

SELF-FORMATION AS A METHOD FOR INTEGRATED DESIGN - FORMFINDING ANALOGIES TO THE BOHMIAN DIALOGUE

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ABSTRACT

The paper presents analogies of self-formations in architectural design linked to the theory of David Bohm on dialogue. Due to Bohm, dialogue offers an effective method for holistic understanding and scientific achievements emerging in an interactive participative self-formation-process. In the field of structural engineering, the scientific community uses the term self-formation in the context of “Active Bending”. This paper presents elastic bending as a creative form-finding tool for complex curved micro-architecture developed by Walter Klasz and his students at the University of Innsbruck and at the Technical University of Vienna. Active Bending structures have the disadvantage of material fatigue and as such the problem of increasingly growing weakness. To guarantee long-term structural strength of such bent forms, selected studies present exemplarily hybrid solutions for long-term stability. The structures form and stabilize simultaneously during the assembling process. The paper focuses on the parallels between this physical emergence from weakness towards strength and the properties of the Bohmian Dialogue, where a strong thought emerges out of the open dialogue. The R&D-Project *Neuschneewolke-Lüsens* (see Fig. 01) presents a full-scale proof of concept.

Keywords: Self-formation, Design-method, Bohmian Dialogue, Integrated Design

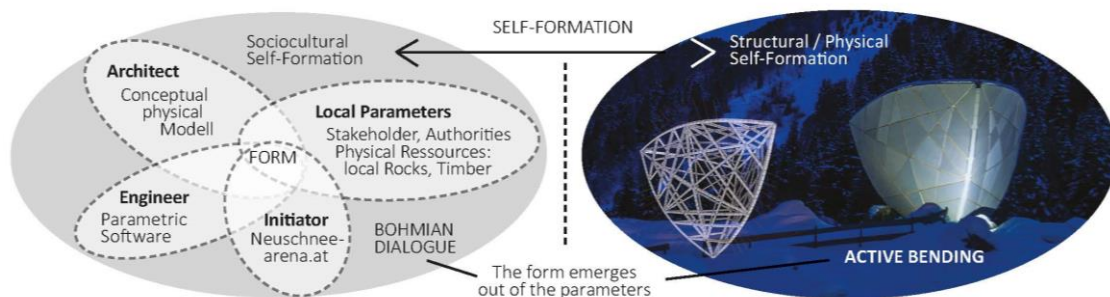


Fig 01: Analogies in physical and sociocultural Self-Formation Processes, Photos and Collage W. Klasz

INTRODUCTION

The theoretical physicists David Bohm became first famous in the scientific field of quantum theory. Inspired by his previous work he has discovered analogies in the field of neuropsychology and the philosophy of mind. Four years after the dead of Bohm, in the year 1996, the book “On Dialogue” edited by Lee Nichol was published [1]. Today, the Bohmian Dialogue is a widely known method in Communication and Organizational Development [2]. In the field of architecture and design, David Bohm is

widely unknown. In Architecture, there is the worldwide technical trend to parametric programming and robotics. On the other hand, participative methods gain in importance to achieve sociocultural acceptable solutions in architecture. There is a link between parametric design and participation, but referring to the sociocultural development of society, Bohm has critically observed a growing fragmentation. The Latin word “pars” has two different meanings. One is “sharing” and the other significance is “giving a part” to a solution or a process. Bohm refers clearly to the first meaning “sharing”. The solution or the process emerges in the “openness” of the process. To share something in a process implicates also actively listening. In a dialogue in the spirit of David Bohm, to “hold something in suspense” (German: “In Schwebe halten”) opens space for collective awareness and for self-formation. The word self-formation will be discussed in the next chapters. On the one hand, it touches the field of parameters, which are forming something in a dialogue or in a structure and on the other hand, it touches intuition and the spiritual dimension of humans in an open dialogue. This work presents the ongoing results of an experimental field-exploring research method. Analogies between physical form-finding of bent wood structures and the Bohmian Dialogue are found and discussed. The built research project and proof of concept *Neuschneewolke* [3] implicates also the sociocultural self-formation during the design-process and during the ongoing temporarily use of the project in a first test phase in 2018.

