the fibre art works in a spatial context. The relationships among the parts – the hand-tufted art works – created a unifi d whole and at same time carried functional meaning. My questions pointed toward the functional purpose of the art works. The interesting fact was that visitors were quite surprised by this connection. The exhibition, of course, was site specific nd temporary.

Surprisingly, only 20% of the visitors who answered the questionnaire knew about the hand-tuft technique. More than 50% felt that installation on the fl or was the most interesting of the various displays in the exhibition. A quarter of the visitors preferred the display that was away from the wall. Almost as many visitors preferred the large rugs that were displayed on the walls. Approximately one-sixth of the visitors were impressed with the presentation of three-dimensional form. Among the visitors, 84 out of 102 answered positively to the question, "Is there anything that has surprised you in the exhibition." For these visitors, the entire exhibition was a surprise, including beauty, originality of technique, the variety of materials, and multiplicity of forms and presentations. Many of them also emphasized that the combination of aesthetic and acoustic qualities was surprising – they were surprised that it was possible to create so-called "functional art works" with such beautiful features. Many of the visitors were also surprised by the possibility of creation through the hand-tuft technique. Also, the choice of materials and the use of different materials together – such as sand and the hand-tufted forms – surprised many visitors. Some of the visitors were surprised that it is possible to use the hand-tuft technique to create elegant three-dimensional sculptural forms. Of course, one of the most surprising features of the exhibition was the fl or installation, where sand and hand-tufted elements created a "carpet." From a distance, the fl or installation looked like a carpet, but as visitors came closer they were surprised to discover the separate materials of sand and fibre art pieces. The overall impression was of a unity, despite the differences of the elements. Another surprise for many visitors was the fact that one could observe many of the art pieces from the back as well as the front – those pieces that were presented away from the wall and offered the opportunity to move around the work.

Only 1% of the visitors indicated that something in the exhibition irritated them. In some cases the irritation arose from the works appearing too light or too dark. In other cases, the visitors wanted to see more art works or more colours in the work. All of the visitors experienced the atmosphere in the exhibition as very positive. Some of them pointed out that the atmosphere was exciting and very creative. Many visitors experienced the atmosphere as relaxing and even sacred. The black-and-white "colourlessness" of many of the works, with faint nuances of natural colour may have contributed to this impression. Responses to the survey questionnaire indicated that the hand-tufted elements were experienced as visually very appealing, and the room was experienced as "inviting."

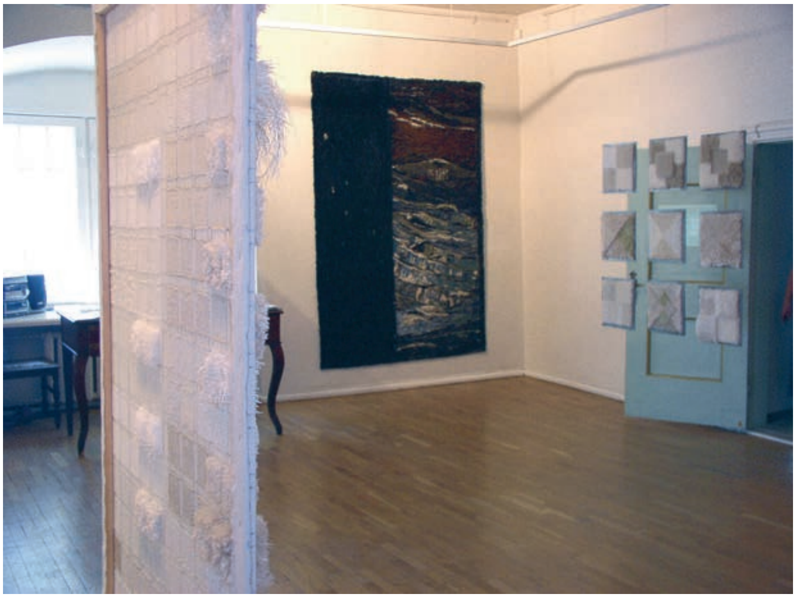
Visitors gave a wide range of answers in response to the question about which of the materials or material compositions in the exhibition made the strongest impression. However, it was clear that for almost a third of the visitors, the installation on the fl or made the strongest impression, because it was unique and surprising. As one visitor wrote, "the installation refer to unspoiled(ness). It gives a feeling that only one light breeze could disturb all this perfection." Some of the visitors liked the "play" with the colours or very playful lighting in the space, which aroused the emotions and established the atmosphere. Others emphasized that they liked the possibility of seeing the art works from the frame side as well as from the backside. They also liked the choice of materials and use of those materials in different forms. One person described one of the art works as a snowy "grass tuft" or bunch of grass.

Almost everybody found that the use and combination of materials (such as textile and metal) was positive, interesting, exciting and fascinating. One person explained that the contrast lifts p the properties of both materials.

Every fi h visitor selected the work called "Backside" as a preferable solution for acoustic problems in a room. This was a work that was hung away from the wall of the exhibition space. The next favourite solution was a large hand-tufted weave against the wall, a work called "Waterfall." After that, the favorite work was the compositions on canvas (work 1, the series called "Composition"). And after that came the compositions in the room that were away from the wall (work nr. 2, the series called "Reliefs"). The artwork that most surprised the visitors (the installation "A Japanese Garden" on the fl or) was not selected as a desirable solution probably because of practical considerations – sand!

In their fi al comments, visitors emphasized that the exhibition was very special and original, and that they had never seen anything like it before. The exhibition clearly showed that the hand-tuft technique yields attractive and pleasing aesthetic qualities, and it revealed that visitors would be very willing to use hand-tuft artefacts in their homes because of the aesthetic qualities of such artefacts.

Picture nr. 13. The view of the room. Photo: Kaja Tooming



Picture nr. 14. The view of the room. Photo: Kaja Tooming

Picture nr. 15. *The Japanese Garden*. Photo: Kaja Tooming

Picture nr. 16. *The Japanese Garden* after. Photo: Kaja Tooming

Picture nr. 17. Jonsered Manor. Photo: Kaja Tooming

chapter 9

Form and Purpose in Synthesis: The Jonsered Manor

The *Backside* exhibition in Estonia was the first step toward formal synthesis of the elements of fibre art in expressive forms. This preliminary step led to Phase Two of the research: the creation of an ensemble of fibre art works for a specific architectural environment, where aesthetic and acoustic problems are the central issue. I will describe the environment and the problem and then discuss the practical work of using fibre art as a design element in a complex and culturally important building: the Jonsered Manor, known in Sweden as the Jonsereds herrgård.

Cultural and Historical Background

Jonsered is a small community not far from Göteborg, situated on hilly ground close to beautiful Lake Aspen. It is well known for its enchanting natural setting, but it is also remembered as the home of Jonsered Industries. Two Scotsmen, William Gibson and Alexander Keiller, founded the company in 1832.[112] Their partnership continued until 1839, when Gibson and his two sons took over the operation and renamed it *Gibson & Söner*.[113]

In the beginning, the company produced canvas sailcloth, but many other products were soon added, including various forms of textiles. While textile manufacturing characterized the company for many years, there was also an iron foundry that produced and repaired machines for textile manufacturing.

112 Martin Fritz, "Jonsereds Fabriker," in *Jonsered: Stenåldersboplats, bruksort, kunskapssamhälle*. Ed. Viveka Overland, Anders Franck. Uddevalla 2006, p. 101-110.
113 Fritz, 2006 p. 102.

Picture nr. 18. Fog on Lake Aspen. Photo: Kaja Tooming

The Jonsered Manor sits on a hill with a commanding view of Lake Aspen. The manor grounds have a long and colourful history stretching back to the end of the Middle Ages.[114] In that period, Jonsered was the property of the Crown. In the 16th century, however, the manor came into the possession of General Brynte Birgersson Lillie and his family. Ownership changed again at the end of the 17th century, and it has changed several times since then. William Gibson bought the Jonsered property in 1832. David Gibson tore down the old manor in 1868 and erected a new building on the same site. The architect Johan August Westerberg prepared the sketches for the new manor. Instead of following the strict definition of a 19th century villa – a kind of summer retreat for people who wanted to get away from work in the city – the new structure would be used throughout the year, serving as a resi-

114 *Jonsered: Stenåldersboplats, bruksort, kunskapssamhälle*. Ed. Viveka Overland, Anders Franck. Bohusläns Museums Förlag: Uddevalla 2006. See even *Jonsereds herrgård*. Text: Anders Franck. Göteborgs universitet 2004.

dence for the owner of the factory.[115] As Lars Stackell observes, the Jonsered Manor was distinguished by its dominant placement in the landscape yet with a relatively discrete external form.[116]

Today, the Jonsered grounds are known as a beautiful nature preserve, and the Jonsereds herrgård, the Manor, serves as a conference center for Göteborg University. It is a place where scientists and scholars, as well as distinguished persons from outside the university, may meet for discussion. As Anders Franck explains, the manor is a meeting place for activities such as seminars and conferences, addressing a wide variety of important themes in areas such as education, research, art and culture, management and economic development, and the quality of life.[117]

When Göteborg University took over management of the facility, it initiated a large renovation project to prepare the environment of the building for its new purpose. Thus began a fruitful collaboration with the Swedish architecture firm *Liljewall Arkitekter*.[118] The goal was to renovate the manor so that it would meet the special needs of the new activities and, at the same time, maintain fidelity to the historical context of the manor and its grounds. In short, the goal was to combine traditional qualities with innovations that are appropriate to modern functions.

The Spatial Context for the Art Works

One is struck by the idyllic setting of the manor. Bright and white, the building stands in a beautiful environment of trees, grass, and water, suffused with special light. The two-story building is visible from a long distance from the east and southeast. The manor is inviting and tempting. Entering the building, one first encounters a large hall with a grand staircase. It is the central meeting place for visitors, and it offers access to the main rooms on that floor.[119] On one side, the hall leads to a large drawing room with a beautiful view of the lake. Through this room one enters a dining room that can easily seat forty people.

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115 Stackell, 2006, p. 228.

116 Lars Stackell, "J A Westerberg – herrgårdens arkitekt," in *Jonsered: Stenåldersboplats, bruksort, kunskapssamhälle.* Ed. Viveka Overland, Anders Franck. Uddevalla 2006, p. 225-239.

117 See *Jonsereds herrgård*. Text: Anders Franck. Göteborgs universitet 2004.

118 Jonsereds herrgård is renovated by *Liljewall Arkitekter* between January 2004 and September 2004.

119 See Appendix 5, plan of the ground floor.

Picture nr. 19. Dining room. Photo: Kaja Tooming

The dining room is elegant, but it also presents a problem. When many people are in the room, there is a somewhat disturbing clamour, revealing a problem of acoustics. The architects have been cautious in attempting to solve this problem because of the preservation ambitions. Obvious solutions were ruled out because they confli ted with the historical nature of the room. It would have been possible, for example, to cover the ceiling with a special sound absorbing fi ish or with sound absorbing panels suspended from the ceiling. As Christer Liljewall, the architect responsible for this project, explains, these and similar solutions were avoided because they would confli t with the historical aspect of the interior.[120]

The design constraints imposed by the historical setting of the room suggested that a subtler approach was needed to deal with the poor acoustics. It is in this context that a fibre art approach began to make sense. The goal was to meet two needs simultaneously. The first need was for fibre art artefacts that would add an

120 A personal communication with Christer Liljewall 15 of March, 2007.

appropriate aesthetic expression, enhancing rather than detracting from the experience of the room. The second need was to design the fibre art artefacts in such a way that they might help to improve the acoustics of the room. Behind this, there also had to be careful consideration of the larger context of the building, including historical, social, and cultural factors. In short, the fibre artefacts had to become part of the whole of the room and of the manor itself.

To understand the broader context of the dining room and the building, it was necessary to visit the manor several times. The first goal of these visits was to experience the environment of manor, and particularly the dining room. It was important to observe with care, immersed in the *perceptual whole* of the space, characterized by individual physical elements, each with special properties that create differences and variations throughout the room.

The second goal of the visits was to understand the orderly relationship among the elements of the room. For example, it was important to understand how the walls, ceiling, windows, and furniture related to each other and how the structural relationships created a *meaningful whole*. Each of these individual elements takes on significance when they are experienced in relation to other elements. The elements and their relationships affect how we interpret the room, whether in the activities that take place during an event or in the social and cultural traditions associated with formal dining or in the aesthetic and acoustic relationships of the space.

The third goal of the visits was to experience the room in its entirety, as a place of social interaction and communication. This is the *experienced whole*, which brings together the perceptual elements and the meaningful relationships of the space and adds to these the expressive qualities of human interaction.

These visits to the manor were important in the preparatory phase of my work. They were important for gathering knowledge of the environment and for understanding what would be needed in order to supply the aesthetic elements that would enhance the aesthetic experience of the dining room. By "aesthetic," I mean both the aesthetic of visual beauty as well as the aesthetic of auditory sensations. Of course, all of my earlier experiences contributed to prepare me for the analysis that was conducted during these visits. My experience as a practicing artist; my studies and observations of the aesthetic qualities of the material; and my scientific tests of the sound absorbing properties of the material: all of these factors were an important preparation. They provided the basic knowledge to support my work. But the knowledge acquired through perception, meaning and experience in the specific spatial context of the manor was also essential. It was situational knowledge – site-specific knowledge that was not transferable to or from any other situation. This site-specific knowledge was important in the working process for finding an appropriate solution for improving the aesthetic environment of the dining room. As an artist, designer, and researcher, I have started from the existing permanent building and its interior as the foundation from which to seek possible and appropriate solutions.

The result was a proposal presented in June 2006 at a meeting with Christer Liljewall, the project architect, and Bengt-Ove Boström, representing Göteborg University. The proposal took into consideration the ideas, desires, and views of all of the parties involved in the process. The proposal included pictures and plan drawings of the placement of fibre artefacts in the dining room, the choice of material for the fibre artefacts, and a description and sketches of the fibre artefacts themselves.[121]

Placement of Art Works in the Room

The first issue was the placement of the artworks in the dining room. To determine this, it was important to analyze the structural relationships within the room and how they affected the placement of sound dampening objects or materials. The resulting proposal was to place objects at three different locations. The first location was on a large "empty" wall, directly visible when entering the room, with the possibility of making with a 10 cm air gap between the artwork and the wall. The second and third locations were existing niches at two corners of the room, opposite the large empty wall.[122] Two fibre art sculptures in the niches of the opposite wall would offer a good balance for the room, not only for the sound experience but also to elevate the visual aesthetic experience. This proved to be the most acceptable proposal.

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121 See Appendix 5, figure 8. The placing of the art works is marked with yellow markings.

122 See plan, Appendix 5.

Picture nr. 20. A large "empty" wall. Foto: Kaja Tooming

Alternative ideas were considered during the process. One was for a fourth element: a movable screen woven double-sided in the manner of the hand-tuft technique and supported by means of an appropriate metal frame. The idea was that this kind of screen could very easily be moved to one or another place in the room, depending on the situation and special needs for sound control, privacy of a meeting area, and so forth. This idea was important because it provided a larger area of fibre material and sound absorption – a significant challenge for such a large room. The proposed screen would supplement the wall hanging and the two niche sculptures, as because I felt that those works alone may not be enough for the level of acoustic quality that was desired in the room. Also, I felt that from a visual and aesthetic point of view, the screen would have been a very effective addition.However, the idea of a mobile screen did not interest the architect, who rejected the idea without further investigation. This was a significant decision in view of the later acoustic testing. I continue to believe that with careful consideration of the existing historical environment of the room and the building, the movable screen would have been not only an interesting addition but also a striking modern multifunctional creation that would have enchanged the aesthetics and acoustics of the room.

Another idea was to use the wall area between the three windows on the west side of the room. This area would also have a hand-tuft hanging and would employ a 10 cm air gap between the artwork and the wall. This idea, too, was rejected, perhaps because of the architect's concern that there would then be too much fibre work in the room. This was understandable, since it remained to be seen what character or quality the fibre artwork would have.

Finally, another idea was to cover the ceiling with appropriate hand-tufted modules, with a playful combination of artwork and light between the ceiling and the modules. I suggested this in the early stages of discussion, but the idea was rejected because of the historical context of the room. However, such a solution may be appropriate in another environment and remains viable in my mind.

All these decisions – rejected as well as accepted ideas – raised important aesthetic questions concerning balance between visual and audible qualities as well as between artistic additions and the preserved spatial atmosphere of the original room.

Material Choices and Description of Art Works

Two considerations guided the selection of suitable materials. The first consideration was the sound absorbing properties of the various fiber materials.[123] The second consideration was the visual aesthetic properties of the fiber materials. Both considerations were equally important. The character of the work of art – its form – determined the number of different fiber materials needed for attaining an aesthetically appealing result. For these three works, I chose seven different fibre materials with different visual characteristics, each possessing a very high sound absorption factor. The following fibre materials were selected: paper yarn (cellulose 100%) + raw silk (object of measurement nr. 11); silk 100%, viscose sizing bleach (object of measurement nr. 8); ramie 100%, knitted tape (object of measurement nr. 5); silk 100%, viscose sizing bleach (object of measurement nr. 4); wild raw silk (silk 100%) (object of measurement nr. 3), cotton 100%, viscose sizing bleach (object of measurement nr. 7), and ramie 100%, knitted tape (object of measurement nr. 15).[124]

123 The selection is based upon the acoustic tests carried out at Swedish National Testing and Research Institute. See Chapter 7.

