Thesis booklet of the dissertation ‚generic space‘ for obtaining the academic degree:

Doctor of technology
(Dr. tech. or PhD)

Supervisor:
Univ.-Prof. Dr.-Ing. Balint Bachmann
Habil. Dr. Tamás Molnár

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fig. 0: This dissertaition is about generic space: generic space is a value of common ground

Statutory declaration

„I declare under oath that I have made the following work autonomously. The from other sources taken directly or indirectly thoughts or formulations are designated as such. The work has not been presented at any other educational institution, and is not yet published.“

Graz, _____ _____

(jan WERNER)

Note on Gendering:
In this work, great emphasis is placed on equal treatment.
In the interest of readability, however, either the masculine or feminine form of names is selected. This is not intended to imply a deprivation of the opposite sex.

» The contemporary city and architecture must free itself from the principle of repetition and differentiation or foreclosure, and instead must focus on architectural flexibility which corresponds better to the complexity, dynamics and compression of our lives today. «

(architekt Zaha Hadid)

(Interview: Sophie Lovell with Zaha Hadid ‚Zaha is out now', Oktober 2015, published in „uncube Magazine Nr. 37", http://www.uncubemagazine.com/magazine-37-15927105.html#!/page11)

content

1 introduction

fig. 1: „offered space versus required space“ - not in every case the same

The world is in motion. Society is in a constant change (1). Demographic trends in Europe ensure an almost 10 percent decrease in population percent by 2050 (2). At the same time communities migrate to Europe and counteract this development (3). The economy fluctuates strongly (4). Technical developments will multiply and have a substantial impact on people (5). Social change is also the driving force for the development of society (6). The past shows that the speed of this development is not constant but increases exponentially (7).

The development of the building industry was based on the idea to support people and enhance their well-being in order to increase their living comfort. As constructions provide artificial spatial home environments they facilitate people's lives and personal developments on a daily basis. In order to satisfy the needs of housing and living society requires built space (8).

The emergence of a building takes time. A corresponding building is preceded by an appropriate planning phase (9). In our European construction culture a building is - on average - maintained for several decades and ideally remains several centuries (10).

As the planned or built structure of today will be obtained for a few decades, architectural approaches should meet present and future requirements of society to a building.

During the life of a building society undergoes changes. Due to the exponential increase of development speed this change accelerates; transitions get faster and proceed within shorter intervals.

In the dissertation „Generic space" the effects of this change on construction are investigated and approaches drafting potential solutions are developed.

1) Cf. ref.: Pädagogisches Institut Bozen (2000), Umbrüche in unserer Gesellschaft. In: Orientierung suchen - Ziele setzen - Schule gestalten (Seite 21 ff.) Hrsg.: Pädagogisches Institut, Bozen

2) Cf. ref.: I. Hoßmann, M. Karsch, R. Klingholz, Y. Köhncke, S. Kröhnert, C. Pietschmann, S. Sütterlin (2008), die demografische Zukunft von Europa (S. 3 f), Hrsg: Berlin Institut für Bevölkerung und Entwicklung, dtv München

3) Cf. ref .: E. Gehmacher (2015-08-23), die neue Völkerwanderung, Die Presse

4) Cf. ref. : De Statis (2015-12-28), Entwicklung des Bruttoinlandsprodukts 2005-2015, statistisches Bundesamt Wiesbaden, Deutschland

5) Cf. ref. : K. Alexander (2014-11-30), Erfindungen und deren Auswirkungen auf den Menschen, Sciense Spirit

6) Cf. ref. : H. Bathelt (1994), Die Bedeutung der Regulationstheorie in der wirtschaftsgeographischen Forschung (S. 64-90), Franz Steiner Verlag

7) Cf. ref. : W. Hehl (2008), Die exponentielle Entwicklung der Grundtechnologien, vdf Hochschulverlag, Zürich,

8) Cf. ref. : J. Rykwert (1981), On Adam's House in Paradise: The Idea of the Primative Hut in Architectural History, Mit University Press Group Ltd.

9) Cf. ref. : E. Neufert (1992), Bauentwurfslehre, Vieweg Verlag

10) Cf. ref..: W. Kleiber; J. Simon, G. Weyers (1998), die wirtschaftliche Nutzungsdauer von Gebäuden, Bundesanzeiger Köln (S. 2123)

2

thesis

fig. 1: vacancy - building closed for renovation

1) Vacancies and life cycle costs of buildings rise due to complex and costly spatial adaptations to changing requirements.

2) A new building standard is necessary: Substantial interior flexibility

3) A generic system is the basis for serial flexibility of the interior.

