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The Creative Process in Practice Based Design Research.

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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. In particular, could the artistic or design experiment function as a legitimate "context of discovery" within research so that the practical results of that experimentation are both themselves an integral part of the research and, when analyzed as to their implications, contribute to theory-generation?

My aim in this paper is to illuminate the possibility of practice-based design research by means of a concrete example where the experimental production of new combinations and compositions of textile acoustic material functions on two levels, providing both samples for acoustic testing, and actual situations for analyzing the products' qualitative (aesthetic) values for interior design. The research results are of specific significance for architects, enriching their repertoire of usable materials and artefacts for interior design, but the methodology has a wider implication concerning the role of practical design work as itself an element in the research process and in theory-generation.

A concrete example of the relationship between theory and practice can be given by a current research project, where consideration has been taken both to the aesthetic and acoustic qualities in interior spatial design in modern environments. Sound-absorption is an important aspect of the architectural experience, especially in public premises. The thickness and density of the textile material is known to be a decisive factor for sound-absorption. Different fibre structures give various absorption results. Through the agency of hand-tuft technique one can reach almost ideal results in sound-absorption. Hand-tuft technique is a modern weave technique and yet an unresearched field. Until now, no one has investigated the various possibilities the technique offers for creating artefacts with high technical quality and rich aesthetical potential that simultaneously solve acoustic spatial problems.

In the case examined here, the design- and art-experimental production of new combinations and compositions of hand-tufted materials, the design outcomes provide both the matrix of samples for the scientific testing of the acoustic properties of the weave and are themselves productive of new possibilities for how the solution of acoustic problems can be solved through the spatial application of hand-tufted textile artefacts. The designed objects are experimental propositions concerning how aesthetic and acoustical issues can be reconciled in spatial design. At a second level, they become the starting points for theoretical propositions concerning how this often difficult to reconcile relationship can be successfully mediated in practice.

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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 here means that the empirical matter 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 experience-based knowledge of what could be aesthetically interesting, partly on a strategy of providing a group of samples which are both representative in 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 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, including acoustic properties, of significance for the interior spatial design 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 that 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. In the discipline of hand tuft technique I have twelve years of experience as a practicing artist.

[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.

Imbedded 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

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[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 arkitekturforskningen.// 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 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 wholeness 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 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 indefinite many 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 principal 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 a concrete case 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 am the one, who 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 has a wider implication concerning the role of practical design work, 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 PROVNING · FORSKNING

RAPPORT

utfärdad av ackrediterat laboratorium/REPORT issued by an Accredited Laboratory

SWEDAC ACKREDITERING 1002

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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