124 See Figure nr. 1, p. 62.

Picture nr. 21. Shades of colours. Photo: Kaja Tooming

In one of these works, only fiber material in natural colour was used. However, the two other works of art, the sculptures, were presented in stark shifting shades of colour. All of the colours were dyed by the artist.[125]

The overall purpose was to create an ensemble of three works that possessed high aesthetic value – that is, works that were visually appealing as well as capable of absorbing sound effectively. In this way, the goal was to affect the "gestalt" of the room and support a more positive auditory experience.

The Hand-tufted Weaving *Flow*

The size of *Flow*, 150 cm x 230 cm (155 x 235 when mounted), is due to the dimensions of the wall and its relation to the rest of the room. It was also important, in the interests of sound dampening, to use the maximum amount of the available surface. In other words, the size of the work of art is important for the resulting experience.

The large "picture," the hand-tufted weave named "Flow," is stretched upon a wooden frame with the dimensions 155 cm x 235 cm. By means of four 172 mm long ESSVE concrete screws, the artwork is mounted on the wall with a 10 cm air

125 See Picture nr. 21.

gap between the frame and wall. A 20 mm aluminium rod with holes secures the gap size and protects screws themselves. Such a mounting is visually pleasing as well as acoustically effective.

Picture nr. 22. *Flow* front side. Photo: Kaja Tooming

Picture nr. 23. Detail. Photo: Kaja Tooming

Picture nr. 24. *Flow*. Photo: Kaja Tooming

Picture nr. 25. Mounting the art work. Photo: Kaja Tooming

The thickness or depth of the material used in the artwork is important for absorbing sound. I decided to work with a 40 mm yarn length for producing a superior sound dampening effect. The choice is based upon the earlier acoustic test results. Separate threads sticking out about 80 mm or more from the surface obtain an additional advantage.[126] The choice of materials for Flow (ramie, silk, paper yarn, cotton, etc.) also affects the overall experience of the work of art.[127]

Picture nr. 26. *Flow*. Photo: Kaja Tooming

The mild nuance of natural colours creates a calm, harmonious atmosphere. The character of the surface contributes to the expressive movement, which adds greater excitement to the experience. The hand style that I employed in the work of hand tufting is what I characterize as a “free” hand style. By this I mean that the lines were woven spontaneously, following the flow and direction of the pattern.[128] This kind of free hand-style promotes a more expressive visual effect. Even the separate threads that protrude more than 80 mm contribute to the expressive effect.

126 See Picture nr. 22 and 23.
127 See Picture nr. 22, 24 and 26.
128 See Appendix 7, Picture nr. 41–44.

Picture nr. 27. The niches. Photo: Kaja Tooming

The Sculptures *Growing I* and *Growing II*

I used the hand-tuft technique for the two sculptures, but I also used double-sided weaving, so that there was no backside to the works.[129] The sculptures consist of long, slender, uneven and richly coloured ribbons, twisting and turning, coming from the "bottom" upward.[130] The sources of inspiration were corals and moving sea plants. The sculptures are two meters high, with a diameter of 40-50 cm. The length of yarn on one side is 20 mm, but the double-sided surface yields a height of thread of approximately 40 mm. As in the case of *Flow*, the separate threads raise the volume's height still more. The choice of materials is identical to the materials chosen for Flow, but it differs in colour. In contrast to the range of natural colours, the sculptures are richly coloured, from blue to red and from dark to light. Unlike Flow, the acoustic properties of the materials were not the primary consideration for the process of creating the sculptures. The hand-tufted ribbons were created spontaneously, with an emphasis on expression.

129 See Pictures nr. 28–32 and 35–38.
130 See Pictures nr. 28–32 and 35–38.

Picture nr. 28. Sculptures *Growing I* and *Growing II*. Photo: Kaja Tooming

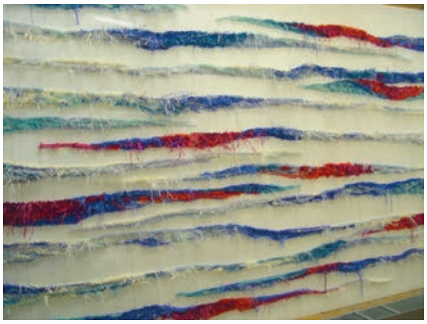
In the process of creating the sculptures, I distinguish three phases. In phase one, I hand-tufted double-sided strips of varying lengths on a backing stretched upon a vertical frame.[131]

The lengths of the strips varied from about 100 cm to 270 cm. The initial step was to dye the chosen fiber materials in various colour tones with varying nuances. The dyeing continued throughout the entire hand-tufting process, because during the process I could decide which colour tones should be introduced. I took into consideration the existing colours of the dining room so that my choice of colours would harmonize with the rest of the room and support the general atmosphere of the room. The whole hand-tufting process was spontaneous and expressive in the sense that the strips were created during the work without preparatory sketches.

131 See Picture nr. 29–32.

Picture nr. 29. Double-side hand-tuft technique, side 1. Photo: Kaja Tooming

Picture nr. 30. Detail. Photo: Kaja Tooming

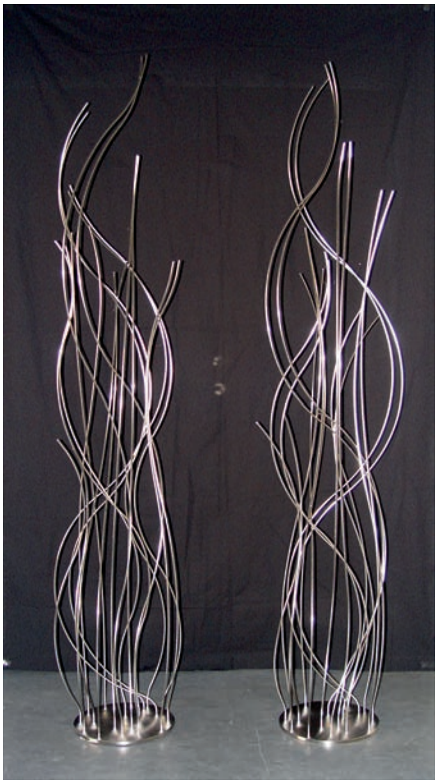


Picture nr. 31. Double-side hand-tuft technique, side 2. Photo: Kaja Tooming

Picture nr. 32. Detail. Photo: Kaja Tooming

In the second phase, the task was to create a metal structure to support the three-dimensional form. It was important that the metal structure allow the fibre strips to maintain balance, free movement, and an easy fl w from the base upward toward the top. I prepared a circular stainless steel disc with a diameter of 30 cm and with a height of 1 cm. I drilled holes in the base and anchored curved 5 mm stainless steel rods of various lengths. Every individual stainless steel rod was curved separately, following the plan of the sculptures. To determine the proper placement of the rods, I fi st tested with a circular model of the base.[132] The process has been expressive in the sense that the whole composition, i.e. the three-dimensional metal structure without fibre strips, was spontaneously created without sketches.[133]

132 See Picture nr. 33–34.
133 See Pictures nr. 33–36.



Picture nr. 33. Working process.
Photo: Kaja Tooming

Picture nr. 34. Detail.

Picture nr. 35 and 36. Working process.
Photo: Kaja Tooming

In phase three, the task was to compose the sculpture, fastening the hand-tufted strips between the supporting metal rods. It was important to consider how the colours should be placed within the three-dimensional form. I wanted to amplify the coherent expression created by the interplay of colour and form. I should note that it was important to create the two sculptures simultaneously, so they would together create a whole and fit into the existing room.[134]

134 See Pictures nr. 28 and 33–36.

Picture nr. 37. *Growing I*.
Photo: Kaja Tooming

Picture nr. 38. *Growing II*.
Photo: Kaja Tooming

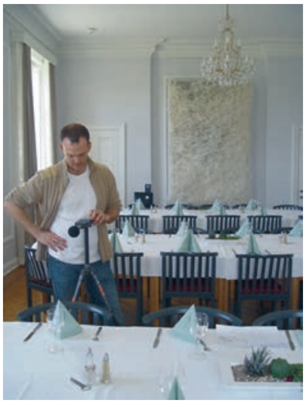
Acoustic Measurements: Methods and Settings

Description. Acoustic measurements were conducted in the Jonsered Manor dining room on April 13th. The acoustic engineer was Roger Fred, from the consultant company *Akustikforum AB*. Two different measurements were performed: measurements of reverberation time (T30) and speech transmission index (STI). These measurements were performed for three different cases in the dining room.[135] The first case was the room without the woven hanging and sculptures; the second case was the room with the woven hanging and without sculptures; and the third case was the room with the woven hanging and the sculptures. All measurements were accomplished in the same session on the same day.

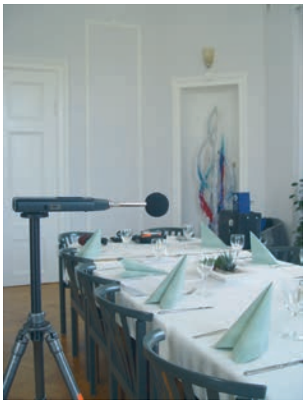
The method that was used for the measurements of reverberation time (T30) followed EN ISO 3382:2000. The method used for STI measurements was the

135 See Appendix nr. 6.

Speech Transmission Index-Public Address (STIPA). According to the acoustic engineer, it is a simplified method compared with the full STI method described in IEC 60268-16, but still giving fully sufficient information.[136] The sketch plan shows the source positions for STI measurements S1 and S2, source positions for T30 measurements S3 and S4, receiver positions (R1-R3), and the positions of the woven hanging (P1) and sculptures (P2 and P3).[137]



Picture nr. 39. Measurement.
Photo: Kaja Tooming



Picture nr. 40. Measurement.
Photo: Kaja Tooming

The characteristics of the dining room are as follows.[138] The height of the dining room is 3.8 m and the volume of the room is 210m^3. According to the acoustic engineer, the ceiling and walls are acoustically hard. Furthermore, each window in the room "was provided with two pairs of curtains, one light (less than 0.1 kg/m^2) and one heavy (more than 0.5 kg/m^2)." Three tables and a total of thirty-six chairs were in the room. There was some sound dampening material underneath the chair seats. The temperature was about 20°C and the relative humidity was about 50%. During the measurements only one person was present. The engineer's report provides a short description of the woven hanging and the sculptures as well as the pictures that are hanging in the room.

136 See Acoustic Measurements Report 3110-A/Roger Fred. Appendix nr. 6, p. 1.
137 See Report 3110-A/Roger Fred, in Appendix 6, p. 3.
138 All this following paragraph bases on Report 3110-A/Roger Fred, in Appendix 6, p. 1.

Analysis of Acoustic Tests

Acoustic absorption depends upon the absorption material's form, size and placement in the room. But it also depends on all of the other forms and materials that are present in the room. For example, the walls, ceiling and floor serve as reflecting surfaces, affected by their material. According to acoustic engineer Ove Brandt, "The greater the reflecting surfaces and the greater the room, the longer time it takes before the sound dies away. The time it takes after the disruption of the sound source until the mean sound pressure level has sunk 60 dB is called the r*everberation time*."[139] In SS025268, *reverberation time* means the highest value in the octave bands 250, 500, 1000, 2000 and 4000 Hz. According to Roger Fred, a reverberation time of 0.5 s is considered optimum, but the construction of new buildings aims for a reverberation time of 0.6 s, and rebuilt rooms aim for 0.8 s.[140] This is related to the function of the room – in this case mainly speeches and conversations in combination with sounds generated from situations of served meals. It may also be related to the historic and overall aesthetic character of the room. If the reverberation time is too short or too long, the sound is distorted or unsatisfactory.

Reverberation times generally vary for different frequencies. For speech, the acoustic engineers Hans G. Jonasson and Håkan Andersson suggest that the most interesting frequency range is between 630 Hz and 1250 Hz.[141] However, acoustic engineer, Roger Fred, suggests that the range from 100 Hz to 10000 Hz should be considered, because of the range of pitch among different speakers and the different circumstances of rooms.[142]

The measured reverberation time in all three test cases has varied from 1.20 s to 0.35 s.[143] The longest reverberation time (1.20 s) occurred in case one, the room without the woven hanging and the sculptures on frequency 400 Hz. The shortest reverberation time (0.35 s) was in case three, the room with both the woven hanging and the sculptures on frequency 10000 Hz. In all three cases the reverberation time has decreased from frequencies 100 Hz to 125 Hz quite rapidly, but after that it increased quickly from 125 Hz to 200 Hz. The longest reverberation time (1.09 s) appeared within the lower frequency range measured in case one (the room without the woven hanging and sculptures). The shortest reverberation time (1.04

139 Ove Brandt, *Akustisk planering*. 1958, p. 162.
140 In consultation with the acoustic engineer, Roger Fred, on April 20, 2007.
141 See discussion of acoustics in Chapter 7.
142 In consultation with the acoustic engineer, Roger Fred, on April 20, 2007.
143 See Appendix 6.

s) was in case two (the room with the woven hanging and without sculptures) and in case three (the room with the woven hanging and without sculptures). From 200 Hz, case one continued to increase up to 400 Hz, where it showed the longest reverberation time (1.20 s). Also, case two increased, but only up to 315 Hz with reverberation time (1.13 s) and began to decrease constantly after that. In case three, reverberation time increased up to 250 Hz and decreased after 315 Hz with 0.99 s, but increased again after 400 Hz to 1.06 s. In all three cases, the reverberation time began to decrease from 400 Hz constantly to 10000 Hz. Only between 2000 Hz and 2500 Hz it was the same (case two and three) or showed a very small increase (in case one).

The shortest reverberation time was in case three, the room with the woven hanging and without sculptures. From the 6300 Hz to 10000 Hz the differences between reverberation time in all three cases was very small or almost constant. According to SS025268 (see above), the reverberation time for the first case (the room without the woven hanging and sculptures) was 1.18 s. The reverberation time for the second case (the room with the woven hanging and without sculptures) was 1.12 s. The reverberation time for the third case (the room with the woven hanging and with sculptures) was 1.10 s. The table and figure (attachment page 4, in the report) also show a hypothetical result for a 3.6 m2 ideal absorber of 150 mm thickness. The reverberation time for the "ideal absorber" was 1.03 s.

The closest result to the ideal absorber was for the third case, the room with the woven hanging and without sculptures. It showed even better results between the frequencies of 315 Hz and 630 Hz. The reverberation time in the third case, and also in the second case, was very close to the result for the 3.6 m2 ideal absorber. The differences were very small. In the 100-10000 Hz range, the difference between case one and cases two and three was evident, indicating that the addition of the fibre art works made the most audible difference.

STI (Speech Transmission Index) measurement shows that the first case has a value of 0.62, the second case has a value of 0.63, and the third case has a value of 0.65. According to the acoustic engineer, a good result would be between 0.6 – 0.75.

Conclusions

Despite the small area covered by the fibre art works (approximately 3.6 m2), the measurements showed acoustic improvement in all frequency ranges. The improvement was rather small, and earlier it was suggested that additional dampening devices could be placed underneath chair seats or by placing a carpet on the floor. Still, the results showed that hand-tufted fibre has considerable potentials for acosutic improvement, based on the types of fibres selected and the technique of weaving.

Significantly, the weave used in the dining room followed closely the ideal sound absorption curve at all frequencies. This confirms the earlier testing of fibre materials that allowed me to select the best materials for use in the works.

As might be expected, the limiting factor was the amount of coverage or area of the works in proportion to the total surface area of the room. The initial proposal was for coverage of a larger area, with three alternatives – a larger wall area, a ceiling expanse, or a mobile screen. A typical desirable value for reverberation time (T30) in a dining room is 0.6 s. According to the acoustic engineer, in order to reach this value it would be necessary to add approximately 37 m2 of an ideal sound absorber.[144]

However, the option that was selected was adequate as a proof-of-concept for the use of hand-tufted fibre work.

144 In consultation with the acoustic engineer, Roger Fred, on April 20, 2007.

part iv

Principles and Conclusions

chapter 10

Reflections on Principles: Unity and Emotional Expression

> "Coleridge used the term 'esemplastic' to characterize the work of imagination in art. If I understand his use of the term, he meant by it to call attention to the welding together of all elements, no matter how diverse in ordinary experience, into a new and completely unified experience."
>
> – John Dewey, *Art as Experience*

Introduction

In the course of this research, through all of the stages of technical analysis and artistic synthesis, we have been guided by the central idea that *perception, meaning*, and *emotional expression* work together in creating the unity or wholeness of the products of design and the experience of the people who are supported by such products. While our strategy of inquiry required that we distinguish the parts or functional elements of fibre art and design – the manner or technique of production, the materials of fibre art, the form and synthesis of these materials, and the function or purpose of the works that we have created – we have made these distinctions so that we may better understand the contribution of each element to the final work of art and design. Indeed, the distinctions allowed us to investigate each element in great detail and with a degree of precision appropriate for the integration of the elements in creative synthesis. In the course of these investigations, however, we have also explored, directly or indirectly, the influence of perception, meaning, and emotional expression in each of these elements. It remains for us to reflect on the nature of the unity that the artist-as-designer creates, as well as the unity that people may experience when they encounter a work of fibre art and design.