4) Generic systems for permanent flexibility of the interior are feasible

5) Permanent interior flexibility enhances the sustainability of a building

6) The development of the Flex-Pass: Sustainability due to flexibility can be measured

Thesis 1

Vacancies and life cycle costs of buildings rise due to complex and costly spatial adaptations to changing requirements.

fig. 3: plumbing and electric in buildings - complex and expensive facilities - difficult to change or to adapt

fig. 4: ventilation in buildings - complex and expensive facilities - difficult to change or to adapt

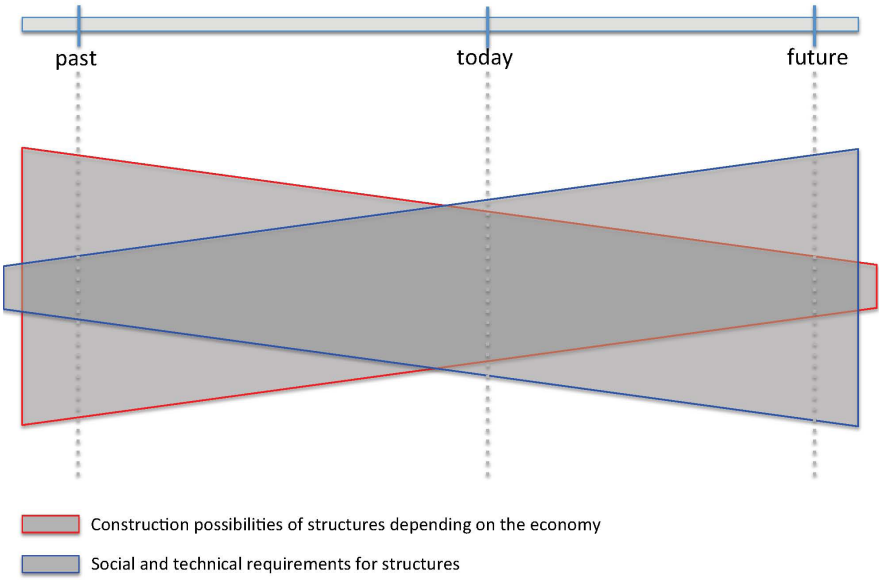


fig. 5: trend of the necessary interior space diversity, depending on available space diversity

Demands of society for buildings change:

Due to pluralization of living conditions, global migration as well as individualization, society is in an accelerated transition and will become increasingly diverse in the future (11). Hence, construction and spatial requirements of society change faster (12). Spatial configurations that used to be regarded as modern and were high in demand in the 1990s have lost their value or are even vacant today.

Remodeling processes are increasingly necessary:

However, due to future uncertainties it is impossible to plan and draft the usage scenarios of the life cycle of a building during the development phase. It is therefore necessary to adapt a building during its life cycle structurally, to adjust spatial configurations in terms of new requirements. For faster changing demands adaptations and modifications are increasingly necessary.

Remodeling processes are complicated, lengthy and expensive:

The adaptation procedure of a building according to new or changed requirements is expensive and time consuming; restructuring processes necessitate a tremendous increase in life cycle costs. During this time the available space is restricted. In addition to the rising life cycle costs also the vacancy of the building increases.

Conclusion:

A building is planned for decades. In this life cycle the spatial requirements of a building change frequently. During the planning period the consideration and anticipation of these changes is impossible. The adaptations of a building in terms of changing requirements are usually complicated, costly and time consuming. In accordance with the reconstruction works also vacancy and life cycle costs increase.

There are no approaches in housing or office construction that facilitate convenient adaptation solutions for technical equipment and spatial configuration.

11) cf. ref.: U. Schimank, Individualisierung der Lebensführung, BpB, Deutschland, 31.05.2012

12) cf. ref.: T. Huber, H. Gatterer, M. Baumgartner, A. Seidl, Ch. Varga (2013), fractal living (S. 22f), Zukunftsinstitut

Thesis 2

A new building standard is necessary: Substantial interior flexibility

fig. 6: interface to the outside world - energy-optimized facades

fig. 7: standard interior fittings - drywall plaster

(Again) the building industry is facing a (r)evolution:

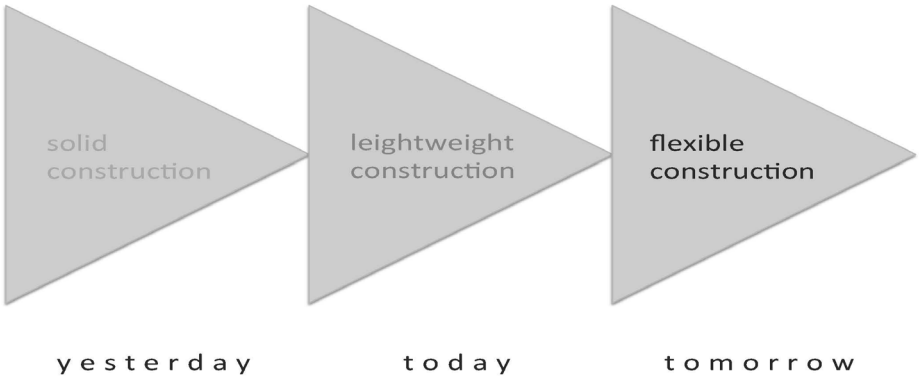


fig. 8: historical development of the building industry

Task of construction engineering:

Fundamental object and purpose of the construction industry is the facilitation of spatial solutions. These solutions are to be provided for society; therefore, space must remain affordable. Simultaneously a sustainable economy and a responsible use of resources are crucial.