SELF-FORMATION & INTEGRATED DESIGN

In the context of this work, the term “Integrated Design” refers to the hybrid character of natural designs. A tree for example, implicates an effective structure, sustainable resource management and aesthetics on a high level of integration. Architecture implicates in addition to structure, sustainable resource management and aesthetics a proper function for humans. This primitive comparison has its relevance in the understanding that natural design follows the principle of integration and not the principle of an additive system. Mobility had a strong influence on Integrated Design in Architecture but always on the level of an additive system. The “chair” in a car is – compared to an average living place – highly integrated into the design, but it is still a separate component and not part of the structure. In furniture design, the full scale realized case study *Bondage* is an example for high integration of form, structure, aesthetics and optional function as a relaxing object for the human body. The form-finding followed the principle of self-formation in the physical meaning of Active Bending [4].



Fig 02: Project *Bondage* by Johannes Fandl and Laurenz Greger; Technical University of Vienna, Institute of Art and Design, Univ. Prof. Christian Kern; 2017; Left: Intuitive scaled model; Right: 1:1 realized project during the presentation at the Vienna Design Week, Lecturer and Photo Walter Klasz

The form itself is not designed, but it emerges following the bending behavior of the material. The designer works exclusively on the following parameter: Choosing the length and wideness of the wooden stripe, which twists along his own axis while being fixed by its end on his own beginning.

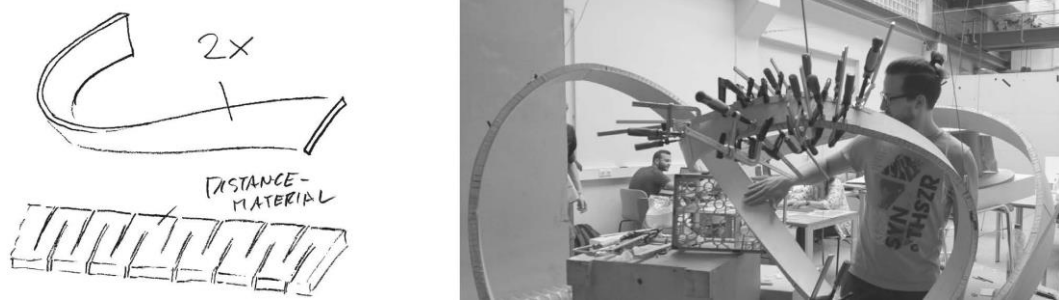


Fig 03: Typological sketch for the statically solution by Walter Klasz, Photo of the production process

The primarily form is structurally weak, but strong enough to sustain the self-weight. A flexible distance material provides the structural height to the offset loop, which creates as a result a bent sandwich construction (see Fig. 03), strong enough to carry a person (see Fig. 02).

SELF-FORMED MICRO-ARCHITECTURE IN BENT WOOD

Julian Lienhard from Stuttgart was the first Engineer naming his observation Active Bending: His Dissertation examines the phenomenon that an actively bent material gains in stability compared to the same material without bending. The growing international scientific community in this field focuses on the digital simulation and structural usage of this phenomenon. As material fatigue is the main disadvantage, Active Bending Structures are at the moment still mainly a research vehicle for Engineers. Except in specific functional fields like the moving façade of the theme pavilion Expo Yeosu in 2012 by soma or some academic research pavilions of small scale, there is until now very little relevance of Active Bending for the built environment.

Due to the positive experiences in research-based teaching for four years, there is a high relevance of Active Bending for form-finding. The disadvantage of material fatigue – respectively the reducing statics of such structures – can be solved in different hybrid solutions individually chosen in dependency of the aesthetical goal, the scale and function of the project.

The main limitation of this form-finding method is self-weight during the assembling-process. The experiences with the full-scale proof of concept *Neuschneewolke-Lüsens* allows the recommendation of a size range up to ten meters. Architecture of such a scale, which is carefully lifted off the ground, touching the earth lightly, is called micro-architecture [5]. Using the form-finding method of Self-formation as described in this

paper, such projects “can be called Self-formed Micro-Architecture” [6]. Figure 04 presents exemplarily some studies of research-based teaching in this field.