For the artist-as-designer – and for the audience or users of a product – the unity and experience of the work arise in what we might call "stages." However, the unfolding of unity is actually an organic growth: an interpenetration of perceptual apprehension, progressive interpretation, and, fi ally, the emotional force of expression, often leading to what Santayana elegantly calls the "hushed reverberations" of association and memory. As an artist, I have felt this progressive organic movement in the course of creating the works that are the subject of this research. However, it has not been enough for me simply to feel the emergence of unity. I have also wanted to understand how it comes about and why unity is the distinguishing quality of some, if not all, works of art and design. For this reason, I have refl cted on the nature of perception, meaning, and emotional expression. Of course, the literature on each of these themes is vast and complex, so I have found it useful to focus my refl ctions on three different perspectives, each offering insight into the nature of unity.

The three perspectives are drawn from phenomenology, structuralism, and the philosophy of pragmatism. While strikingly different in many ways, they also offer a way to understand the progressive unity that is the principle lying behind my work. The method of discussion is to present each perspective in its own terms, offer a brief assessment of the perspective, and then identify the connective thread that links one perspective to another. The discussions are detailed and, at times, philosophical. But the goal is not philosophical critique. Rather, by discussing these perspectives in their own terms, a connective thread has been found that indicates the principle of organic, progressive unity in the experience of the works I have studied and created. The goal was a degree of depth that is relevant to understanding the principle of organic growth in creating fibre art and design. Equally important is therefore that this discussion reveals aspects that the artist and designer may always consider when creating their works.

The Unity of Perception: Maurice Merleau-Ponty

The fundamental starting point for phenomenology is that reality appears primarily to the intentional consciousness – that is, a consciousness directed toward something other than itself. Two key concepts – the *life-world* and the *lived body* – are signifi ant for the understanding of phenomenological reasoning and have a central part in phenomenological discussions. *Life-world*, from the perspective of phenomenology, constitutes a condition for empirical theories and scientific activity. For Merleau-Ponty, the *life-world* is the starting point for understanding the "concrete experienced reality," and it is signifi ant that the human body, which moves in the world, is taken into consideration from the start. The *life-world* is the world vividly apprehended in our perceptions and indivisibly joined to a perceiving subject. For Merleau-Ponty, the subject is chiefly its own lived body. The lived body is a subject-object – an irreducibly ambiguous existence – with a fundamental circularity between body and subject. The life-world's distinguishing feature is the circular, refl xive relationship that prevails between the world and the subject: the subject characterized by the world and the world characterized by the subject.

For Merleau-Ponty, *perception* is the essential starting point for understanding consciousness. It is historical and cultural as well as social, in the sense that what is perceived appears to us against the background of *former experiences* developed by the perceiving subject in the world. What happens in a concrete situation of perception is that a new concrete meaning, norm, or value arises in interplay with earlier experiences. Another concept is *being-in-the-world* and interaction with the world. Merleau-Ponty emphasizes the *lived body's being-in-the-world* as a mediate concept between "pure" consciousness and "pure" nature, and also between individual and collective structures. A lived room and a lived time arise through the *lived body* and its *being-in-the-world*, from the subject's interaction and its communication with the world.

The most important task is to examine the contents of experienced objects that vary from the one to the other, and consist of "meaning-components." It is important in every separate case to clarify what the components in question are and how they are constituted.

By this connection we can say that the meaning-components (with all individual properties and differences) of an experienced object's contents constitute the *material of form* – a concept that we discussed in chapter 2 with regard to Aristotle's distinction between the material of a work of art and the material of form. Finding these components is part of the unifying structure of an action. Interaction – the circular relation between the world and the subject – is a signifi ant link in the investigation of the individual properties and differences of experienced objects, which are examined by perception and clarifi d from outside of experience. Interaction is also a signifi ant link in communication – communication between the individual and the collective structures of the life-world. Through living together and interaction with other people in the world, the world is in a fundamental way *intersubjective*. The world is experienced as an intersubjective world, but the world is a social environment set in a concrete situation. Communication is connected to purpose or function in such an environment. It supports our efforts to understand reality as it appears to the consciousness.

However, it is important to consider the strengths and limitations of a phenomenological approach to experience. According to American philosopher Richard McKeon, "Taking its beginning from experience of the sciences and logic, the phenomenological method does not consist in deducing, in *erklären* (mere "explanation by theories"), but rather in *aufklären* (seeing things as they are)."[145] McKeon also points out about phenomenology in general that "the analytic method may follow an inferential or even a deductive model, or it may seek to avoid deduction and return at each point of analysis to direct experience of phenomena without abstract separation of language, thought, and thing."[146] From McKeon's point of view, in these forms of analysis "there is a tendency to refute or destroy the errors of other philosophers. Error is a mistaken synthesis, in judgement or method, and since there are many forms of analysis, many errors of analysis are detected by uncovering concealed syntheses." Finally, according to McKeon, "there are problems for philosophy of method as well as for the many controversies about method in these theories of method and in the uses of method in science and practice which accompany and refl ct them."[147]

The starting point and way of thinking in phenomenology is neither objective nor subjective; and this is a limitation of phenomenological method. However, despite the limitations of the phenomenological method, Merleau-Ponty's ideas are important for focusing our attention on the perceptual whole of experience. Experience begins in perception, and how consciousness and mind discover unity or wholeness in the environment of perception. This is important for the artist or designer who seeks to communicate with an audience or, indeed, contribute to the collective life of a community. Pure consciousness – not merely awareness – comes from grasping the unity of all of the desperate meaning-components of a situation. This constitutes the environment of perception as an object (or subject-object). Unfortunately, Merleau-Ponty gives few tools for analysing intersubjective communication. For this we must turn to others.

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145 *Selected Writings of Richard McKeon: Volume 1: Philosophy, Science, and Culture.* Ed. by Zahava K. McKeon and William G. Swenson. 1998, p. 181.

146 *Selected Writings of Richard McKeon: Volume 1: Philosophy, Science, and Culture*. 1998, p. 182.

147 *Selected Writings of Richard McKeon: Volume 1: Philosophy, Science, and Culture*. Ed. by Zahava K. McKeon and William G. Swenson. 1998, p. 182.

The Unity of Meaning: Roland Barthes

Contrary to Merleau-Ponty and phenomenological thinking, *structuralism* distinguishes between conscious and unconscious levels of the mind. Structuralism maintains that what is real or carried out is positioned elsewhere than in the "subjective" or conscious level of the experience of the subject. In this way, structuralism constitutes a reaction against "existentialism" (the philosophy of subject), or, more accurately, the phenomenological-dialectical tradition.[148] From the perspective of structuralism, as commonly understood, the subjective level is governed by unconscious working structures. "Structure" means the orderly relationship among the elements of a language, and over time "structural" came to mean this way of looking at things. However, Roland Barthes furthered the application of this structural way of seeing things by extending the idea beyond linguistics – for example, in ideologies and art. This is possible when these other areas display a linguistic structure, in which case they can be viewed as a *system of signs*, that is, as a *system of communication*.

Structural linguistics sees language as a system of inner differences or interdependencies between the elements of the language (a system of signs, according to Saussure). It highlights the character of differentiation of the signs of language; an isolated sign is nothing in itself, but is brought about through differentiation in relation to the other signs of the language. Language thus constitutes a coherent whole. Structuralism examines the interrelations of the parts, which contrasts against seeing language merely as an assembly of independent parts.

Barthes is of the opinion that structuralism is able to provide a broader description embracing more levels than the refl xive level of language. He presumes that there are artists for whom a certain structure – when put into practice – presents a particular experience. When writing of coherent parts (signs) forming a whole, Barthes states that the goal (purpose) of every sort of structuralizing activity, refl xive as well as poetic, is to reconstruct a certain "object." Through the result of reconstruction one can discover rules for the function of the object. Structure is in fact the actual imitation of the object, but not an imitation without concrete direction or goal, for the imitation materializes that which had been invisible or *unintelligible* in the imitated object. The structuralizing person *takes the real, tears it in pieces and compiles it again*. This precise process has a decisive signifi ance, since

148 See for example *Filosofilexikonet* 1997, p, 528–529; *Semiotics: An Introductory Anthology*, ed. by Robert E. Innis, 1985.

between these two objects – the two stages of the structuralizing activity – something new arises.[149] The temporary tearing, subordinate to the imitation, involves fi d-ing mobile parts whose particular placement creates a concrete meaning. Such a fragment has in itself no meaning. However, just a small change in placement may bring about a change in the whole meaning.[150]

It is not a question of the character of the imitated object, but what a human being adds in putting together a new object. According to Barthes, art and all creative activity is a *technique*. What distinguishes structuralism from other analyses is that its goal is inseparably bound to a certain technique: an object is put together in order to make its functions visible. The "way" or technique of structuralizing transforms the work of "putting together" into a work of art.

The imitation, built up by the technique of structuralizing, does not uniformly conformed with the model that was its original source in the world. This is what gives structuralism its importance. First, imitation brings forth not reality or rationality but the object's *functionality*. Thus, imitation unifi s the object with the complexity of experience and knowledge. Even more important, it brings forth the process that human beings employ in creating the meaning of objects. The "object" of structuralism is not a human being who carries meaning, but a human being who creates meaning.

The focus of Barthes' structuralism is how human beings make meaning in the world. His method is analytic. That is, he analyses signs, the relations of signs, and then the system of relations in language and art works. This analytic approach is useful in the current research because it directs attention to the way an artist or designer places elements within a whole in order to create meaning. In particular, the observation that no part, in itself and alone, has meaning is useful for the artist or designer. It indicates that meaning comes from differentiation and relationships with other parts.

However, it is appropriate to consider the limitations of the structuralist approach. In contrast to the goal of phenomenological analysis, which is to grasp the *perceptual whole* of experience as consciousness, the goal of structural analysis is to grasp the *meaningful whole* in experience. Indeed, for Barthes, to create meaning is more important than the meaning itself, since the function of the structuralist approach is to broaden the work of art. While this is important, we may wonder

149 Barthes 2002, p. 21–22.
150 Barthes 2002, p. 23–24.

if experience is more than either perception or meaning. Is there a wholeness of experience that goes beyond perception and the discovery or creation of meaning? To put this another way, are there purposes and qualities in human experience that involve perception and meaning yet involve us in the world in different ways, in ways that are both emotional and fulfilling for human beings? Is there a unity or wholeness of experience within which unities of perception and meaning are only parts? To pursue this question we must turn in another direction.

The Unity of Emotional Expression: John Dewey

John Dewey does not begin with the problem of intentional consciousness or the problem of how we make meaning in our lives. Rather, he begins with the human being in a complex, indeterminate environment, facing problems that are obstacles to his continued existence. Experience takes shape and form out of the struggle to resolve those problems. The problems are fundamentally practical – they are problems of practical action or, as he calls them, problems of doing. But Dewey recognizes that out of the struggles of practical life can come both intellectual as well as artistic or aesthetic activities – activities of thinking and making that are different from overt acting or doing. The distinguishing feature of art and aesthetics, for Dewey, is its focus on emotion. All experiences have aesthetic and emotional qualities, but the work of art, explicitly focused on creating an aesthetic experience, lifts the factors that shape and determine an experience above the threshold of perception, giving unity through an emotional quality that permeates the entire work of art. And "work," for Dewey, is not the physical art object. Work is the activity of making and remaking the experience that is made possible by the physical object.

The aesthetic "is the clarifi d and intensifi d development of traits belong to every normally complete experience."[151] Dewey takes this to be the only secure basis upon which aesthetic theory can be built. The word *aesthetic* refers to experience as appreciative, perceiving, and enjoying. It denotes the consumer's rather than the producer's standpoint, which instead is denoted by the word *artistic*, referring primarily to the act of production. He observes that, since the two words "artistic" and "aesthetic" refer to different processes, there is unfortunately an absence of a term designating the two processes taken together. An object yields an aesthetic

151 Dewey, p. 57.

experience when the determining factors of an experience "are lifted high above the threshold of perception and are made manifest for their own sake."[152]

Conclusion

Merleau-Ponty seeks, in a concrete situation of perception in interplay with earlier experiences, a new meaning or value (to understand the experienced object's contents with the meaning-components); the form, for him, is set by interaction between the subject and the world. For Dewey, perception does not complete the experience; it is only the fi st dimension, where the observer or consumer or audience gains access to the work of art in order to *begin* an experience. Barthes seeks an orderly relationship among the elements or parts, which by structuralizing activity creates a meaning. Dewey, like Barthes, emphasizes that the relationship gives meaning to the experience, and to grasp the relationship is the objective of all intelligence. But for Dewey, meaning is only part of a broader context, and it does not complete the entire experience; it occupies the position of a part in the whole. For Dewey, art in acting is qualifi d by *aesthetic form*.[153]

Phenomenology emphasizes the individual object itself, and trying to fi d by perception the experienced object's contents with individual properties and differences. Structuralism, contrary to phenomenology, underscores interrelations of the parts; an isolated sign (an object) is nothing in itself, but is brought about through differentiation in relation to the other signs of the unifi d whole (language). Structuralism does not seek the content of the object, but orderly relationship among its elements.

Merleau-Ponty and Barthes both stress methods of *analysis*. For Merleau-Ponty, the method is the analyses of perception, and the elements of perception are combined or synthesized in the structure of consciousness as an interaction of a subject-object's communication in the life-world. For Barthes, the method is the analysis of structuralizing activity, and the elements of this activity are combined or synthesized in the reconstruction of a meaningful object. In contrast to Merleau-Ponty and Barthes, Dewey emphasizes synthesis, but fi ds an important place for an analysis.

From a theoretical perspective, it appears that the concept of unity or wholeness is progressively deepened from Merleau-Ponty's concern for a *perceptual whole*

152 Dewey, p 57.
153 Dewey, p. 79–80.

(gestalt), to Barthes' concern for a *meaningful whole* in the arrangement of signs, to Dewey's concern for an *experienced whole* that integrates perception and meaning through the interaction of thought, practical action, and emotional or aesthetic quality.

In each case, the unity or wholeness – of perception, meaning, or experience – is not a mere formal condition – a concern for form for its own sake. Instead, unity or wholeness is a *necessary intelligibility of emotional expression* arising from form and purpose as they work together and integrate the materials and the manner of human action. As intelligibility deepens or expands in the "stages" of organic progression in art and design, it fi ds its emotional ground in wonder – the surprise or astonishment that comes when both the artist and the audience fi st recognize the compelling correctness of the artist's decisions in creating the work.[154] This does not preclude spontaneity or even chance in the creative act – as, for example, in the two sculptures that are part of the ensemble of works for the dining room of the Jonsered Manor. It only means that spontaneity and chance are guided by the artist's informed sensibility of the correctness of decisions reached in creating a work.

The issue of *necessary intelligibility* brings us to the edge of a deep philosophical problem that I am not prepared to resolve in the present work. I can only point toward the paradox of chance and necessity in so much of twentieth century art. Spontaneity and chance are highly valued aspects of art in the work of many artists. Yet, not all examples of spontaneity and chance are equally valued. It appears that some examples are regarded as trivial and boring while other examples rise above others as artistic expressions. That is, they are *necessarily* different, displaying a necessity in the unity of form that absorbs spontaneity and chance – for example, in "found art" – for a further quality that engages the human mind and leads it to grasp a profound and compelling necessity of emotional expression in the work. Clearly, there must be some further factor that explains the signifi ance of the latter works. The nature of this factor is a central problem for philosophical inquiry in aesthetics, and this is beyond the scope of my current investigation of the poetics of fibre art and design. However, to the degree that such a quality

154 See R. Buchanan, "Anxiety, Wonder and Astonishment: The Communion of Art and Design." In *Proceedings of Enhancing Curricula: contributing to the future, meeting the challenges of the 21st century in the disciplines of art, design and communication*, the third international conference of the Centre for Learning and Teaching in Art and Design (London. 2006).

involves the nature of necessity, it seems remarkably relevant to the type of poetic inquiry in which we have been engaged. Poetic method is about artistic logic. Not the philosophic and scientific logic of propositions and syllogisms, but the artistic logic of decisions made toward creating compelling works of art.[155]

155 See Stephen Halliway's discussion of "Craft, Nature and Unity in Art," in *Aristotle's Poetics*.

chapter 11

Conclusion and Epilogue

This inquiry began with a problem of aesthetics. The central question was whether fibre art and design could serve a practical utilitarian purpose in enhancing the quality of sound in interior spaces as well as an aesthetic purpose in adding beauty to an environment. The answer is that it can, under certain qualified conditions.

Finding the nature of those qualifications is more than a matter of artistic intuition and sensibility. The artist's intuition and the engineer's common sense tell us that the fibre materials make a difference. They also tell us that the total area of a work of fibre art must have some proportionality to the total surface area of the environmental space. Beyond this, we know little more, unless we have specific knowledge. Gaining this knowledge, and understanding how it bears on the practical and artistic matter of creation, is the problem of inquiry.

Our inquiry pursued two closely related lines of investigation. In the first line, it was necessary to investigate the acoustic and aesthetic properties of a variety of fibre materials. Some of these materials are unfamiliar. They are unusual combinations of paper yarn with raw silk, rayon with 100% picot and polyurethane sizing, ramie with viscose sizing, and so forth. These come from Japan. Other materials are more familiar in Nordic countries. In all cases, the materials were subjected to careful acoustic testing based on recognized methods of measurement of sound absorption and speech transmission. However, it was not enough simply to test the fibre materials. The materials had to be formed in such a way that they could be tested – and, hence, the testing was a study of the technique of handling the materials as well as the materials themselves.