Today‘s building standard:

Today established design principles for spatial configurations require adaptations in terms of demolition, renovation and construction of space solutions. Therefore, these approaches are not sustainable; they are neither resource-efficient nor do they meet the ever more rapidly changing needs of society!

The building envelope: An interface to the outside world

The envelope of a building defines the maximum usable space. The parameters are complex, but remain steady throughout the life of a structure.

The building envelope depends on the property. Its development is therefore customized, according to the laws in the present, climatic influences, structural requirements, the principles of building physics, etc.

The envelope of a building is thus a fixed interface between heterogeneous outside world with customized requirements and homogeneous interior for user-oriented space solution.

The interior: Protected habitat

The interior comprises the usable total volume of a structure; separation into ceilings and walls facilitates user-oriented units. The interior has to provide a solution to the spatial demands of society.

Since the 1960s the „non-structural dry wall“, in particular the plasterboard wall, has been established as key element of partitioning in interior design. In theory this construction seems to be flexible, however practice proves otherwise. The adaptation of spatial configurations created with plasterboard walls require - in addition to rubble and vacancy - the construction of new walls.

Potential of ‚interior space‘:

The interior has the potential to create a structure that is faster and easier to adapt. This necessitates a flexible spatial configuration. If a facile and convenient adaptability of the interior in terms of changing requirements is ensured, the whole building can meet the altered needs of society.

Conclusion: New building standard necessary

Currently established planning processes and the adaptation of construction methods of the interior by complicated conversion (thesis 1) generate rubble and vacancy during the construction period; each conversion increases the life cycle costs of a building considerably. This standard does not suit the rapid change of requirements in the building industry.

To prepare the building for the future, new approaches in terms of planning and implementation of works are necessary.

(Again) the building industry is facing a (r)evolution:

solid construction -> leightweight construction -> flexible construction

a generic system is the basis for serial flexibility of the interior.