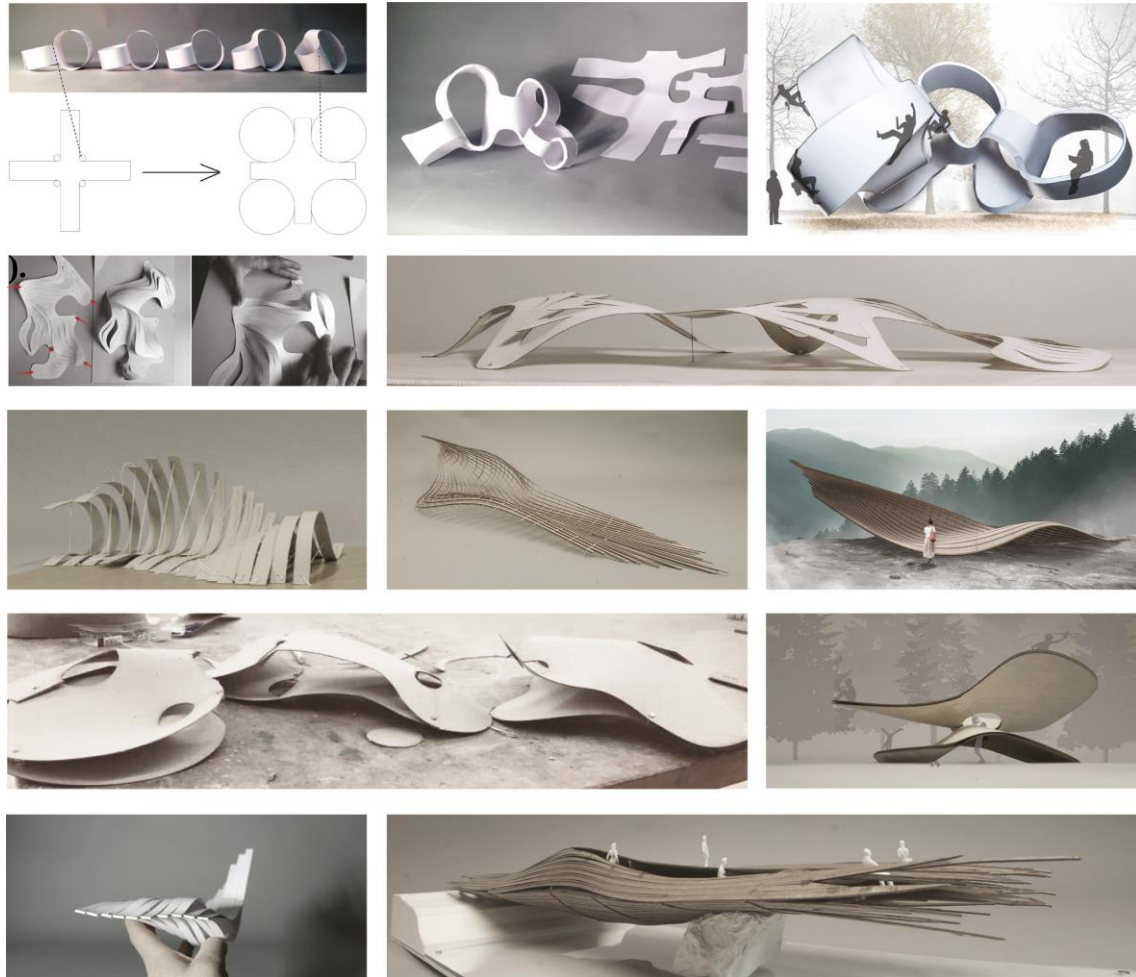


Fig 04: Selected self-formed micro-architectures developed by students of Walter Klasz at the University of Innsbruck; From up to down: Maria Hasenauer, Sandra Camini, Bernhard Blaschette, Blanca Fabrega, Fabian Venier (Winner of the Student Competition “Structures in bent Wood” powered by Sunkid, 2018).

Working with this method of self-formation in scaled models helps students intuitively to get an understanding for the bending behavior, for the form-finding-process and the limitations of the material. The physical model-making is a kind of training in the spirit of David Bohm. The form emerges out of the outer parameters. An important aspect of design-process is the exploration and modification of the connections of elastic bending members to each other. The process asks for little inputs, careful observation and pointed reactions to what the material is doing. The designer never works on the form itself, but mainly on the parameters. The design method is characterized by a primarily listening behavior of the designer, whereas a basic intuition or desire is necessary to get started into the process of self-formation.