The technique employed in this research is called hand tufting. This is an emerging technique whose history and characteristics are not well addressed in the literature. For this reason, I had to investigate the background of the technique, the development of the machines used in modern practice, and the expanding use of the technique in many products and in many cultures around the world. Hand tufting is a powerful technique of modern weaving, when it is used appropriately and with imagination.

The technique of hand tufting opens into the second line of investigation: the artistic and design use of the technique in creating forms that possess some measure of beauty and charm. In formal theory and design methodology this is called "synthesis," but this is a dry, academic term for the struggle of the artist and designer who seeks to bring together all of the functional elements of his or her craft, art, or discipline. How do we study the informed intuition and inventiveness of the artist and designer? This is a critical question because it is not enough to understand the acoustic and aesthetic properties of materials. The materials must be formed, and formed by an idea that is progressively realized in the work of art and design.

This led to a search for deeper understanding of the strategy employed in the research, the strategy of "poetics" or "productive science." This strategy contrasts sharply with "design science," which seeks explanation in the underlying materials of the world and in the mechanisms of the mind by which decisions are made in art and design. Instead of a study of the physics of the materials or a psychological study of the fibre artist or a consumer study of fibre art and its reception by an audience, I turned to the functional elements of art and design – the elements that are necessary for the existence of a work. In the tradition and contemporary use of this strategy, I explored the *manner of production*, the *materials employed by the artist and designer*, the *qualities of form in the created work*, and the *purpose or function to be fulfilled by the work*. I assumed, in accordance with the assumptions of this strategy, that artistic and design creation is the integration of these functional elements by whatever means or methods are suitable to the individual artist or designer.

The strategy began with analysis of the manner of production – hand tufting – and the fibre materials – various kinds of fibres and threads. It continued with an exploration of form and function, testing through artistic creation the combinations of manner and material that may be suited to the fi al product. In the course of work, small samples were developed and then tested in an exhibition in Estonia. From this, I proceeded to the Jonsered Manor, where the environment was investigated through perception, observation, interpretation, and refl ction on what factors should influence the fi al creation of forms suited to the history and traditions of the building and its contemporary use.

Productive science may seem like an academic enterprise in itself, but has an affinity with so-called "practice-based research." More important, it suggests the artistic logic of someone who studies a situation, refl cts on all of the factors that bear on creation, carries out the work of realizing an idea in concrete form and materials, and then refl cts on the total experience in order to gain deeper understanding of an art. Intuition is informed with the results of analysis – just as this work has been informed with the initial technical studies and then with a careful consideration of the environment of the Jonsered Manor.

What we have learned from this strategy of inquiry and its organization of the methods and techniques of research is at times surprising and at times a confi mation of initial ideas. For example, we learned that some of the fibre threads that were tested are nearly ideal in sound absorption, as determined by acoustic science. This was a surprise not only for my own part but also for the acoustic engineer who performed the tests. We also learned the specific absorption properties of all of the materials that were tested. These results are reported in Chapter 7. In addition, the weaving technique of hand tufting appeared to contribute to the quality of sound absorption because of the intertwining of fibre threads and the use of unglued or glued backing.

The *Backside* exhibition demonstrated that audiences, at least in Estonia, found the colour and forms of the fibre models that were displayed to be warm, inviting, and intimate, surprising, natural, and almost sacred. In fact, many viewers were surprised at the combination of aesthetic and practical purpose. How much can one generalize from this sample of reactions? At least, we were encouraged that this is a reasonable direction for further artistic and design exploration. Certainly, it was obvious from the making of the samples that further experimentation with the technique is warranted. The Backside exhibition also generated more knowledge on how to use the technique of hand tufting, and to use it in unusual and innovative ways.

The creation of the ensemble of fibre art works for the Jonsered Manor gave more, complex insight, for example, that fibre art and the hand-tuft technique could be used to create sculptural forms. There are other examples of fibre art sculpture, but none that we know about that are formed with the double-weave hand-tuft technique. This is something new and innovative in the fi ld of fibre art that deserves further exploration. We also learned – and this is a personal learning related to professional development as a fibre artist and designer – that it is possible to create fibre art works deliberately within a specific environment, and that a working method which grows out of analysis and research can achieve a degree of alignment with the traditions and history of that environment. Whether others fi d value and beauty in the ensemble of works for the Jonsered Manor is a matter for time to tell. No strategy of inquiry or method of research can predict the fi al quality that an artist or designer can bring to a work. At best, we hope to explain the factors that bear on the problem and gain insights that can better inform creative intuition.

The matter of acoustics is more precise. Acoustic testing at the Jonsered Manor yielded several important fi dings. The fi st fi ding is that the choice of fibre materials and the form of their presentation resulted in an absorption pattern that closely approximated a so-called ideal absorber, as understood within acoustic engineering. That result was expected, based on earlier testing and analysis. What testing at the Jonsered Manor further revealed was that the total surface area of the works of fibre art was not large enough to considerably reduce reverberation time in a vast, hard-surfaced space like the dining room of the manor. That is, further use of fibre art would be needed to effect a major change in enhancing the quality of sound in the room. This was not unexpected. Indeed, our initial proposal suggested three alternatives, each of which would have increased the surface area of the fibre art works. An appropriate proposal was selected for a variety of reasons. Nonetheless, the test provided a proof-of-concept that is encouraging for further exploration.

Of special interest for further work is the idea of mobile fibre art screens. Properly designed and fabricated screens of fibre art could easily support the idea of a "reconfigu able" room or even an office space. The dining room of the Jonsered Manor is a grand room, with high ceilings and many hard-surfaced tables. Sound control in this space is certainly a challenge. In other rooms and kinds of work or social areas, fibre art works – for example, screens – could function effectively. However, one thing that has been learned is that fibre art and design, used most effectively, should be site specifi . It should grow out of the unique features of each situation and environment as much as possible.

Epilogue

The last step in the strategy of poetic inquiry or productive science is a reflection on the nature of unity and emotional expression. It speaks to the question "what is the significance of this work and how does it advance understanding and practice."

In one sense, the signifi ance of this work is quite practical. It contributes to the body of knowledge that may be useful for architects, designers, and design researchers as they pursue the practical problem of enhancing the quality of sound in interior spaces. We have discussed the nature and value of the double-weave hand-tuft technique, the specific acoustic properties of a variety of fibre materials, and how the exploration of form and function may contribute to enhancing the experience of interior spaces. These matters are certainly an aspect of the unity that we have sought in understanding how fibre art becomes an art of design. Unity is found in an integrative discipline of thought and action, informed with appropriate and relevant technical knowledge.

However, we may consider the signifi ance of this work in another sense, as it contributes to the theoretical foundations of the study of design and the place of fibre art and design within the broader domain of the design arts and sciences. This contribution takes two forms. The fi st form of theoretical contribution is the demonstration of the strategy of productive science or poetics as a strategy of design inquiry. Although, as Richard Buchanan has argued, this strategy has emerged from time to time throughout the twentieth century, the present work shows its application to a new area of design thinking in exploring the aesthetic and acoustic qualities of fibre art and design.[156] While the strategy is perhaps unfamiliar in its name and in its formal rigor, it is a strategy that is quite familiar in the common sense of the practicing designer and artist. And, of course, it is familiar to some design researchers, although not necessarily by the name of productive science or poetics. The central feature of the strategy is the identifi ation of the essential *functional elements* of design, the exploration of those elements in an appropriate degree of precision, and the integration of those *functional elements* in design and artistic practice. By elaborating this strategy and developing an inquiry around its concepts and methods, we have contributed to further use of the strategy in other inquiries.

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156 Richard Buchanan, "Strategies of Design Research: Productive Science and Rhetorical Inquiry." Unpublished manuscript, forthcoming in 2008.

The second form of theoretical contribution concerns the nature of unity and emotional expression. If the first contribution lies in the area of strategy and method, the second contribution lies in the area of principles. We have *sought* principles in the unity of the perceptual whole, the unity of the meaningful whole, and the unity of the wholeness of experience. In the course of our search, we have discussed the ideas of Maurice Merleau-Ponty, Roland Barthes, and John Dewey – leading figures of phenomenology, structuralism, and pragmatism. By combining these in succession, we believe to have *found* principles in the progression of unities that lead to emotional expression. This has yielded the paradox of necessity in fibre art and design – the *necessary intelligibility of emotional expression* arising from the intimate connections of form and purpose as they work together to integrate materials and the manner of human action. This is the basis of the compelling correctness of the artist's decisions in creating a work of art and design. It is the criterion that we sought for artists and designers through our reflections on principles and unity.

What distinguishes design from fine art is the practical, functional purpose of design work. However, design cannot ignore emotional expression without losing human significance and sinking to the level of mere commercial and narrow utilitarian interests. Commercial and utilitarian success depends, in a deep sense, on the quality of emotional expression that unifies a work or a product, touching the experience of those who view the work and use the product. That such emotional expression is too often lacking in the commercial world only points to how valuable it is in developing effective products.

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Appendix

Appendix 1

Paper: Kaja Tooming, "The Creative Process in Practice-based Design Research."
International Design Research Society (DRS) conference *Futureground*, 2004. Melbourne, Australia.

Kaja Tooming

The creative process in practice based design research

Introduction

Design research, especially practice based design research is a relatively new field. One of the most important inquiries in this area is how practical experiments can promote and develop theoretical enquiry – could the artistic or design experiment function as a legitimate "context of discovery" within research? Opposite to natural or social sciences, design research inquires into the artefactual reality, and thus has the unique opportunity to produce its own empirical objects.

This paper discusses how the production of empirical objects in an on-going research project may contribute to the development of concepts and understanding of aesthetic qualities. The aim is to illuminate the possibility of experimental production in my own research. In this case new compositions and combinations of textile material with hand tuft technique provide empirical situations in which specific qualities of the material, both "in itself" and as part of interior architectural design, are studied.[1]

Hand tuft technique is a modern weave technique and, as yet, an unresearched field. Until now, no one has studied the various possibilities the technique offers for creating artefacts with high technical quality and rich aesthetical potential that simultaneously solve acoustic spatial problems. In this research project both aesthetic and acoustic qualities in interior spatial design are considered. Sound-absorption is an important aspect of the architectural experience, especially in public premises. The preliminary results (from acoustic testing) show that through the agency of hand tuft technique one can reach almost ideal results in sound-absorption.

The results from this study may be applied in industrial production of textile and acoustic materials, but do also contribute with *new concepts* intended to deepen our more general understanding of the function of textile materials in modern interior architecture.

On a meta-level it is also intended to exemplify how creative production of empirical objects may contribute to the development of more precise concepts for describing and understanding aesthetic qualities.

[1] ***Hand-tuft technique,*** in Swedish "handtuftteknik", is a direct adoption from German**.** It is a modern weaving technique, in which thread is shot into a vertical suspended bottom weave by means of a hand-steered machine driven by air pressure. Author's definition. *Thread* – designates here a thinner or thicker prolongated material consisting of one or more fibres, regardless if it is spun, twined or produced in any other way. *Fibre* – a thread formed element regardless its origin, which alone or in a bundle (composition) constitutes a thread.

Methods and theory

This research project is practice based, which means that the empirical material is produced in the process of research.[2] The choice of which combinations to be produced in the first material samples is founded partly on (personal) experience-based knowledge of what could be aesthetically interesting, and partly on a strategy of providing a group of samples; both elements are representative of possible variations and provide good possibilities for comparison. The practical identification of differences in the samples' properties is decisive for which samples to be tested acoustically.

As in the production of the material samples, the creative (gestalt) process of the interior spatial design will be based on both an artistic drive for aesthetic qualities and a strategy for producing examples that represent possible variations and offer good opportunities for comparison. In this process the hand tufted material will be included in a whole, which simultaneously brings forth the material's significance and makes it accessible for analysis.

The central practical question in this project is: ***Which properties of significance for the interior spatial design,*** *including acoustic properties*, ***could the hand tufted artefacts carry?***

Samples of the hand tufted material is "in itself" described from a phenomenological perspective. For the description and analysis of the hand tufted material's significance in interior spatial design (in the later phase of work), I will partly make use of concepts from architectural theory, phenomenological description and semiotic analysis.

I choose to investigate, in terms of textile, the acoustic materials' dimensions of signification by trying to identify which kinds of meanings could be associated with different objects/artefacts. This will be done through using both *phenomenological* and *semantic* methods, the latter for detecting differences in associated meanings. I will also use the structuralist theory of Barthes in order to elucidate design as a construction of an imagined world - man is the decisive link in the interaction.

The project is divided into two phases. In the first phase the hand tuft samples are in focus. These are observed through a descriptive phenomenological description and from among these a selection is made for acoustic measurements carried out by means of the *pipe* method. [3] In the second phase, the hand tufted material will be placed in a spatial context.

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[2] All the research material is produced by myself. My artistic experience and technical knowledge in the area underlies the practical implementation. This means that I can consciously control the process and discern the possibilities and limitations that are present in hand tuft technique. I have twelve years of experience as a practicing artist in the discipline of hand tuft technique.

[3] The *sound absorbing* aspect is investigated with methods of measurement used in acoustics, namely the *room method* and the *pipe method*. The *pipe method* is mostly used for various comparisons. H. Jonasson, *Ingenjörsakustik.* SP Swedish National Testing and Research Institute, Printout 2002-02-30, p. 12.

First phase investigation into the properties of the hand tuft technique material

Observations of the aesthetic qualities of the material

I have tried to describe the material as clearly and richly as possible, in the manner of descriptive phenomenology to get close to "the thing itself". [4] The starting point has been to see the phenomena from as many diverse angles as possible. In "pure" descriptions without interpretations I have focused upon the character, colour, form, light and shadows, and even similitudes of the material. The empirical interpretations lay the foundation for and deepen the understanding for the material's "essence".

The diameter of the selected samples is 10 cm. The surface creates a total width that varies: the length and the behaviour of the threads create the dimension of the surface. The following designations of the material depend on the length of the thread and if the bottom weave is either glued or unglued: long-threaded (L), unglued long-threaded (OL), short-threaded (K), unglued short-threaded double-sided (OKD), unglued long-threaded double-sided (OLD).[5] I have chosen material samples whose thread materials have various sorts of character and properties, like wool, linen, cotton, paper thread, ramie and silk.[6]

I will here account for an observation of the hand tufted cotton thread material. The cotton material has a soft character, is very plastic and light dampening - the light creating almost invisible "flattened" shadows making the material look like a stuffed animal toy or soft moss. They are important properties when experiencing the material from an aesthetic view. The empirical interpretation leads to a comprehension of the material becoming very plastic as the threads grow longer, due to the softness of the thread; the fibres are easily bendable and the height of the surface becomes wholly or partly compressed. Unlike moss it does not rise itself again. This gives the character of a "dependent" thread, which cannot stand upright without help from the "neighbours" – the other threads. The pallid white colour gives a "sterile" impression and the material is experienced colder than the impression from the fibre alone. The strong contrast between soft (the soft surface) and the bleached white cold colour tone can be the reason for the specific experience of the material, that is, that the material is experienced as both refreshing and warming. That can also explain why the material has the (perhaps contradictory) character of cozy exclusivity.

Length, thickness, and structure of the fibre and thread, even thread density has significance for the material's character and thus even for the experience of the material. Colour can amplify or dampen the experience of the fibre material's physical properties. Light is an additional fact that strongly influences the experience of the material and helps mediate the character of the material/fibre, accomplishing a tranquil or dramatic experience of the material. Both light and colour affects the experience depending on the properties of the fibre material, that is, the thread's fibre

[4] Deeper observations were carried out on 18 material samples. These samples were later on tested acoustically.
[5] I have used identical terms in the sound absorption tests. See figure 1, 2, 3, 4 and 5.
[6] More precisely: wild raw silk; silk 100%, viscose sizing bleach; ramie 100%, knitted tape; ramie 100%, viscose sizing, unbleached; rayon 100% picot poly-urethane sizing; paper yarn + raw silk; paper yarn viscose-sizing, white.

configuration. All these properties influence the aesthetical experience of the material.

Conclusions from observations are of great value for the selection of working samples to be tested acoustically.

Acoustic qualities – discussion of the acoustic measurement results

The starting point has been to select and test material samples that are comparable and provide broad possibilities of variation with a wide spectrum of diverse expressions. Data designates the results of the sound absorption tests on selected material samples. The tests were carried out at *SP Swedish National Testing and Research Institute*.[7]

Sound absorption tests
Variables (properties of the sound absorbing material)
- *values of the variables*: the sound absorption factor
- *physical variables* (properties): the material's denseness, thickness (or height), the fibres' and/or the yarn threads' interrelationship; the structure of the surface and the structure of the fibre.

The following *question* has been guiding:

- The threads stand densely side-by-side in all the hand tufted samples. Does the *structure of the thread* in these cases affect the absorption factor significantly?
- Is the distance between threads' a factor that affects the absorption factor significantly?
- Does the treatment of the bottom weave affect the absorption factor?

These questions decided which samples were to be tested acoustically, taking into account the aesthetic qualities. I chose to test the samples in two different ways: placed directly against the wall and placed 5 cm from the wall, in order to discover if the gap of air between the object and the wall would be of significance. In order to answer the question of how significant the thickness (height) of the material may be, I chose to test the material at two different heights. The tests have also been made with identical material, but differently treated (glued or unglued) bottom weaves.