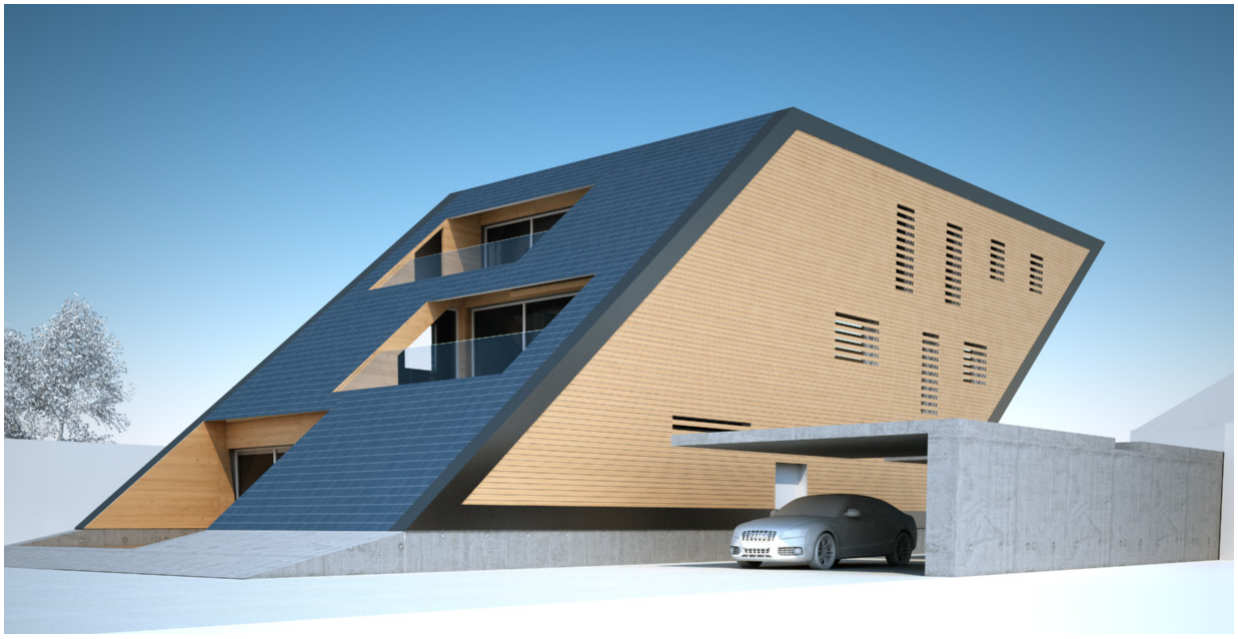


fig. 9: building G, Tristach/Austria: adaptable floorplan for different uses

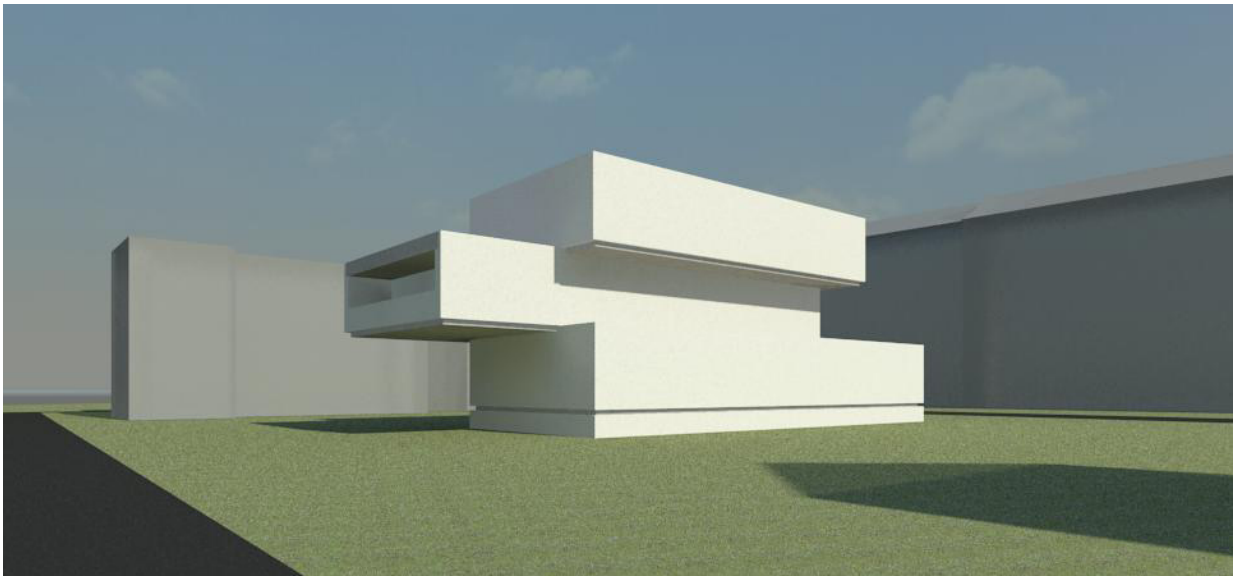


fig. 10: building B, Graz/Austria: structural design with flexible dwelling units

Need for flexible interior:

Numerous investigations of building practice and surveys of relevant user groups have shown that sustainable flexible spatial solutions are in great demand. Individual and customized solutions have been provided for a quantity of construction projects.

The building industry: a project based business

The building industry is a project based business. Every building is planned and established as individual project.

In particular cases spatial planning and island solutions can offer a sustainable and permanent flexible space utility. Individual customized solutions can however not provide a basic and comprehensive standard. Normally they are not multiplied or reproduced at another place.

Systems, comprehensive standards, can however be implemented in island solutions. The building industry has launched systems that are utilized in the implementation of individual buildings.

Building is therefore a 'serial individualism.'

Conclusion:

Individually planned buildings have individual requirements. Different utilities require different spatial solutions.
The demand for „flexible space" is however not individual. Permanent flexible interior space should not only be integrated in individual solutions but should be established as building standard. Therefore, the establishment of systems that provide interior spaces with permanent flexibility is required. These systems must be applicable on every building project.

The basis for permanent flexible interior space can only be a generic systematics that is capable of reacting to different utilities and generating various spatial solutions.

Thesis 4

generic systems for permanent flexibility of the interior are feasible: the geccoWall

fig. 11: open interior space

fig. 12: Do-it-yourself: subdivision of the interior space with a permanent flexible partition wall system

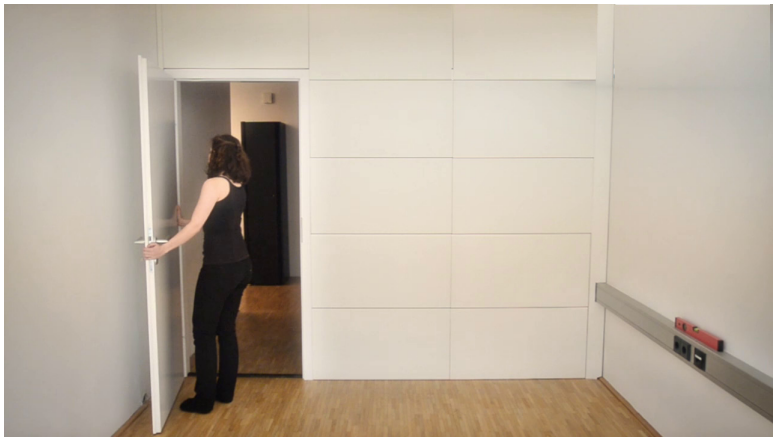


fig. 13: the permanent flexible ‚geccoWall‘ as a partition system

Parameterization:

In order to develop and design a generic system a structural and cross-functional parametrics which considers all relevant impacts is necessary. A system following these parametrics is individually applicable. It can be implemented within diverging conditions and influences and is therefore a suitable construction standard.