ANALOGY: PHYSICAL SELF-FORMATION & THE BOHMIAN DIALOGUE

The analogies between the Bohmian Dialogue and Self-formed Micro-Architecture are systematized referring to the steps of the assembling process of the proof of concept *Neuschneewolke* (see Fig. 05 right side).

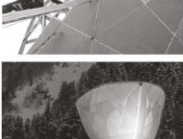
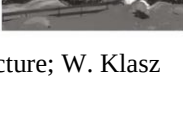
CONVENTIONAL COMMUNICATION	BOHMIAN DIALOGUE	SELF-FORMED MICRO-ARCHITECTURE	PROOF OF CONCEPT <i>Neuschneewolke</i>
In a discussion members start already in „tension“ aiming to convince the others from their point of view.	Dialogue members are starting „relaxed“ in a calm atmosphere of confidence.	Wooden stripes, a slack cable for stressing and connection points are prepared to come into a new order.	
Self-defensive activity of participants prevents listening.	Giving full attention, while trying to understand the others entirely.	Allowing elastic deformation while finding an inner equilibrium of forces	
If a discussion member has found a strong position, there is a tendency to strengthen this position and to weaken others.	If a formation seems to be useful, reiteration could be tried out to prove the thought and to understand the inner order.	Self-formation describes a form-finding process, in which always the same form emerges, if the parameters don't change.	
In a discussion members defend their individual position without starting a deep relation with the others.	In a dialogue in the spirit of David Bohm an open space emerges inbetween the dialogue members.	Intuitively spatial solutions are found. Proper connection points are developed and installed.	
Discussions have winners and losers in the end. Once a strong position is found, there is less flexibility for exploration.	„Dialogue explores the manner in which thought [...] is generated and sustained on a collective level“. (Quotation Preface „On Dialogue“)	Exploring up and downs; Changing perspectives and Implementation of secondary members, which are bent between the primarily members.	
If a thought or an argument works in one context and scale, conventional thinking tends to simplify it to a common principle without rethinking necessary adaptations in another context.	A strong thought may be tried out in different scale and changing context. A careful look from the group accompanies such a process for possible necessary adaptations.	The step from scaled physical models to full scale realisations is limited by the selfweight of the material, the available size of members and the assembling method.	
At the end of a discussion, opposite positions are worked out and argued properly. There may be the disadvantage, that members leave a discussion without gaining holistic value for society.	An open dialogue gives the members a certain feeling of lightness. Thoughts may be lifted into different fields or sites or areas of society.	Lightness and the reduction of materiality is a main character of Self-formed Micro-architecture. Site-assembling, lifting the whole object or hybrid solutions are found due to the local parameters.	
Conventional thinking tends to build heavy foundations for found solutions.	A main aspect of the Bohmian Dialogue is to „suspend a thought“. (German: „In Schwebe halten“). It refers to the attitude, not to judge, but rather to lift the thought and to look at it carefully.	„Touching the earth lightly“ is a design attitude with roots in the culture of the indigenes. Richard Horden uses this phrase to establish a design language for Micro-Architecture [5].	
In discussions, successful arguments are not questioned anymore. There is the tendency to cover a form-finding process and to show the result only. Maybe the process is lacking aesthetics, which prevents transparency.	David Bohm uses the word „open“ dialogue. There is no hierarchy in the process-organization, but rather a collective awareness. It may help to make a break and to keep distance to the thought.	Self-formed Micro-Architecture is characterized by the quality of the space „inbetween“ the object and the landscape. A small form may define a huge space.	
In a conventional discussion paradoxical items may not get enough attention as arguments against arguments are blocking the flow of deeper observations.	Thoughts emerging out of an Bohmian Dialogue may have paradoxical items and a strong relevance at the same time.	In terms of geometric understanding a plane panel cannot be double curved. In full scale realizations the inaccuracy plays no relevant role and it proves to be possible.	
A conventional discussion tends to leave behind opposite positions rather than a new outcome.	A Bohmian dialogue leaves behind calmness and surprise simultaneously.	Self-formed Micro-Architecture implicates a hidden inner order, which attracts attention in a calm way.	