No one could foresee, before the measurements were performed at SP, that among the tested material several samples would reach or come very close to the most ideal level.[8] It implies that my inquiry, that the hand tufted material can have very good sound absorption properties, had been confirmed. The main principle that the threads stand densely side by side in all the hand tufted samples may be important. The

[7] Rapport from SP, Swedish National Testing and Research Institute 2003-06-17, Reference P302599. Test runs were carried out 2003-06-12 and 2003-06-16.
[8] See and compare figure 2 and 3. Rapport from SP, Swedish National Testing and Research Institute 2003-06-17. The frequency interval between 600 and 1250 is the most interesting in commonplace room situations. The level measured, the absorption factor, is defined as the ratio of absorbed sound to incident sound. Jonasson, Hans, *Ingenjörsakustik*, 2002-01-30, p. 12.

physical properties – the height and density – belong to the hand-tufted material's characteristics.

One very interesting fact is that materials with unglued bottom weave generally was shown to have a higher absorption factor than those with glued bottom weave in the frequency interval of 500-1250. (Logically, it should be the other way around: a higher sound absorption factor should follow from a denser surface).[9] This supports the idea that not only thickness and density of the material have impact on the sound absorption, but also the fibre structure of the thread and the threads' interrelationship have decisive significance upon the sound absorption.

Treatment (in this case the gluing of the bottom weave) of the material affects the absorption factor, but ends up as an insignificant result compared with the untreated material.

Generally, one can state that tests performed against a wall, with unglued bottom weaves and a thread length of 18 mm, gave very low absorption factors, which did not grow considerably with higher frequencies; while some unglued material samples with 40 mm showed a very high absorption factor at very high frequencies.[10]

Thread structures that are airy, uneven in its surface structure, shaped by shorter fibres, and which give the impression of constituting a "softer" material, have shown to possess the best sound absorption properties; while threads that have a shiny and even surface have poorer sound absorption properties.

Conclusions from acoustic testing of selected samples:

- The *structure of the thread* affects the absorption. Threads twined together with short, uneven fibres return higher absorption results than threads glued together or having an even fibre structure.
- Treatment of the bottom weave affects the absorption factor. The absorption factor of materials, with an otherwise lower absorption factor when unglued, is increased after treatment. Conversely, the absorption factor of materials, with an otherwise higher absorption factor when glued, is decreased after treatment.
- Thickness (height) of the material has great significance for the absorption factor. A longer length of the thread means a greater height of the material. This yields a greater thickness of the material, which ultimately results in a higher absorption factor.

Conclusions from phase *one*

This research project serves as an example of how the creative work, in practical experiments may serve theory generation, and in a fruitful way lead to new knowledge.

Embedded in the preliminary results is, on the one hand, the cognisance of the hand tufted material's character and the importance of the aesthetic qualities, and on the

[9] Compare figure 2 and 3. Figure 2 includes the unglued bottom weave and figure 3 the glued.
[10] See figure 4 and 5.

other hand, the importance of sound absorption and the properties the material must have for attaining the best absorption factor. The acoustic qualities have been tested through the provision of sound absorption tests, while the knowledge of the hand tufted material's character so far has been attained through phenomenological observation.

The results from the phenomenological description of aesthetic qualities and the sound absorption tests covering the acoustic qualities is knowledge that make up a base for further work in phase two of this project (the gestalt process in the room with consideration to the aesthetic and acoustic qualities).

Future work

I intend to use *case study* methodology as a starting point for my investigations in the next phase of this project. I will proceed from the Swedish research architect Rolf Johansson's view of case study namely that “the case study is distinguished by a manner of approach which aims to both explain and understand a case in its context, including as many relevant variables and properties as possible”, because it is not initially clear which features of the context that will make understanding of the case possible.[11] This is the *explicative approach* aiming to attack a new problem without any variable restriction, in order to extract that of significance (for example a selection of the hand tufted module elements, taking consideration to both the aesthetic and acoustic qualities).

In this *explicative* approach the *deductive* case study methodology, characterised by a case with the conception of one or more hypotheses of the principles that are at work in the case, fits well with my second phase of work.[12] The hypotheses lead the investigation further and indicate which facts that can be of importance. The facts will be diversified through triangulation, and through the use of several methods of gathering data – both quantitative and qualitative.[13]

In the *second* phase the hand tuft material will be placed in spatial contexts, where the products' qualitative (aesthetic) import for interior spatial design will be described and analyzed. Here the ambition is to design and use hand-tufted material in interior spatial design, which are both visually expressive and, at the same time, are forming practical and aesthetically auditive (audible) qualities. A partial goal at this point is to develop easily mountable hand tufted module elements, which give ample possibilities of variation and are useful in both public spaces and private

[11] The author’s own translation. According to Johansson, Yin's view is too narrow and Stake's view is too broad. Johansson, Rolf, Ett explikativt angreppssätt – fallstudiemetodikens utveckling, logiska grund och betydelse i arkitekurforskningen.// Nordisk arkitekturforskning 2002:2, p. 19-20 and 26. See even R. K. Yin, *Case Study Research. Design and Methods*. 2nd ed. London 1994 and Robert Stake, *The Art of Case Study Research*, California 1995.
[12] The deductive method is, according to Johansson, best described by Yin. Ibid., p. 23.
[13] According to Johansson, many other books on case study methodology, for example Glaser & Strauss, Patton, Strauss & Gorbin, Stake, Gillham, Flyvbjerg, have lately been published and they all call for studying cases combining qualitative and quantitative methodologies. Johansson, 2002:2 p. 22. Robert Yin combines, for example, quasi-experimental analysis methods and experimental research design with qualitative investigations. See R. K. Yin, *Case study Research. Design and Methods*, London, 1994.

environments. For this reason I attach great importance on trying out, in real spatial environments, the knowledge (collected data, performed tests, evaluations, and even critical analyses) I have distilled through practical experiments on material samples and through acoustic tests.

Aspects I must take into consideration
Interaction in the room on two levels:

- *How artefacts in the room are related to each other* (interaction between signs; the meaning and interrelation of signs). How does total experience of the room arise when the colour setting, the form setting, the object's/element's pacing in the room, the object's relation to each other and so forth are constituents of the whole.
- *man's/people's relation to artefacts* (where artefacts are stabile, static elements in the room, while people are those in movement).

Reflect upon Barthes' scheme of natural components, an adaptation of Saussure's concepts: the signifier, the signified and the sign![14] The art work/object is in this case the sign. Possibly one can say that the aesthetic qualities are the signified and the acoustic qualities are the signifiers. Barthes has written about coherent parts (signs) forming a whole, namely, that all sorts of structuralizing goals of activity, reflexive as well as poetic, is to reconstruct a certain "object". Through the result of reconstruction one can discover rules for the objects' functions. Structure is in fact the object's actual imitation, but an imitation with concrete direction and goal, because the imitation materializes that which had been invisible or unintelligible in the imitated object. The structuralizing person *takes the real, tears it in pieces and compiles it again.* This precise process has a decisive significance, since *between these two objects – the structuralizing activity's two stages – something new arises.* [15] The temporary tearing, subordinate to the imitation, involves finding mobile parts, or units, whose peculiar placing creates a concrete meaning. Such a fragment has in itself no meaning, but just a small change in placing may bring about a change in the whole.[16]

The hand-tufted module elements in interior spatial design can be seen as such spatial mobile parts (and according to Barthes' even *immediate units*), which through replacement continually creates new situations with a number of indefinite possible variations of experience of the room as a whole, where the aesthetical and acoustic qualities are included. It is not only through the replacing of these immediate units something new is created, but even through the new configurations within units, in this case the hand-tufted module elements, something new is created continually.

[14] R. Barthes, *Mytologier*, 1970 p. 207-214.
[15] *Roland Barthes: Autori surm: valik kirjandusteoreetilisi esseid.* Red. Kajar Pruuli. 2002 p. 21-22.
[16] Ibid., p. 23-24.

Final discussion

One of the most important points of this research is that the studied material can be produced within possibilities for the research process. This implies rich advancement of new scientific knowledge based on the professional knowledge by experience.

My research project with hand tufted module elements is an occasion for studying the role of the creative production in the development of knowledge. The symbiosis of creative artistic thought and experience in the technical knowledge of a certain field is a beneficial condition for developing new knowledge.

The importance of the fact that I personally carried out these experiments, lies in my position of knowing the material's technical possibilities as far as possible, while the possibilities of artistic expression are countless and opens a broader horizon. The point is that not only I but also even many others can consciously apply the new knowledge in interior spatial design, where regard has been taken to the acoustic and aesthetic qualities. This can, with advantage, be realized when others utilize the hand tufted prototypes in their endeavors. A strong point with it all is to reach two wholly separate goals simultaneously by integrating the two goals, to create a work both aesthetic appealing and with an acoustic function. This is what makes this project unique.

Case study as a research methodology brings forth the possibilities for various perspectives and shows the way toward problem solutions from the perspective of approaching the research problem pluralistically, where several theories and methods are utilized simultaneously for solving the case. This is possible in the explicative approach as a consistent theme binding together professional practice and the systematic aggregation of knowledge through research in the practical professions, such as my design project. I have succeeded in combining two different investigations: the phenomenological description of the material's properties, which underpins the acoustic tests. The phenomenological perspective has been important for investigating the acoustic materials' dimensions of signification by trying to identify the kinds of meanings associated with different materials.

The world of the imaginary involves, according to Barthes, the way the creator conceives the practiced structure with his/her intellect. This means that the creative process has a decisive role to play for the end result, where the practical professional knowledge underlies the creation of incisive empirical objects. (Through a structural composition of various parts, new things and new situations are continually being created).

The research results will be of specific significance for architects, enriching their repertoire of usable materials and artefacts for interior design, but the methodology applied has a wider implication concerning the role of practical design work, constituting itself an element in the research process and in theory-generation.

Key words:

practice based design research, a legitimate "context of discovery", experimental productions, hand tufting, aesthetic qualities, acoustic qualities, interior spatial design

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Appendix

Figure 1
Outline for *Measurement of sound absorption through the pipe method*

Figure 2
Unglued bottom weave, 5 cm from wall

Figure 3
Glued bottom weave, 5 cm from wall

Figure 4
Test against wall, 18 mm thread length

Figure 5
Test against wall, 40 mm thread length

Appendix

Figure 1
Outline for *Measurement of sound absorption through the pipe method*

SP SVERIGES PROVNING · FORSKNING

RAPPORT

utfärdad av ackrediterat laboratorium/REPORT issued by an Accredited Laboratory

SWEDAC ACKREDITERING 1002

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Handläggare, enhet/*Handled by, department*	Datum/*Date*	Beteckning/*Reference*	Sida/*Page*
Håkan Andersson, Akustik Tel: +46 (0)33 16 54 23 Email: hakan.andersson@sp.se	2003-06-17	P302599	1 (5)

Bestämning av ljudabsorption med rörmetoden
(5 bilagor)

Mätobjekt — Tuftade textilprover numrerade enligt tabell nedan.

1	Bomull 54/2 (Narva Krenholm)
2	Lin 16 (Bockens Lingarn 4/4 BL)
3	Wild raw silk (silk 100 %) reeled by hand, unbleach ab. 3000 denier, (Japansk garn nr. 27)
4	Silk 100 %, viscose sizing bleach, (Japansk garn nr. 7)
5	Ramie 100 %, knitted tape, (Japansk garn nr. 17)
6	Rayon 100 % picot (twisted yarn) poly-urethane sizing (un-dye-able), (Japansk garn nr. 19)
7	Cotton 100 %, viscose sizing bleach, (Japansk garn nr. 4)
8	Silk 100 %, viscose sizing bleach, (Japansk garn nr. 16)
9	Paper yarn (cellulose 100 %) viscose-sizing, white (dye-able), (Japansk garn nr. 23)
10	Ramie 100%, Lea 7/2 viscose sizing, unbleach, (Japansk garn nr. 29)
11	Paper yarn (cellulose 100 %) + raw silk 28 denierx3 (twisted, dye-able), (Japansk garn nr. 22)
12	Chenille, bomull
13	Ull 100% (Brage), Nm. 7/2, Tex 280
14	Lin 35
15	Ramie 100 % knitted tape, (Japansk garn nr. 18)
16	Ull 100% (Mora), Nm. 20/2, Tex 100
17	Linen 100%, viscose sizing unbleach, (Japansk garn nr. 3)
18	Bottenväv ESTEX 263 grey, constr. 60/80, (Schilgen GmbH & Co)

Proverna fanns i utförande med limmad och olimmad botten, märkta i resultattabellen med L resp. OL. Prover med dubbelsidig tuftning var olimmade och är märkta med D i resultattabellen.

Proverna var tuftade med två olika garnlängder, 18 mm resp 40 mm.

Mätdatum — 2003-06-12, 2003-06-16

SP 511

SP, Sveriges Provnings- och Forskningsinstitut, Box 857, 501 15 BORÅS, Tel 033-16 50 00, Telefax 033-13 55 02, E-mail info@sp.se, Org.nr 556464-6874

Ackrediterat laboratorium utses av Styrelsen för ackreditering och teknisk kontroll (SWEDAC) enligt lag. Verksamheten vid de svenska ackrediterade laboratorierna uppfyller kraven enligt SS-EN 45001 (1989), SS-EN 45002 (1989) och ISO/IEC Guide 25 (1990:E). Denna rapport får endast återges i sin helhet, om inte SWEDAC och SP i förväg skriftligen godkänt annat.

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Figure 2
Unglued bottom weave, 5 cm from wall

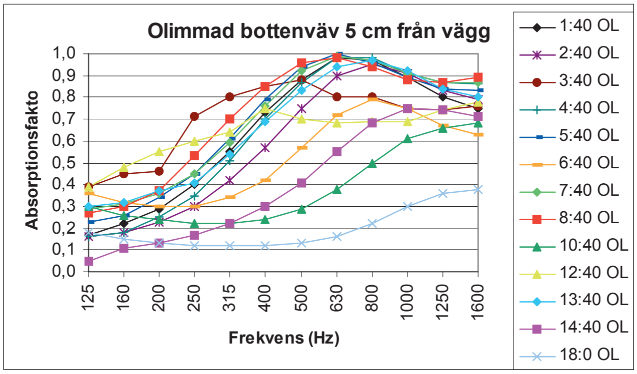


Figure 3
Glued bottom weave, 5 cm from wall

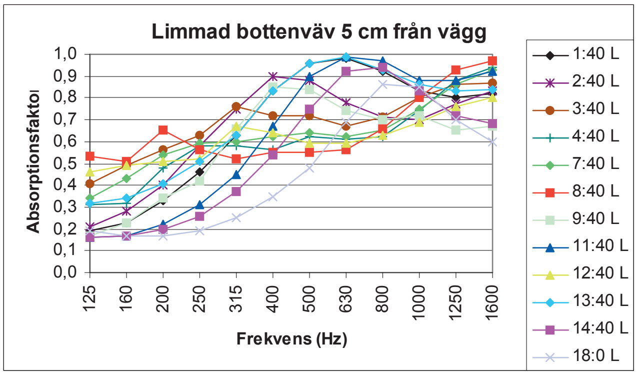


Figure 4
Test against wall, 18 mm thread length

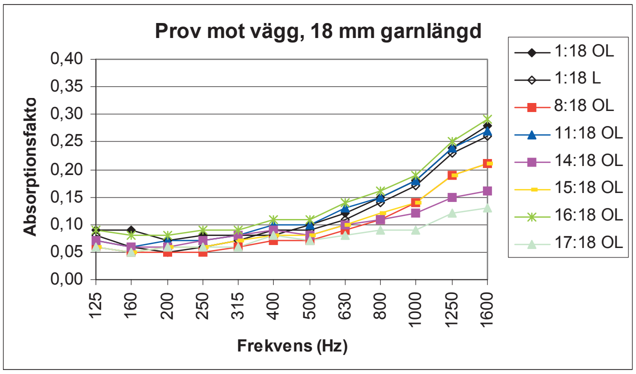
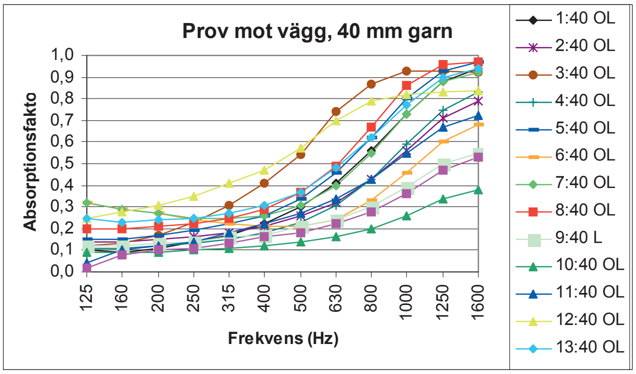


Figure 5
Test against wall, 40 mm thread length



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Appendix 2

Paper: Kaja Tooming, "The Unity of Experience: Perspectives on the Products of Design." International Design Research Society (DRS) conference *Wonderground*, 2006. Lisbon, Portugal.