Features and indicators:

Aside from technical functionality also legal feasibility plays an essential role. Only if both values are met, the use of a system in a building is permitted.

Whether an approved system actually comes into use depends on the acceptance and efficiency of the system. According to surveys and investigations the acceptance of a permanent flexible system is based on usability and sustainability. Therefore, a generic system facilitating permanent flexibility in interior spaces is based on the following influential variables:

- *Efficiency*

- *Legality*

- *Economics*

- *Sustainability*

- *Usability*

„geccoWall“

In consideration of these indicators a permanently flexible wall system has been developed by the author. The system is patented and therefore accounts for innovation. The feasibility of this system has been detected in a first long-term prototype and in various simulations and finite-elements-calculations. „geccoWall“ is supposed to verify theoretical assumptions.

Conclusion:

A system as building standard to improve the flexibility of the interior is subjected to appropriate parameters some of which can be verified in terms of defined characteristics and indicators. However, a theoretical scheme is only useful if it also succeeds in practice and if it generates deployable systems that meet all essential features.

Currently there are no systems on the market that meet these characteristics. Thus, a new system was developed by the author and has already been patented. It proves the feasibility of generic systems based on defined characteristics.

Therefore, the development of the space system „geccoWall“ points to the feasibility of generic systems for permanent flexibility. A first long-term prototype has confirmed the feasibility in practice for the past five years.

Generic systems for permanent flexibility of the interior are feasible.

fig. 14: enormous waste production due to restruction

fig. 15: partition of interior space through flexible systems

fig. 16: adaptable surfaces of the permanent flexible partition system ‚geccoWall' for individualization of walls through the user. Recource conservation and waste prevention. (example: geccoWall)

Reduction of life cycle costs and vacancy:

The interiors of buildings can be customized by permanent flexible space systems at any time.

The use of permanent flexible space systems reduces the vacancy rate. Adaptation becomes faster, more economical and straightforward. Outdated inefficient space configurations can be easily adapted.

Moreover, the use of flexible space systems encourages conversion and the remodeling of interior spaces of existing well-performing envelopes largely without littering or other damages.

Increase of sustainability:

Minimizing the reconstruction effort to ensure the functionality and usability of the interior space saves not only costs but also valuable resources. In addition to the economic benefits a more flexible interior space also contributes to the efficiency and sustainability performance of a building.

The sustainability of buildings is currently measured according to its energy consumption. The assessment and classification is depicted on the so-called Energy Performance Certificate of a structure.

Conclusion:

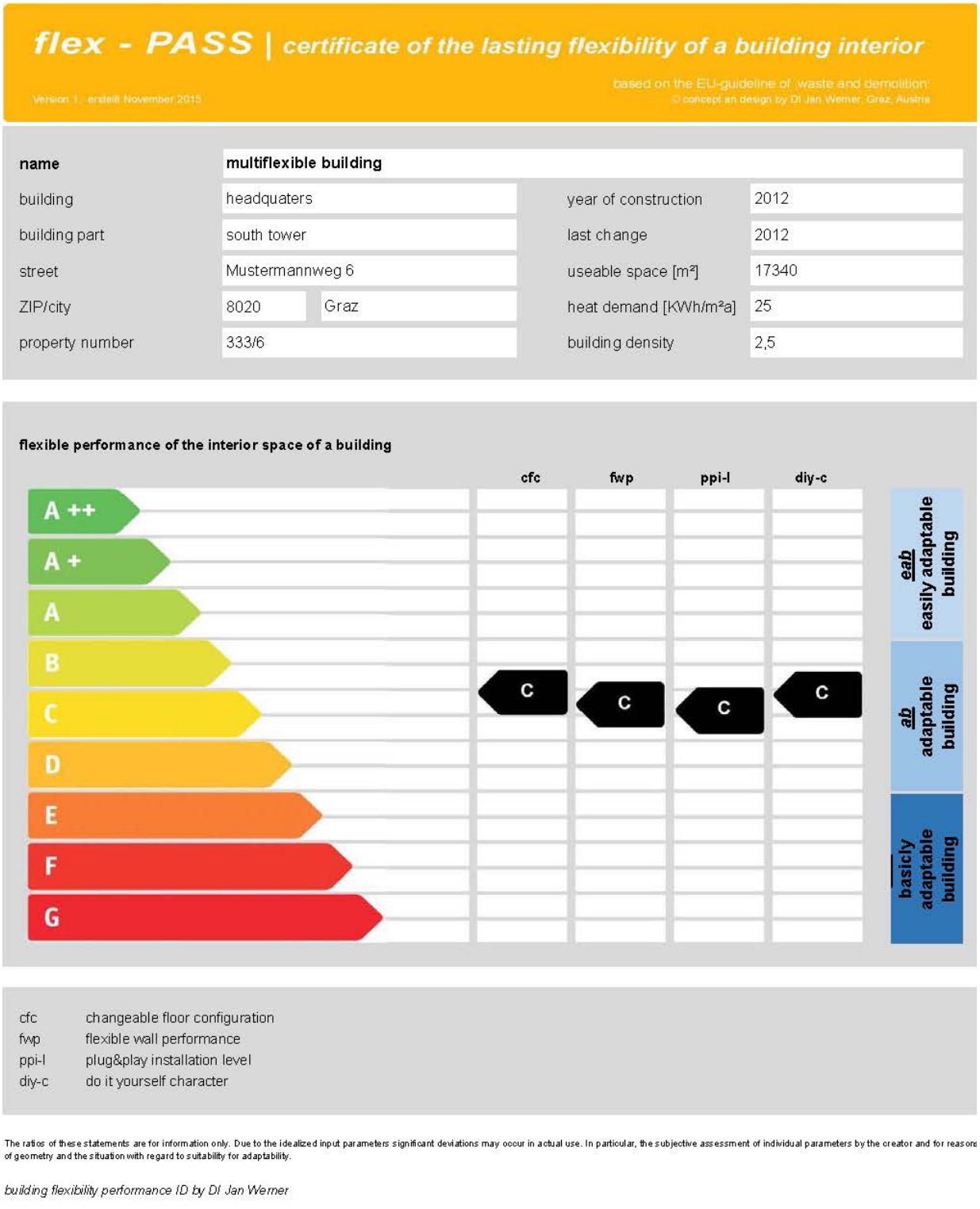
Due to the conservation of resources and the increased spatial utility, the spatial flexibility of a building impacts the sustainability of a structure.