Fig 05: Analogies between Bohmian Dialogue and Self-formed Microarchitecture; W. Klasz

PROOF OF CONCEPT - *NEUSCHNEEWOLKE-LÜSENS*

The publicly funded Research- and Development Project *Neuschneewolke* serves as a proof of concept on two levels: First referring to the practical application of the dialogue in the Spirit of David Bohm in the multidisciplinary research team and secondly in the form-finding of the project itself.



FORMATIONPROCESS OF AN **INTEGRATED DESIGN** in Workshops with Dialogues in the Spirit of David Bohm

PARAMETERS OF THE MATERIAL
(Using the Elastic Modulus of fresh cut timber)

PARAMETERS OF THE SITE
(3D-Scan of the topography)

PARAMETERS OF THE FUNCTIONAL „SKIN“
(Bent Composite Panels by Valentine Troi)

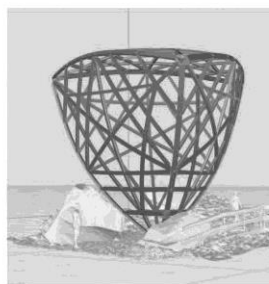


Fig 06: Collage of Photos of the Form-finding-process during Workshops of the Research Group *Neuschneewolke-Lüsens*. Documentation by W. Klasz as Project Leader, University of Innsbruck.

The constructional typology of the spherical tetrahedron and the basic geometric grid system bases on the initially intuitive physical model by Walter Klasz. The research group has worked in close collaboration on the optimization and integration of all functions and parameters. Following solutions are identified as specifically results of the workflow in the spirit of David Bohm (see Fig 06): First, Active Bending is used mainly for form-finding and less for the final statics. The hybrid solution of self-formed double T-beams in combination with the grid-shell configuration and the panels provide the long-term stability. Second, the scale of the project and of the components have been optimized in an iterative process, keeping in mind the requirements for the snow-production, the efficiency in the assembling process and the local topography. Third, the double curved wooden panels are only two-dimensionally CNC cut, as the bending occurs during the assembling in a self-formation-process.

The digital form-finding for the statically self-interlocking structure is done with the parametric software Kangaroo2-Engineering, which is developed by Format Engineers from Great Britain. The project *Neuschneewolke* proved in a size of 8,5m side length of the structure that the bending behavior was simulated precisely. As such, the accurate cutting of the members and the knots worked out to be successful to simplify and to

fasten the assembling process. The cables of the bent edge-beams are removed in the final configuration (see Fig. 07). The panels support the statics against twisting - especially in the lower part close to the three connections points to the local rocks. The full-scale structure proves the feasibility to build complex double curved forms out of straight members and plane panels without any supporting form or scaffold. The structure forms and stabilizes simultaneously itself during the assembling process. The ongoing applied research-project combines aspects from land-art containing advanced technology for sustainable winter-tourism [7], and combined with as sport without ski lifts (see Fig 08).



Fig 07: Collage of the bent edge beams of the *Neuschneewolke-Lüsens* during the production and assembling process. The tension cables are removed in the final configuration; Photos W. Klasz



Fig 08: Impressions of the *Neuschneewolke* in the context of the Neuschnee-arena Lüsens in Tirol. The bent wooden cloud-construction provides space for the emergence of snow-flakes providing everyday fresh snow for the users; Photos W. Klasz 2018 (see also www.neuschee-arena.at)

CONCLUSION

The most relevant analogy between the Bohmian Dialogue and physical self-formation in the field of architecture is the simultaneousness of formation and stabilization, which leads to integrated design solutions. In contrast to conventional discussions, where antagonism leads to a defensive attitude of the participants, in a dialogue in the Spirit of David Bohm polar oppositions may turn into creative parameters for the emergence of unique forms [8]. The results of such self-formation-processes leave behind a high level

of identification of the involved members. Summarizing self-formation is not only a physical phenomenon in the field of Active Bending, but it implicates a certain spirit with strong analogies to the philosophy of David Bohm. Self-formation represents a typology of creative form-finding enabling to solve complex challenges and to discover new forms in the field of communication as well as in architectural design.

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