Title:

The Unity of Experience:

Perspectives on the Products of Design

Abstract: (Up to 200 words)

This paper arises from practice-based design research that I am conducting for my doctoral degree. In that research, I am investigating the acoustic and aesthetic properties of hand-tufted fibre products that may be used in interior spaces. After producing and testing material samples, I am now moving on to further questions about the experience of such materials in situations of practical use. Specifically, I am investigating how such materials may be used to enhance experience when they are placed in interior spaces. I want to understand the possible criteria for explaining how these materials help to create a unified experience. To me, this is a question of principles. What principles shape our understanding of wholeness in experience? To address this question, I will explore the idea of unity or wholeness of experience in three philosophers, seeking criteria that may be employed by the practicing designer when seeking a concrete solution to a problem of interior space. The three philosophers are Maurice Merleau-Ponty, Roland Barthes and John Dewey. Through this work I hope to demonstrate how practice-based research can lead to fruitful investigation of fundamental theoretical problems. The research results will be of significance foremost for architects, designers and design researchers.

Keywords: aesthetics, artefacts (for generating understanding of the design space and for "use" in a broad sense), case-based design, experience, interior space

Paper : (Up to 2000 words for a working paper or 6000 for a full paper)

Introduction

This paper arises from practice-based design research that I am conducting for my doctoral degree. In that research, I am investigating the acoustic and aesthetic properties of hand-tufted fibre products that may be used in interior spaces. The first phase of that research involved the creation of aesthetically pleasing fibre modules that serve as samples of what is possible using the technique of hand-tufting. After the creation of a variety of modules, I tested the acoustic properties of these samples, trying to find the best solution for sound absorption. With these results in hand, I am now moving on to further questions about the experience of such materials in situations of practical use. Specifically, I am investigating how such materials may be used to enhance experience when they are placed in interior spaces. I want to understand the possible criteria for explaining how these materials help to create a unified experience. To me, this is a question of principles. What principles shape our understanding of wholeness in experience? To address this question, I will explore the idea of unity or wholeness of experience in three philosophers, seeking criteria that may be employed by the practicing designer when seeking a concrete solution to a problem of interior space. The three philosophers are Maurice Merleau-Ponty, Roland Barthes and John Dewey. Through this work I also hope to demonstrate how practice-based research can lead to fruitful investigation of empirical phenomena as well as fundamental theoretical problems.

I presented the results of the first phase of my research at the DRS International Conference *Futureground* in Melbourne in 2004 (Tooming, 2004). I explained that the goal of phase one was to give an account of the initial aesthetic observations and the acoustic tests that have been performed on a selection of the produced material samples—note that hand-tufting is a modern weave technique that is largely unresearched. I also explained that the goal of the second phase of my research is to understand what principles may be at work when hand-tufted materials are placed in an environment of practical use (e.g. the interior spaces of a building).

In that presentation, I concluded with two considerations that are important for understanding the interaction of people with an interior environment. The first consideration is how artefacts in the environment (for example, a room in a large public building) are related to each other. How does the experience of the wholeness of the room arise when colour, form, placement in the room, and relationships of various elements to each other are brought together? In this consideration, the focus is on the design elements independent of human beings. The second consideration is the relationship of people with each other and with the artefacts of the environment. In this consideration, the artefacts are stable and the people are engaged in activity. These two considerations provide a basic framework for investigating the issue of unity or wholeness in experience.

It quickly becomes apparent that there are several alternatives to explain the unity or wholeness of an experience. Indeed, the different possibilities are, themselves, worthy of investigation and exploration. This is where practice-based research deepens into serious theoretical issues, requiring a method of investigation that allows one to compare and contrast different perspectives on unity or wholeness. The method I have selected is the comparative case study, derived from the Swedish architect Rolf Johansson. He argues that his methodology—modified from the case study methods of Robert Yin as well as Stake—"is distinguished by a manner of approach which aims to both explain and understand a case in context, including as many relevant variables and properties as possible (Johansson, 2002:2). In practice, this method allows the researcher to explore several hypotheses about "wholeness" in the practical use of hand-tufted materials.

The hypotheses that I will explore are derived from Maurice Merleau-Ponty, Roland Barthes and John Dewey. With Merleau-Ponty, I will explore, first, whether a change in any of its parts would have a repercussion in the composition as a whole, and, second, whether the whole remains unchanged when all the components change simultaneously while concurrently preserving their interrelations. With Barthes, I will explore whether a small change in the placement of coherent parts, whose peculiar placing creates a concrete meaning, brings about a change in the whole. And with Dewey, I will explore the *unity* or *wholeness* constituted by a *single quality* that pervades the entire experience in spite of the variations of its constituent parts. The remainder of this paper is a discussion of the core ideas about unity or wholeness in the work of each author.

Maurice Merleau-Ponty

The fundamental starting point for phenomenology is that reality appears primarily to the intentional consciousness—that is, a consciousness directed toward something other than itself. In phenomenology, one attempts to find the a-theoretical foundation that liberates us from the theoretical and historical constructions, which hinders us from understanding phenomena as they present themselves in direct experience (Tooming, 2005).

Merleau-Ponty attempts to clarify a series of important concepts significant for the understanding of phenomenological reasoning. He develops the Husserlian concept of the *life-world*, one of the central concepts in phenomenological discussions. Another concept of great importance to Merleau-Ponty is the concept of *being-in-the-world* and interaction with the world. In order to understand the latter, one must clearly understand how Merleau-Ponty views the relationship between the *object-subject* and the *lived body*. All this should be seen in the context of *time and space*. Henri Bergson's theory of perception had great influence on the philosophical thinking of Merleau-Ponty, which prompted him to see perception as the essential starting point for understanding consciousness (Bergson, 1992). This is explained by the observation that a perceiving consciousness persists and can therefore not be comprehended unless the human body, which moves in a world, is taken into consideration from the start (Maurice Merleau-Ponty, 2004 p. 10).

In his thesis *La Structure du comportement* Merleau-Ponty attempts to formulate a new philosophical theory of perception inspired by gestalt theory (Merleau-Ponty, 1983). According to Merleau-Ponty, a gestalt is a composition, which cannot be reduced to the sum of the parts composing it. On one hand, a change in any of its parts would have a repercussion in the composition as a whole, while, on the other hand, the whole remains unchanged even when all the components change simultaneously—so long as they concurrently preserve their interrelations (Merleau-Ponty, 2004, p. 11).

To Merleau-Ponty, the *life-world* is the world vividly apprehended in our perceptions and which is thus indivisibly joined to a perceiving *subject* (Bengtsson, 2001). For Merleau-Ponty, the subject is chiefly its lived body. The life-world's distinguishing feature is the circular relation that prevails between the world and the subject: the subject characterized by the world and the world characterized by the subject. Merleau-Ponty continually returns to the fundamental circularity between body and subject. The lived body is a *subject-object*—an irreducibly ambiguous existence. A lived room and a lived time arise through the *lived body* and its *being-in-the-world* , from the subject's interaction and its communication with the world. For Merleau-Ponty perception is historical and cultural as well as social, in the sense that what is perceived appears to us against the background of former experiences developed by the perceiving subject in the world.

Roland Barthes

"Structure" means the relationships of order between the elements of a language. Over time, "structural" came to mean this way of looking at things. Roland Barthes furthered the application of this structural way of seeing things in other areas than linguistics—for example, in ideologies and art. This is possible when these other areas display a linguistic structure, in which case they can be viewed as a system of signs, that is, a system of communication. Structuralism highlights the unconscious character of the level exposed by structural analyses. It maintains that what is actually real or carried out is positioned elsewhere than in the "subjective", conscious level, of the experience of the subject. The subjective level is, on the contrary, governed by unconscious working structures. Structuralism constitutes a reaction against "existentialism" (the philosophy of subject), or, more accurately, the phenomenological-dialectical tradition (*Filosofilexikonet*, 1997, p. 528-529). Barthes is of the opinion that structuralism is able to provide a broader description embracing more levels than the reflexive level of language. He presumes that there are artists for whom a certain structure (not just thinking)—when put into practice—represents a particular experience.

When writing of coherent parts (signs) forming a whole, Barthes states that the goal of every sort of structuralizing activity, reflexive as well as poetic, is to reconstruct a certain "object". Through the result of reconstruction one can discover rules for the functions of the object. Structure is in fact the actual imitation of the object, but not an imitation without concrete direction or goal, for the imitation materializes that which had been invisible or unintelligible in the imitated object. The structuralizing person *takes the real, tears it in pieces and compiles it again.* This precise process has a decisive significance, since *between these two objects—the two stages of the structuralizing activity—something new arises* (Barthes, 2002, p. 21-22). The temporary tearing, subordinate to the imitation, involves finding mobile parts whose particular placement creates a concrete meaning. Though such a fragment has in itself no meaning, just a small change in placing may bring about a change in the whole meaning (Barthes, 2002, p. 23-24).

John Dewey

Dewey attempted to break with what he considered the traditional philosophical dualism between knowledge and the world: he argued that we cannot step outside of ourselves and place ourselves on equal footing with something absolute, i.e. we cannot think of the world without describing it in one way or another (*Filosofilexikonet*, 1997, p. 112). Dewey therefore attacked what he saw as an "epistemological theory of observance," that is, the supposition that knowledge is a passive viewing of an eternal and invariable world. Truth is not the correct image of a reality existing independently of people and their actions. For Dewey, reality consists of problematic situations, and the solution to these problems is experience. *Unity* "is constituted by a single *quality* that pervades the entire experience in spite of the variation of its constituent parts" (Dewey, 1934, p.35-57). *An* experience, as a whole, is a process of movement from a beginning to a close. Fulfilling and consummating are continuous functions, not mere ends. A *conclusion* is the consummation of a movement, not a separate and independent thing. An experience has pattern and structure, which consists of doing and undergoing in relationship. The relationship gives meaning, and to grasp the relationship is the objective of intelligence. The scope and content of the relationships measure the significant content of an experience. "In every integral experience there is form because there is dynamic organization" in the fusing of experience with the vital organization of the results of prior experience, bringing about dynamic growth through inception, development and fulfilment (Dewey, 1934, p. 55).

Action itself is dominantly practical. The activity is, according to Dewey, too automatic to permit of a sense of *what it is about* and *where it is going*. Any *practical* activity will have aesthetic quality, provided that it is integrated and moves by its own urge to fulfilment. The aesthetic "is the clarified and intensified development of traits that belong to every normally complete experience" (Dewey, 1934, p. 46). Dewey takes this to be the only secure basis upon which aesthetic theory can be built. The word *aesthetic* refers to experience as appreciative, perceiving, and enjoying. It denotes the *consumer's* rather than the producer's standpoint, which instead is denoted be the word *artistic* referring primarily to the act of production. Since the two words *artistic* and *aesthetic* refer to different processes, there is unfortunately an absence of a term designating the two processes taken together. An object yields an aesthetic experience when the determining factors of "*an* experience are lifted high above the threshold of perception and are made manifest for their own sake" (Dewey, 1934, p. 57).

Discussion of principles: *Merleau-Ponty, Barthes* and *Dewey*

Dewey points out that *an* experience is a *unity* with a single individuating quality, where *emotional, intellectual* and *practical* qualities are integrated parts of experience. For Dewey, unity requires aesthetic quality and consummation. The subject has central importance for both Dewey and Merleau-Ponty. The world is experienced through the subject and a circular relationship arises between the subject and the world. Both Dewey and Merleau-Ponty emphasize the importance of the historical, cultural and social context of experience. Moreover, all this should be viewed in the context of time and space. According to Merleau-Ponty, this context is of importance in the sense that the perceived always appears to us against the background of former experiences developed by the perceiving subject in the world. Dewey emphasizes even more strongly than Merleau-Ponty that everything is built upon former experiences and that experience is a flow, an on-going process on its way towards consummation. Both Dewey and Merleau-Ponty highlight the subject's interaction and communication with the world. For Merleau-Ponty, this is facilitated foremost through one's own lived body and through one's being-in-the-world.

Dewey even points out that any practical activity will have aesthetic quality, where the aesthetic is the clarified and intensified development of traits (properties) that belong to every complete experience. According to Richard Buchanan's interpretation of Dewey, *Emotional qualities, Signs or Symbols* and *Overt doings* tells us *what* "an experience" is about. One should even distinguish between *material, form* and *purpose* in *an* experience, in which *nature of form* and *making form* constitute common patterns of experience. Finally, differences among experiences arise because of differences of interest and purpose (Buchanan, 2006).

Wholeness (gestalt), according to Merleau-Ponty, is a composition that cannot be reduced to the sum of the parts composing it. He accentuates the fact that a change in any of its parts has a repercussion in the composition as a whole, while the whole remains unchanged when all the components change simultaneously while concurrently preserving their interrelations. It is interesting to compare Merleau-Ponty's theory of *perception* with Roland Barthes' evolved theory of *structuralism*. Barthes' point of departure is that even a small change of position of mobile parts (units), whose peculiar position creates a concrete meaning, brings about a change in the whole. He accentuates the fact that, quite contrary to Merleau-Ponty, the whole changes when even a small change of position of mobile parts occurs, since these coherent mobile parts form a whole. Barthes emphasizes the process as a structured activity where the subject is a "structuralizing person", who takes the real, tears it in pieces and compiles it again. He emphasizes the process of this structural procedure. For Barthes, it is a precise process, since between these two stages—tearing and compiling—something new arises. He means that the structuralizing goal of activity is to reconstruct a certain "object".

For Dewey, the emotional phase binds parts together into a single whole. For Barthes, the wholeness consists of the structuralized activity. Barthes emphasizes the doing as an *activity*. He did not place this activity in a broader context, where *emotional* qualities are integrated parts (of doing) of experience. For Dewey, who also emphasizes doing as an activity, the *unity* is constituted by a single *quality* that pervades the entire experience in spite of the variation of its constituent parts.

From a theoretical perspective, it appears that the concept of unity or wholeness is progressively deepened from Merleau-Ponty's concern for the *perceptual whole* (gestalt), to Barthes' concern for a *meaningful whole* in the arrangement of signs, to Dewey's concern for an *experienced whole* that integrates perception and meaning through the interaction of thought, practical action, and emotional or aesthetic quality. The final paper will explore precisely this unfolding of wholeness and its implications for the kind of design work in which I am engaged.

Future work

One of the essential points of the research project as a whole is that the material under investigation can be produced within conditions of the research process and can be tested and used in real environments. For this practical work I will carry through one case study example. The context for this study is a mansion, called *Jonsereds Herrgård*, which is the property of Göteborg University and is utilized as a conference center. The dining room has poor, disturbing acoustics with considerable noise (clamor) when many people are present in the room. My aim in this case is to attain two goals simultaneously: first, to improve the acoustics in the room through the agency of hand-tufted elements, and second, to present these "acoustic" elements in such a way that they have qualities that would be visually and aesthetically appealing to the observer, that is, have artistic qualities. Consideration must be given to a larger context, in which the social, cultural and historical aspects are included. Not least does this apply to the mansion house, which was built in the 19th century. This case study is an on-going process and this practical work is in its preliminary phase.

Conclusion

This research project is a concrete example of how practice based-design research can be fruitful for theory as well as practice. It demonstrates for example, how empirical research can lead to theoretical issues such as the problem of unity or wholeness. This research is also aimed at applied knowledge and the development of new technical ideas for industry, especially regarding textiles and acoustic materials. My research project with hand-tufted module elements is a concrete case for studying the role of the creative production in the development of new knowledge. The research results will be of significance foremost for architects, designers and design researchers. Furthermore the conceptual framework of unity developed here could be a promising step in the process of theory-generation and practice based design research.

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Appendix 3

Introductory study on the "shootability" of the thread material

Column I

Line	Nr.	Material	Number of threads	"Low" 18 mm	"High" 40 mm	Double-sided	"Shootability" and comments[1]
1	1-3	Linen 16	16	x			"Shootability": 2
1	4-5	Linen 16	16		x		"Shootability": 2 (3)
2	1-3	Linen 16	16		x		"Shootability": 2 (3)
2	4-5	Linen 16	16		x		"Shootability": 2 (3)
3	1-3	Jap. nr. 16	6	x			"Shootability": 2
3	4-5	Jap. nr. 16	6	x			"Shootability": 2
4	1-3	Jap. nr. 16	6		x		"Shootability": 2 (3)
4	4-5	Jap. nr. 16	6		x		"Shootability": 2 (3)
5	1-3	Cotton (Narva)	18	x			"Shootability": 2
5	4-5	Cotton (Narva)	18	x			"Shootability": 2
6	1-3	Cotton (Narva)	18		x		More difficult to tuft than short 18 mm height, the thread is too "soft"; certain threads prefer to be "loose". "Shootability: 3
6	4-5	Cotton (Narva)	18		x		More difficult to tuft than short 18 mm height, the thread is too "soft"; certain threads prefer to be "loose". "Shootability: 3
7	1-2	Jap. nr. 19	3	x			Three threads bring about a volume too "thick" and hard". "Shootability": 3
7	3	Jap. nr. 19	2	x			Two threads are easier than three. "Shootability": 2
7	4-5	Jap. nr. 19	2	x		x	"Shootability": 2
8	1	Jap. nr. 19	3		x		Difficulty with three threads at this height. "Shootability": 4
8	2-3	Jap. nr. 19	2		x		"Shootability": 3
8	4-5	Jap. nr. 19	2		x	x	"Shootability": 3
9	1-3	Jap. nr. 22	6	x			"Shootability": 3
9	4-5	Jap. nr. 22	6	x			"Shootability": 3
10	1-3	Jap. nr. 22	6		x		"Shootability": 4
10	4-5	Jap. nr. 22	6		x	x	"Shootability": 4
11	1-3	Jap. nr. 4 (white)	6	x			Eight threads are excessive; they are tuftable, but produce too much "thickness" on the reverse side. "Shootability": 3
11	4-5	Jap. nr. 4 (white)	6	x		x	"Shootability": 3
12	1-3	Jap. nr. 4 (white)	6		x		"Shootability": 3

[1] I have employed a scale from 1 to 5 to describe the "shootability". The higher the grade the more streneous the tufting.