Permanent flexible space systems facilitate a tremendous increase in terms of the sustainability of space, as well as the sustainability of buildings.

The assessment of KWh/m2a is an insufficient classification scheme regarding the sustainability of a structure.

The flexibility of the interior leads to a completely new prospect:

Only volumes with energy-optimized façades and energy-optimized technical equipment, which are simultaneously adjustable to the changing needs of users, are truly sustainable.



flex - PASS | certificate of the lasting flexibility of a building interior

Version 1, erstellt November 2015

based on the EU-guideline of waste and demolition
© concept an design by DI Jan Werner, Graz, Austria

name	**multiflexible building**		
building	headquaters	year of construction	2012
building part	south tower	last change	2012
street	Mustermannweg 6	useable space [m²]	17340
ZIP/city	8020 Graz	heat demand [KWh/m²a]	25
property number	333/6	building density	2,5

flexible performance of the interior space of a building

	cfc	fwp	ppi-l	diy-c
A ++				
A +				
A				
B				
C	C	C	C	C
D				
E				
F				
G				

eab easily adaptable building
ab adaptable building
basicly adaptable building

cfc	changeable floor configuration
fwp	flexible wall performance
ppi-l	plug&play installation level
diy-c	do it yourself character

The ratios of these statements are for information only. Due to the idealized input parameters significant deviations may occur in actual use. In particular, the subjective assessment of individual parameters by the creator and for reasons of geometry and the situation with regard to suitability for adaptability.

building flexibility performance ID by DI Jan Werner

fig. 17: Design of the first page of the all new flex-pass to point out the sustainability of the interior space of a building

Comparability of flexibility:

At present flexibility is a dictum. Also in construction „flexibility“ is used as marketing element. However, „flexibility“ is a rather loose concept. A precise definition and delineation is not provided. Hence, the terms „flexibility“ or „flexible“ are not inherently meaningful.

The evaluation of a system or space as „flexible“ says nothing about the actual flexibility. In order to make a user-friendly decision it is necessary and essential to compare different systems. Since „flexibility“ has an elastic connotation a comparison of different systems which purport to flexibility by an appropriate titling is required.

Indicators:

The comparison of different systems with the same or similar flexibility demands is only possible if single parameters are measured and defined according to similar recurrences. Research has shown that certain indicators are indispensable.

Indicator ‘cfc’ - changeable floor configuration

Indicator ‘fwp’: flexible wall performance

Indicator ‘ppi-l’: plug & play installation level

Indicator ‘diy-c’: ‚do it yourself‘ character

Development of a measuring system:

The energy performance of a structure is depicted by means of an Energy Performance Certificate. This energy pass provides a standardized comparability of various structures.