Figure 2
Unglued bottom weave, 5 cm from wall

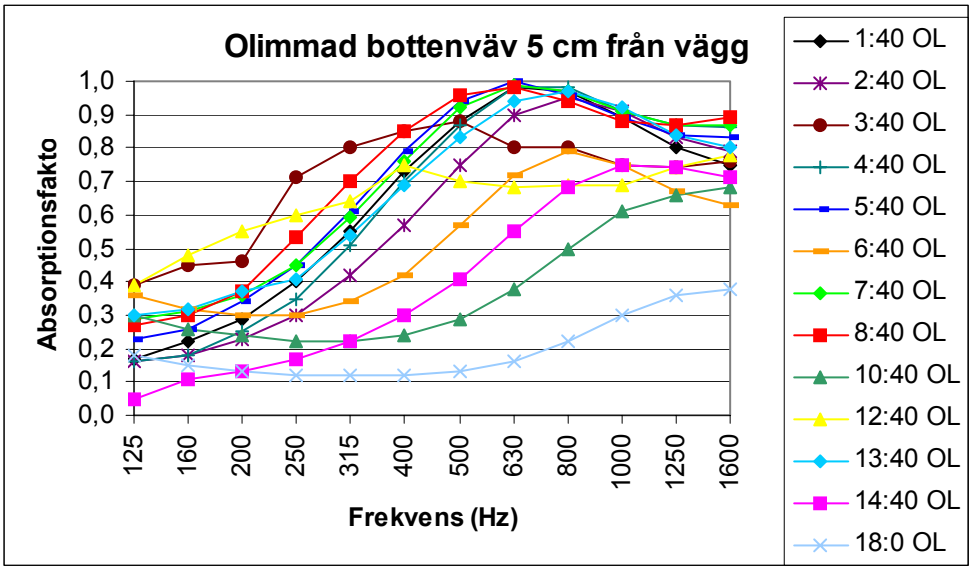

Figure 3
Glued bottom weave, 5 cm from wall

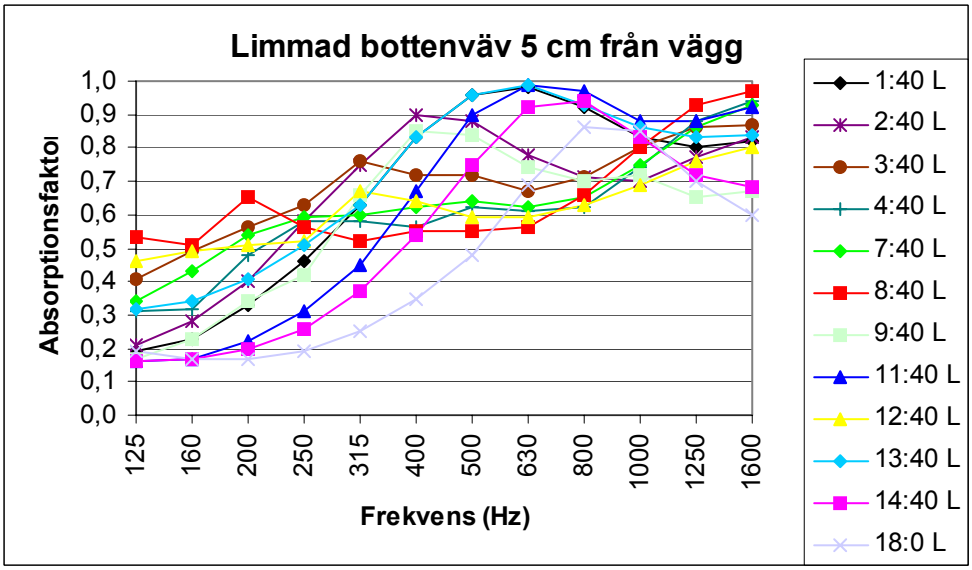

Figure 4
Test against wall, 18 mm thread length

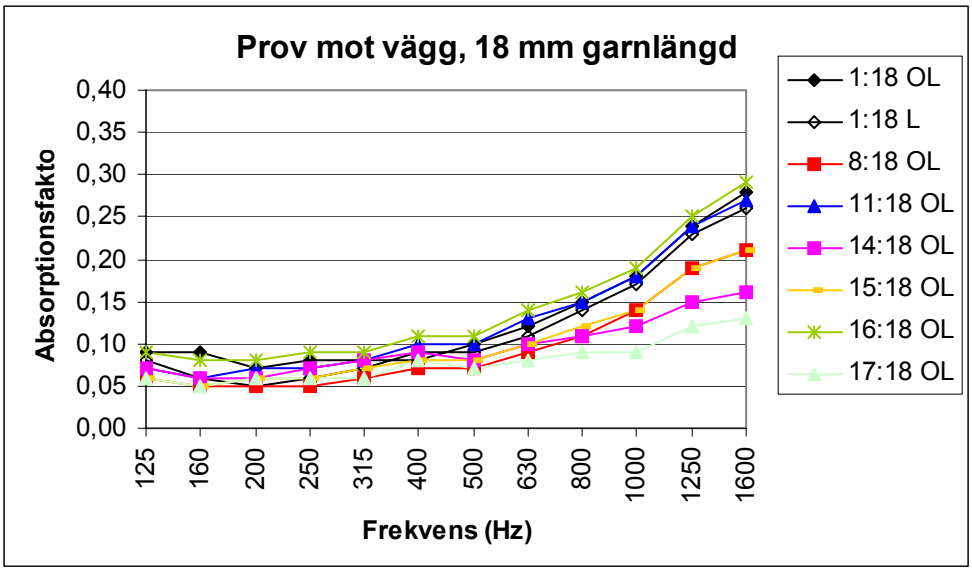

Figure 5
Test against wall, 40 mm thread length