12	4-5	Jap. nr. 4 (white)	6		x	x	"Shootability": 3
13		Jap. nr. 3	6	x			It could not be tufted with six threads. "Shootability": 5
13		Jap. nr. 3			x		It didn't work! "Shootability": 5
13	1-3	Jap. nr. 7	4	x			It was very difficult with six threads, but four did work. "Shootability": 3
13	4-5	Jap. nr. 7	3	x		x	It was difficult with either six or four threads. "Shootability": 3
14	1-3	Jap. nr. 7	4		x		A bit more difficult than with needle 18. "Shootability": 4
14	4-5	Jap. nr. 7	4		x		A bit more difficult than with needle 18. "Shootability": 4
15	2-5	Cotton + Jap. thread nr. ?	12 +1	x			"Shootability": 2
16	1-3	Cotton + Jap. thread nr. 16	15 + 1	x			"Shootability": 2
16	4-5	Cotton + Jap. thread nr. 16	12 + 2	x			"Shootability": 2
17	3-5	Cotton + Jap. nr. 19	14 + 1	x			"Shootability": 2
17	1-2	Cotton + Jap. nr. 19	14 + 1	x			"Shootability": 2

Column II

Line	Nr.	Material	Number of threads	"Low" 18 mm	"High" 40 mm	Double-sided	"Shootability" and comments
1	1-3	Jap. nr. 18	6	x			Easy to tuft; "Shootability": 2
1	4-5	Jap. nr. 18	6	x		x	Easy to tuft from one of the sides. "Shootability": 2 (3)
2	1-3	Jap. nr. 18	6		x		More difficult with needle 18, but still rather easy; "Shootability": 3
2	4-5	Jap. nr. 18	6		x		More difficult with needle 18, but still rather easy; "Shootability": 3
3	–	Jap. nr. 5	2	x			Very difficult to tuft; "Shootability": 5
3	1-3	Jap. nr. 6	6	x			Rather easy to tuft; "Shootability": 3
3	4-5	Jap. nr. 6	6	x		x	"Shootability": 3
4	1-3	Jap. nr. 6	6		x		Difficult to tuft since the machine does not cut well att this length. "Shootability": 4
4	4-5	Jap. nr. 6	6		x	x	"Shootability": 4
5	–	Jap. nr. 20		x			It did not work with either 2 or 3 threads! "Shootability": 5
5	1-2	Jap. nr. 26	4	x			Easy to tuft. "Shootability": 2
5	3	Jap. nr. 26	3	x			Easy to tuft. "Shootability": 2

5	4-5	Jap. nr. 26	4	x		x	"Shootability": 2
6	1-3	Jap. nr. 26	4		x		Easy to tuft even at a longer height. "Shootability": 2
6	4-5	Jap. nr. 26	4		x	x	"Shootability": 2
7	1-2	Jap. nr. 27	4	x			Easy to tuft. "Shootability": 2
7	3	Jap. nr. 27	3	x			Easy to tuft. "Shootability": 2
7	4-5	Jap. nr. 27	4	x		x	Easy to tuft. "Shootability": 2
8	1-3	Jap. nr. 27	4		x		Easy to tuft even at a longer height. "Shootability": 2
8	4-5	Jap. nr. 27	4		x	x	Easy to tuft. "Shootability": 2
9	1-3	Jap. nr. 21	4	x			Does not work too well, aborted. "Shootability": 5
9	4-5	Jap. nr. 21	4	x		x	Difficult to tuft, does not cut that well, the thread is often blown back. "Shootability": 5
10	1-3	Jap. nr. 21	4		x		Very difficult, aborted. "Shootability": 5
10	4-5	Jap. nr. 21	4		x	x	"Shootability": 5
11	1-3	Linen 35	18	x			"Shootability": 2
11	4-5	Linen 35	18	x		x	"Shootability": 2
12	1-3	Linen 35	18		x		"Shootability": 3
12	4-5	Linen 35	18		x	x	"Shootability": 3
13	1-3	Jap. nr. 17	3	x			Easy to tuft. "Shootability": 2
13	4-5	Jap. nr. 17	3	x		x	"Shootability": 2
14	1-3	Jap. nr. 17	3		x		Easy to tuft. "Shootability": 2
14	4-5	Jap. nr. 17	3		x	x	"Shootability": 2
15	1-3	Wool	4	x			Easy to tuft. "Shootability": 1
15	4-5	Wool	4	x		x	"Shootability": 1
16	1-3	Wool	4		x		Very easy to tuft even at a longer height. "Shootability": 1
16	4-5	Wool	4		x	x	"Shootability": 1
17	1	Cotton + Jap. nr. 4	14 + 2	x			"Shootability": 2
17	2	Cotton + Jap. nr. 22	14 + 2	x			"Shootability": 2
17	3	Cotton + Jap. nr. 7	14 + 1	x			"Shootability": 2
17	4	Cotton + Jap. nr. 27	14 + 1				"Shootability": 2
17	5	Cotton + Jap. nr. 26	14 + 1				"Shootability": 2

Japanese Thread Terms

The terms are based on the catalog from the Japanese company Nakachuu Co., Ltd.

Japanese thread nr. 3
Linen 100% viscose sizing unblecah

Japanese thread nr. 4
Cotton 100% viscose sizing bleach

Japanese thread nr. 5
Cotton 100% viscose sizing bleach

Japanese thread nr. 6
Silk 100% amorphophulus sizing unbleach

Japanese thread nr. 7
Silk 100% viscose sizing bleach

Japanese thread nr. 16
Silk 100% viscose sizing bleach

Japanese thread nr. 17
Ramie 100% knitted tape

Japanese thread nr. 18
Ramie 100% knitted tape

Japanese thread nr. 19
Rayon 100% picot (twisted yarn) polyurethane sizing (un-dye-able)

Japanese thread nr. 20
Silk 100% roving polyurethane sizing (un-dye-able)

Japanese thread nr. 21
Silk 100% roving polyurethane sizing (un-dye-able)

Japanese thread nr. 22
Paper yarn (cellulose 100%) + raw silk 28 denier x 3 (twisted, dye-able)

Japanese thread nr. 26
Chenille (silk 100%) Type A

Japanese thread nr. 27
Wild raw silk (silk 100%) reeled by hand, unbleach ab. 3000 denier

Appendix 4

Questionnaire

QUESTIONNAIRE 2003-07-26

In connection with the exhibition "Backside" as a part of a research at the University of Göteborg
Compiled by Kaja Tooming

Date:

Name: age: citizenship: occupation:

1 – Do you know about the hand-tuft technique?

2 – Which of the various exposure possibilities are felt as most interesting to you?
a) large rugs on walls (work number 7 and 11)
b) compositions on canvas (work number 2 and 6)
c) compositions in the room, that is, away from the walls (work number 1 and 5)
d) installations on the floor (work number 8)
e) 3D form in the room (work number 13)

3 – Is there anything that has surprised you in the exhibition? Which thing?

4 – Is there anything that has irritated you in the exhibition? Why?

5 – How do you experience the atmosphere in the exhibition?

6 – Which of the materials or material compositions at the exhibition have made the largest impression on you? Please elaborate and indicate the index number of the work.

7 – How do you feel about the possibilities of using combinations of materials such as combining textile and metal, for example?

8 – Which of the aesthetic solutions would you preferably use in a room as solutions to acoustical sound problems, if you knew that works in the hand-tuft technique grant large sound-reducing effects? Please elaborate and indicate the index number of the work.

9 – Additional observations or suggestions

Thank You!

Appendix 5

Plan: Jonsered Manor

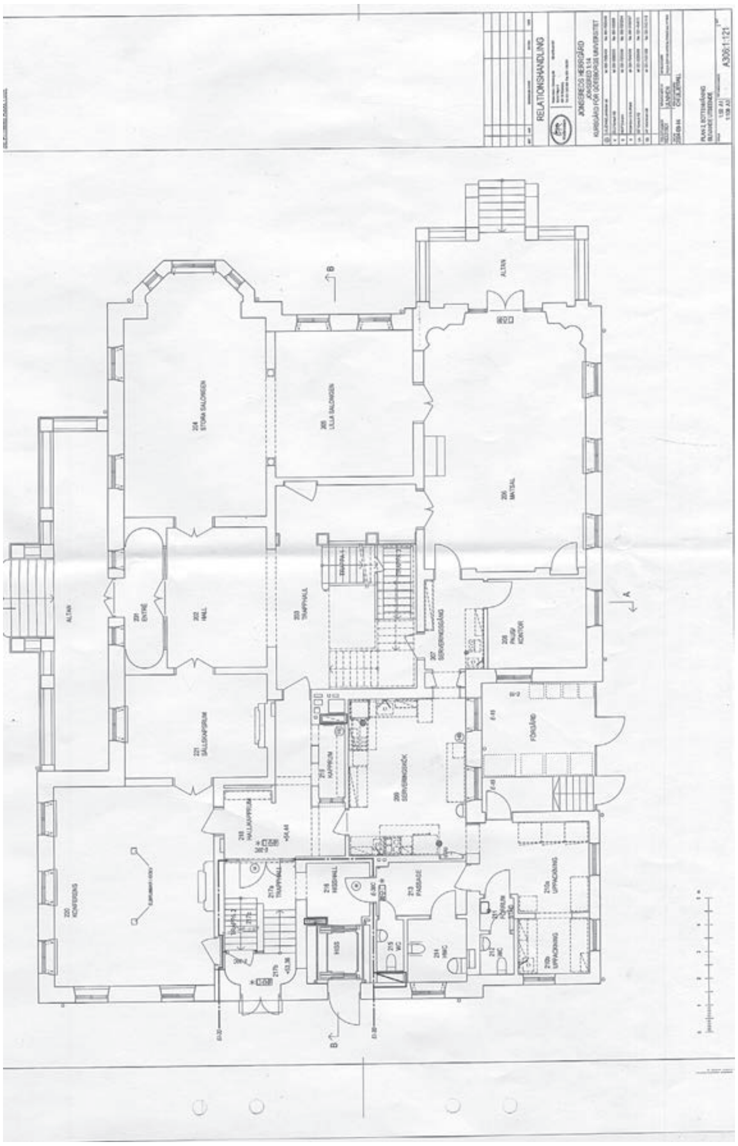

Figure 7. Plan: Jonsered Manor.

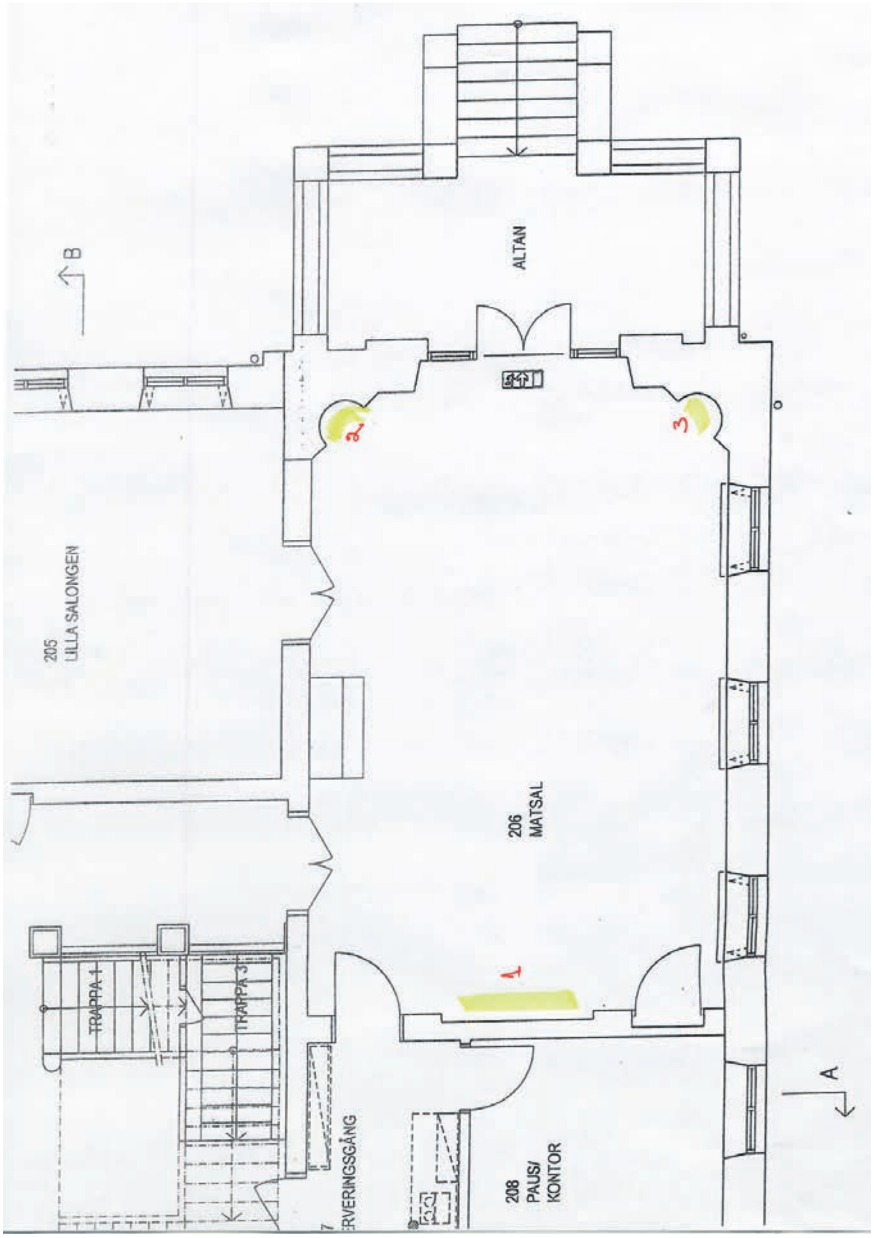

Figure 8. Plan: the dining room. Placement of art works in the room.

Appendix 6

Acoustic Measurement Report

Rådgivande ingenjörer inom *Ljud, Buller, Vibrationer.*

Report 3110-A /Roger Fred

Jonsereds Herrgård – measurements of reverberation time and speech transmission index

This report also includes four pages with tables and curves named 3110/1-4

On Friday, 13 April 2007 we performed measurements of reverberation time (T_{30}) and speech transmission index (STI) for three different cases in the dining room at Jonsereds Herrgård.

Contents

1. Method

The method used for T_{30} measurements is according to EN ISO 3382:2000

The method used for STI measurements is STIPA (Speech Transmission Index – Public Address), a simplified method compared with the full STI-method described in IEC 60268-16

The measurement uncertainty is 0.02 for STI and 0.2 s (100 Hz) - 0.02 s (10 kHz) for T_{30}.

The equipment used during the measurements is a real time sound analyser called Norsonic Nor118, a loudspeaker called Tivoli Audio PAL (for STI measurements) and a loudspeaker called JBL EON-15 (for reverberation time measurements).

The sketch plan on page 3 shows the source positions for STI measurements (S1 and S2), source positions for T_{30} measurements (S3 and S4), receiver positions (R1-R3) and the positions for weave (P1) and sculptures (P2 and P3).

2. Object

Dining room (Matsal 206), Jonsereds Herrgård. The height of the room was 3.8 m and the volume was 210 m³. Ceiling and walls are acoustically hard. Each window was provided with two pairs of curtains, one light (less than 0.1 kg/m²) and one heavy (more than 0.5 kg/m²). There were three tables and totally 36 chairs in the room. The temperature was about 20 °C and the relative humidity about 50 %. During the measurements only one person was present.

The type of weave was 40 mm thread length on unglued backing with a distance of 100 mm to the wall. Some threads were more than 120 mm long. Se picture 1. The area of the weave was 3.6 m². The two sculptures (se picture 2 and 3) were made of double sided weave. The height of them was about 2 m and the diameter 0.4-0.5 m.