Similar measuring systems can depict and standardize size, flexibility and the potential of generic spatial systems. This system has not been established. It is the aim of my dissertation to discuss this measuring system and define its fundamental features.

flex - PASS | certificate of the lasting flexibility of a building interior

Version 1, erstellt November 2015

based on the EU-guideline of ‚waste and demolition'
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building characteristics

gross floor area	21670 m²	heating system	Infrared	use	gemischt
reference base	17340 m²	heat recovery	PV	method of construction	diy-c
gross volume	70860 m³	electric installation	plug&play	construction system	scelett
buildong envelope	56680 m²	lightning control	funk	partition walls	flexible
compactness (A/V)	0,8 m²	cooling system	decentral	degree of complexity	1
characteristic length	1,3 m²				

complexity and effort in change of use (summary)

		degree of complexity (1=easy, 9=complex)	effort coefficient DIY (1=simple, 9=high)	total	requirement	rating
changeable floor configuration	basic grid					not fulfilled
	ceiling					
	wall					
	floor					
flexible room performance	reusability					not fulfilled
	flexibility of surface					
	without damage					
	load capaticity					
energy supply	230 V supply					fulfilled
	12 V supply					
	internet/phone/com					
heating supply	routing					not fulfilled
	heat recovery					
	heat dissipation					
waterbased installations	heating system					not fulfilled
	fresh water					
	warm water					
	used water					

created

GWR-number		**creator**	DI Jan Werner
date of creation	26.Februar 2014	**signature**	
effective date	26.Februar 2024		

The ratios of these statements are for information only. Due to the idealized input parameters significant deviations may occur in actual use. In particular, the subjective assessment of individual parameters by the creator and for reasons of geometry and the situation with regard to suitability for adaptability.

building flexibility performance ID by DI Jan Werner 2

fig. 18: Design of the following page of the all new flex-pass. The shown tables and parameters are to measure the flexibility of the interior space.

The FLEX-PASS as measuring system for sustainability of interior spaces:

The development of a measuring system in order to measure and categorize permanent flexible interior spaces is based on the previously discussed and defined indicators.

Concept and aim:

The concept and aim of the Flex-Pass is the quality assessment of a building in terms of its adaptability. Therefore, the already established and comprehensible presentation of an efficiency-scale is used. The energy pass comprises this scale.

Structure and content

The Flex-Pass illustrates an assessment and classification of structures in terms of their flexibility. The scale on page one displays this parameter.

In order to determine an evaluation and classification, specific sections have been established; they reveal different areas where flexibility can take place and point to the possibilities of flexibility.

The categorization scheme in terms of flexibility rank results and derives from these sections. The classification and assessment of used systems, building parts and materials has been included. The categorization and depiction of flexibility degrees enables a comparison of different approaches and systems regarding the flexibility of a structure.

Application and implementation:

The application of a „Flex-Pass“ allows for an overall assessment of the sustainability of a building from its formation to its utilization and eventual recycling. Complementary to the Energy Performance Certificate a new sustainability-based building certificate is established.

An additional measuring system leads to additional efforts in terms of feature assessment as well as indicator examination and - analysis. However, in addition to the effort the commitment to a Flex-Pass encourages willingness and acceptance to create permanent flexible interiors. A positive Flex-Pass assessment of a building increases its value.

The expected value regarding long-term usability and sustainability of a structure by means of integrating the systems for the permanent flexibility of interior space is very high. Besides minimizing vacancy rates and the reduction of life cycle costs, durable flexible interiors are a decisive contribution to sustainability and resource conservation in construction.

This surplus value justifies the increasing effort resulting from the introduction of an additional measuring system. In order to implement the Flex-Pass appropriate political support is required.

The Flex-Pass is therefore an assessment scheme to measure the sustainability of interior spaces.

3 conclusion

fig. 19: total free spatial configuration supported by ‚augmented reality'

Spatial flexibility in buildings is a necessity in the future.

Flexibility in structures: The idea is very old; already Le Corbusier developed the Unité d'habitation - a guiding principle for flexibility and adaptability in the building industry. To date, there have been numerous attempts, prototypes and concepts to integrate flexibility in construction. They were able to detect flexibility as an added value in buildings; yet, their findings on flexibility were not standardized.

This will change in the future. Adaptations throughout the life of a structure in terms of remodeling and adjustment processes have a huge impact on energy – and resource consumption, as well as on life cycle costs. Due to conversions even buildings with energy-efficient envelopes increasingly release and spend energy and resources. Thus, aside from considering the energy performance of a structure also resource consumption plays an increasingly important role in terms of assessing the sustainability and cost-efficiency of a building.

Permanent flexible space systems minimize the resource expenditure of a building and increase its cost-efficiency. In terms of a responsible utilization of resources as well as the minimization of life cycle costs spatial flexibility of a building is not necessary in the future.

For the first time in building history the aim is not to generate a surplus value through flexibility but to implement flexibility in order to satisfy the needs of society.

The implementation of permanent flexible spatial systems improves the sustainability of a structure.

Today, the sustainability performance of a building during the deployment, operation and recycling phase is determined on an energetic level. It is excluded that an energetically high building performance is no guarantee of a sustainable building. A changing society involves changing needs of spatial configuration and utilization. In order to meet these requirements a conversion is necessary - also in a building with a high-quality building performance in terms of energy consumption. If this reconstruction is not accomplished, the risk of vacancy increases. If a conversion is carried out, significant amounts of construction waste accumulate for disposal. The building can possibly not be used during the reconstruction phase.