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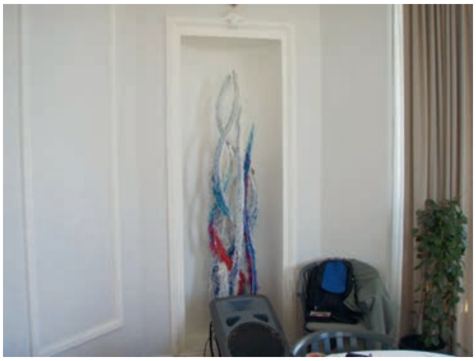
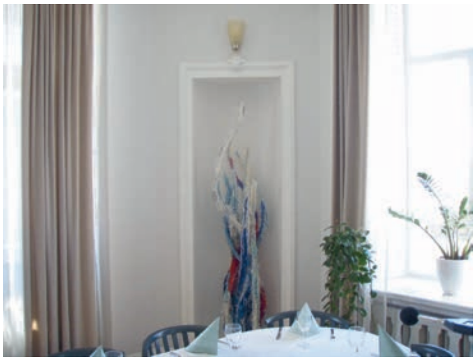
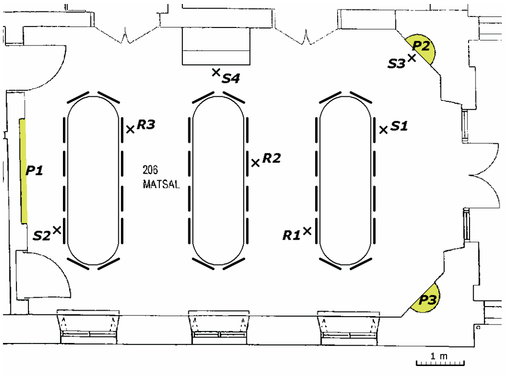
Picture 1. The weave in position 1



Picture 2. One of the sculptures in position 2



Picture 3. The second sculpture in position 3



Sketch plan. Source positions for STI measurements (S1 & S2), for T_{30} measurements (S3 & S4), receiver positions (R1, R2 & R3) and positions for weave (P1) and sculptures (P2 & P3)

3. Results

The four attached pages 3110/1-4 show T_{30} and STI for three different cases:

1. Without weave and sculptures
2. With weave, without sculptures
3. With weave and sculptures.

4. Comments

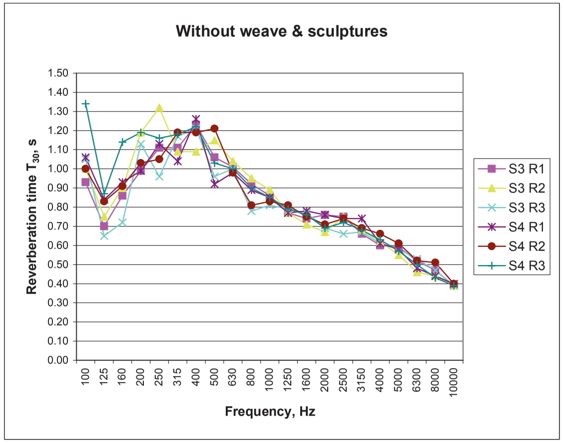
These measurements show two important things:

1. Both the weave and the sculptures are too small to contribute significantly to the room acoustics in this dining room.
2. This weave could be very close to an ideal sound absorber of this thickness

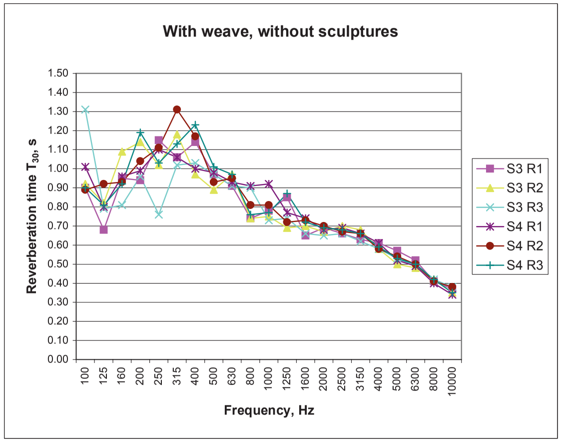
Göteborg 23 April 2007
Akustikforum AB

Roger Fred

T_{30} without weave (position 1) and sculptures (position 2 and 3)						
Source position	S3	S3	S3	S4	S4	S4
Receiver position	R1	R2	R3	R1	R2	R3
Frequency, Hz						
100	0.93	1.00	1.05	1.06	1.00	1.34
125	0.70	0.75	0.65	0.84	0.83	0.87
160	0.86	0.90	0.72	0.93	0.91	1.14
200	0.99	1.19	1.13	0.99	1.03	1.19
250	1.11	1.32	0.96	1.13	1.05	1.16
315	1.11	1.09	1.17	1.04	1.19	1.18
400	1.23	1.09	1.21	1.26	1.19	1.22
500	1.06	1.15	0.96	0.92	1.21	1.03
630	1.01	1.04	1.00	0.98	0.98	1.00
800	0.92	0.95	0.78	0.89	0.81	0.90
1000	0.86	0.89	0.81	0.85	0.83	0.85
1250	0.77	0.77	0.79	0.77	0.81	0.79
1600	0.74	0.71	0.77	0.78	0.75	0.76
2000	0.76	0.67	0.69	0.76	0.71	0.69
2500	0.75	0.75	0.66	0.74	0.74	0.72
3150	0.66	0.68	0.67	0.74	0.69	0.68
4000	0.60	0.62	0.61	0.61	0.66	0.63
5000	0.59	0.55	0.58	0.58	0.61	0.57
6300	0.52	0.46	0.53	0.48	0.52	0.50
8000	0.47	0.44	0.47	0.44	0.51	0.43
10000	0.39	0.39	0.39	0.40	0.40	0.39
According to SS025268	1.16	1.26	1.14	1.17	1.17	1.18
Source position	S1	S1	S1	S2	S2	S2
Receiver position	R1	R2	R3	R1	R2	R3
STI	0.64	0.6	0.61	0.61	0.64	0.62



T_{30} with weave (position 1), without sculptures (position 2 and 3)						
Source position	S3	S3	S3	S4	S4	S4
Receiver position	R1	R2	R3	R1	R2	R3
Frequency, Hz						
100	0.90	0.92	1.31	1.01	0.89	0.90
125	0.68	0.82	0.79	0.80	0.92	0.81
160	0.95	1.09	0.81	0.96	0.93	0.92
200	0.94	1.14	0.96	0.99	1.04	1.19
250	1.15	1.02	0.76	1.10	1.11	1.03
315	1.06	1.18	1.02	1.06	1.31	1.13
400	1.14	0.97	1.03	1.00	1.17	1.23
500	0.97	0.89	0.97	0.98	0.93	1.01
630	0.91	0.97	0.91	0.93	0.95	0.97
800	0.74	0.74	0.90	0.91	0.81	0.76
1000	0.78	0.75	0.73	0.92	0.81	0.77
1250	0.85	0.69	0.74	0.77	0.72	0.87
1600	0.65	0.70	0.66	0.74	0.73	0.72
2000	0.69	0.67	0.65	0.68	0.70	0.69
2500	0.66	0.70	0.66	0.69	0.67	0.68
3150	0.63	0.68	0.62	0.66	0.66	0.66
4000	0.61	0.58	0.58	0.61	0.58	0.59
5000	0.57	0.50	0.53	0.52	0.54	0.53
6300	0.52	0.48	0.49	0.49	0.50	0.50
8000	0.41	0.42	0.42	0.40	0.41	0.42
10000	0.37	0.35	0.38	0.34	0.38	0.35
According to SS025268	1.10	1.14	1.00	1.07	1.23	1.15
Source position	S1	S1	S1	S2	S2	S2
Receiver position	R1	R2	R3	R1	R2	R3
STI	0.64	0.63	0.64	0.63	0.63	0.63



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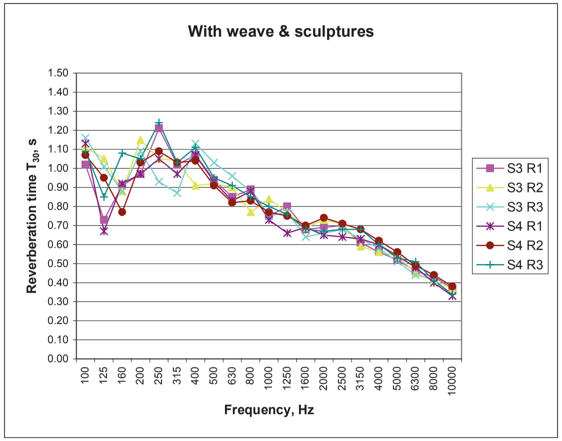
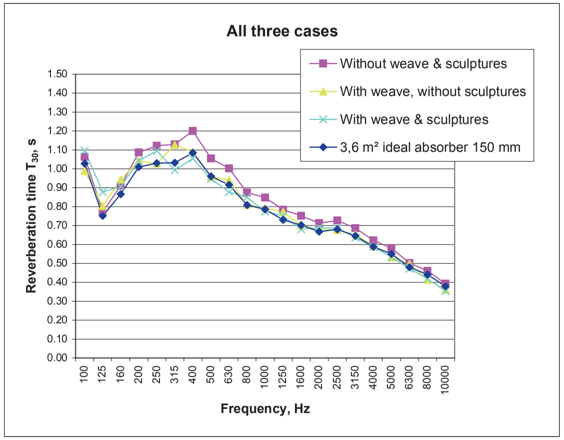
T_{30} with weave (position 1) and sculptures (position 2 and 3)						
Source position	S3	S3	S3	S4	S4	S4
Receiver position	R1	R2	R3	R1	R2	R3
Frequency, Hz						
100	1.02	1.11	1.16	1.13	1.07	1.09
125	0.73	1.05	1.01	0.67	0.95	0.85
160	0.91	0.88	0.88	0.92	0.77	1.08
200	0.97	1.15	1.09	0.97	1.03	1.05
250	1.21	1.05	0.93	1.05	1.09	1.24
315	1.02	1.04	0.87	0.97	1.03	1.03
400	1.07	0.91	1.13	1.07	1.04	1.11
500	0.94	0.92	1.03	0.93	0.91	0.95
630	0.85	0.90	0.96	0.83	0.82	0.91
800	0.89	0.77	0.88	0.88	0.83	0.85
1000	0.75	0.84	0.75	0.73	0.77	0.80
1250	0.80	0.77	0.77	0.66	0.75	0.76
1600	0.68	0.69	0.64	0.69	0.70	0.68
2000	0.69	0.73	0.66	0.65	0.74	0.67
2500	0.70	0.71	0.68	0.64	0.71	0.68
3150	0.61	0.59	0.63	0.63	0.68	0.68
4000	0.56	0.56	0.58	0.60	0.62	0.60
5000	0.52	0.54	0.51	0.54	0.56	0.53
6300	0.46	0.45	0.44	0.48	0.49	0.51
8000	0.43	0.41	0.42	0.40	0.44	0.41
10000	0.37	0.37	0.33	0.33	0.38	0.34
According to SS025268	1.14	1.11	1.08	1.02	1.07	1.17
Source position	S1	S1	S1	S2	S2	S2
Receiver position	R1	R2	R3	R1	R2	R3
STI	0.65	0.63	0.65	0.64	0.66	0.65

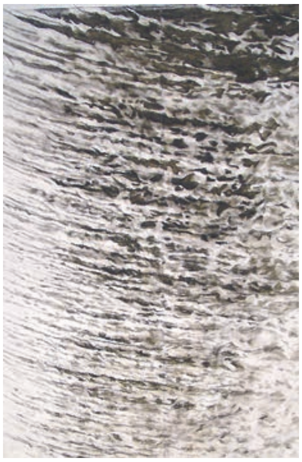


T_{30} with and without weave (position 1) and sculptures (position 2 and 3)				
Weave		×	×	3,6 m² ideal absorber
Sculptures			×	of 150 mm thickness
Frequency, Hz				
100	1.06	0.99	1.10	1.03
125	0.77	0.80	0.88	0.75
160	0.91	0.94	0.91	0.87
200	1.09	1.04	1.04	1.01
250	1.12	1.03	1.10	1.03
315	1.13	1.13	0.99	1.03
400	1.20	1.09	1.06	1.08
500	1.06	0.96	0.95	0.96
630	1.00	0.94	0.88	0.92
800	0.88	0.81	0.85	0.81
1000	0.85	0.79	0.77	0.79
1250	0.78	0.77	0.75	0.73
1600	0.75	0.70	0.68	0.70
2000	0.71	0.68	0.69	0.67
2500	0.73	0.68	0.69	0.68
3150	0.69	0.65	0.64	0.65
4000	0.62	0.59	0.59	0.59
5000	0.58	0.53	0.53	0.55
6300	0.50	0.50	0.47	0.48
8000	0.46	0.41	0.42	0.44
10000	0.39	0.36	0.35	0.38
According to SS025268	1.18	1.12	1.10	1.03
STI	0.62	0.63	0.65	0.6-0.75 = Good



Appendix 7

Design Process: The Jonsered Manor



Picture nr. 41. sketch for *Flow*

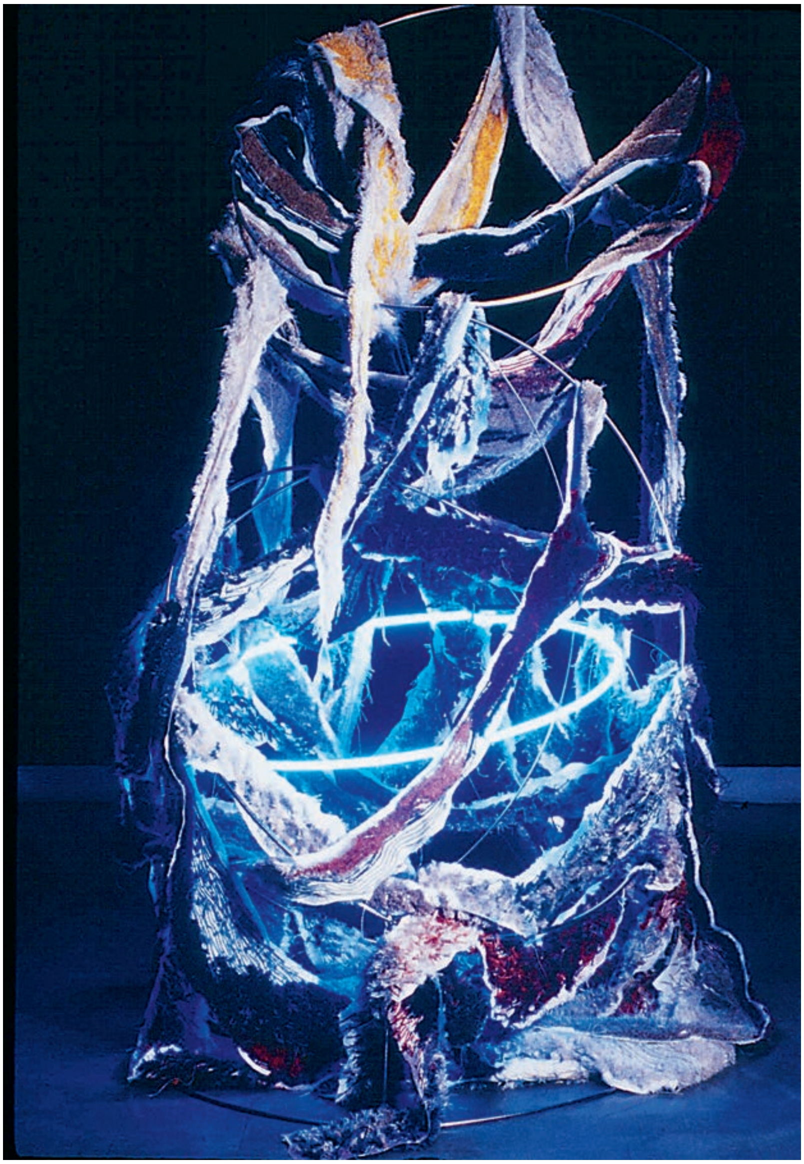
Picture nr. 42. Sketch, detail

Picture nr. 43. Fibers

Picture nr. 44. *Flow* “growing up”

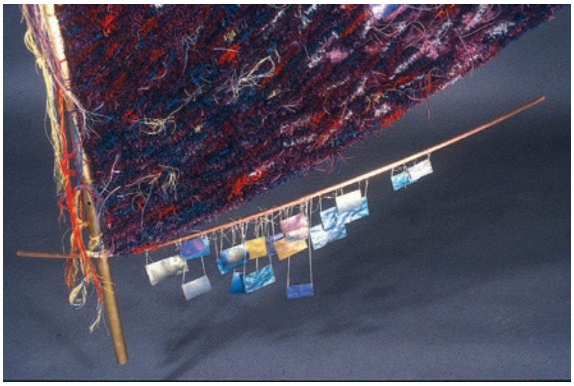
Appendix 8

Material from Earlier Exhibitions

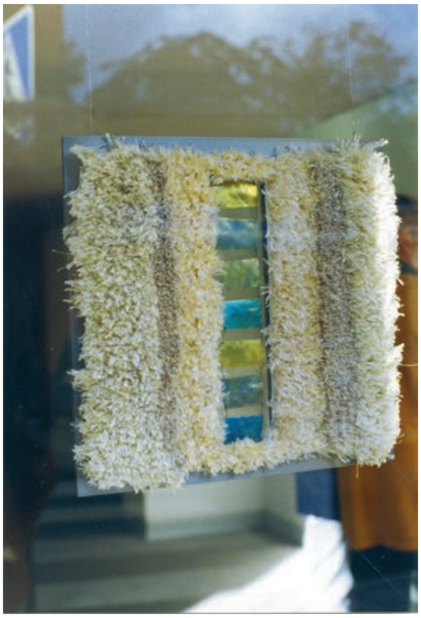


Picture nr. 45. Installation *The Nordic Tree,* 1996. Hight, 3 m. Röhss' Museum, Göteborg, Sweden

Picture nr. 46. *Sail*, 1995. Photo: Bengt Kvist



Picture nr. 47. *Sail*, 1995. Detail. Photo: Bengt Kvist



Picture nr. 48. *Composition I.* Front side
Photo: Kaja Tooming

Picture nr. 49. *Composition*. Detail
Photo: Kaja Tooming

Picture nr. 50. *Composition I.* Back side
Photo: Kaja Tooming

Picture nr. 51. *Between Heaven and Earth*
Photo: Bengt Kvist

Picture nr. 52. *Celebration*, 1999. Photo: Bengt Kvist

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Kaja Tooming, *Backside* 2003.