In addition to the energy rating and an assessment regarding the adaptability of a structure considering and examining a building in terms of its sustainability will become indispensable in the future.

Measurable flexibility increases the value of a building

In order to determine the sustainability of a building due to its permanently flexible space utilization, the measurability and comparability of flexible space systems is necessary. The actual flexibility of buildings is not reflected in theory, but only in daily use. Complementary to parameters for the qualification of economic efficiency and reusability the usability of appropriated flexibility-systems is therefore an important indicator in assessing the degree of flexibility in a structure.
A Flex-Pass makes the flexibility of a building measurable and enables the comparison of flexibility performances in different structures.

The joint analysis of energy performance (Energy Performance Certificate) and flexibility performance (Flex-Pass) facilitates a comprehensive sustainability consideration – from the manufacturing phase and throughout the entire life cycle of the building.

In the near future permanent flexible space systems will be a mesurable standard for the interior design in buildings!

relevant publications of the author

publications (2011-2016)

N	Titel of publication	name of journal, book, congress	publishing company, Congress	year of publication	ISBN	peer reviewed
1	Office Buildings	International project 'object construction'	Universität Göteborg / Schweden	Feb. 11		
2	Nachhaltigkeit und Energieeffizienz durch Entwurf und Konstruktion	Interdisziplinäre Ausbildung 2011	UAS JOANNEUM, Graz, Austria	April 11		
3	Bedingende Dualismen	Interdisziplinäre Ausbildung 2012	UAS JOANNEUM, Graz, Austria	Sep. 12	3-902103-43-4	
4	Design liaises technology	Green Design, Materials and Manufacturing Processes	Sim 2013, CRC Press, Lissabon, Portugal	Aug. 13	978-1-138-00046-9	x
5	Offroad Architecture (editorial)	Offroad Architecture (editorial)	UAS JOANNEUM, Graz, Austria	41671	978-3-200-03685-7	
6	dynamic space	Phd Symposium Pécs	Marcel Breuer Doctoral School, Pécs, Hungary	Okt. 14		
7	commercial building G.	Holzbaupreis Tirol 2015	ProHolz Tirol, Innsbruck, Austria	30.01.15		
8	adaptable rooms	International doctoral Day	Marcel Breuer Doctoral School, Pécs, Hungary	27.05.15		
9	Eine kleine Geschichte vom Bauwesen	Bauleistungen	UAS JOANNEUM, Graz, Austria	Sep 15	978-3-902103-58-1	
10	Smarte Raumlösungen aus der Zukunft	woodletter N°44	Holzcluster Steiermark, Graz, Austria	Sep.15		
11	Von der Immobilie zur Mobilie	Zukunftsforum Holz Steiermark	Holz-Innovations-Zentrum Zeltweg, Austria	09.10.15		
12	the impact of social change on construction methods	III. Coinvedi	Universidad Politécnica de Madrid, Spain	Dez. 15		x
13	flexible building construction	Pollak Periodika	Akadémiai Kiado Zrt., Budapest, Hungary	April 16		x

related works (2011-2016)

N	name of the building		location of the building	built in
1	commercial building G.		Tristach, Austria	2010-2012
2	commercial building R.		Leoben, Austria	2013
3	patent "Flexible Partitionsystem"		Wien, Austria	2011-2013
4	Villa S.		Graz, Austria	2014
5	Aparmentbuilding B. with 6 flexible dwellings		Graz, Austria	2014/15
6	Villa K.		Dölsach, Austria	2015/16

4 publications

postgraduate research interests

In this thesis, the prospected fast-growing demand for generic space systems has been widely investigated and proven. On the one hand, structurally feasible solutions for generic space systems have been developed; on the other hand, the feasibility of a measuring system for the flexibility of space has been developed. This system facilitates the categorization and comparison of structures. In order to analyze the system meaningful categories deriving from test results have been developed; moreover, required methods as well as crucial indicators have been discussed and developed.

Definition of measuring parameters and measuring methods:

In order to provide contents for indicators, sections and categories specific parameters are to be depicted; measuring methods must be defined.

Creating a measurement and evaluation catalog:

Therefore, the further research interest lies in the establishment of a measurement and evaluation catalog in order to describe measurement points and measurement methods in detail.

Field test and verification:

Furthermore, the design and implementation of a field test to verify the validity of the „Flex-Pass“ is an essential step in order to transform the developed „Flex-Pass“ construct into an applicable tool for actual, daily work - in terms of designing and determining the sustainability of a building to perform generic adaptable space structures.

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publishing company: Pädagogisches Institut Bozen
language: german

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author: Iris Hoßmann, Margret Karsch, Reiner Klingholz, Ylva Köhncke, Steffen Kröhnert, Catharina Pietschmann, Sabine Sütterlin
editor.: Berlin Institut für Bevölkerung und Entwicklung
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language: german

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author: Ernst Gehmacher
editor & publishing company: Die Presse (2015-08-23)
language: german

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