Dematerialization

A Changing Paradigm in Architecture

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Fig. 01 Models of use

Introduction

This paper introduces the need for dematerialization in architecture as presented to the University of Texas at Austin, School of Architecture by Niklaus Kohler on September 30, 2009. This paper will begin by defining dematerialization, rematerialization, and virtualization, specifically in terms of their applications to architecture. Secondly, this paper will outline the importance of dematerialization in architecture as it applies to sustainability. Thirdly, the conceptualization of dematerialization, which can be implemented as a step-by-step process, or as individual methods to reduce the impact of the built environment on the planet. All of these issues are closely related and in fact it may be useful to think of rematerialization and virtualization as possible strategies for realizing dematerialization. These approaches both offer valuable new perspectives on the issue while exposing their own sets of difficulties to effective implementation.

What is Dematerialization?

In economics, dematerialization is a reduction in the amount of materials required to serve society's functions, it is the counter argument to the idea that more is better. For architecture, dematerialization means reducing the quantity of material resources used to meet society's needs. Dematerialization begins with a shift away from viewing resources as limitless and determining their value in terms of consuming resources, to viewing resources as limited assets and value is linked to their re-usability. Dematerialization in architecture represents a fundamental change from an ethos of "more is more" to one of "less is more."

Why is Dematerialization relevant to architecture?

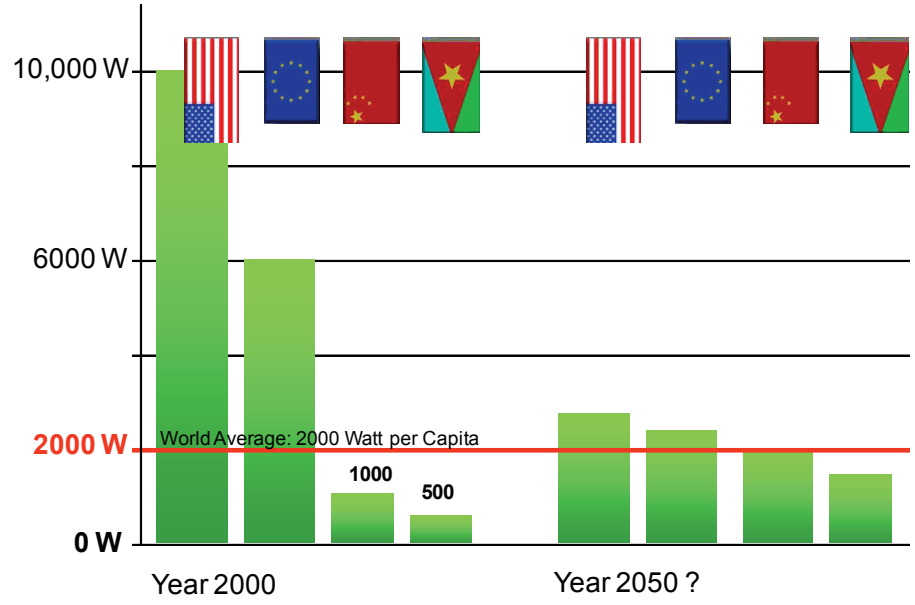

Fig. 02 Energy use by nation

Fig. 03 Cowboy vs. Spaceman economy

Dematerialization is important to architecture because it creates a context for evaluating the built environment.
Dematerializing the built environment as a goal for the way we approach the world leads to a reexamination the necessity of building in the shifting environment, designing for things like flexibility, durability, and deconstructability as well as the particular materials and resources used for the manufacture and operation of a particular building.

Why do we need to dematerialize?

Currently the United States uses five times the global average of Watts per capita, which indicates an attitude towards consumption in which resources are limiteless. However, mining the resources required to generate that much power is taxing the planet to its limits. Eventually, the earth will run out of the resources necessary to sustain life on the planet if consumption is not curbed. By accepting that there are a limited number of resources available on the planet, the problem of how to use the limited resources available most effectively arises.

Changing Paradigm

Traditionally, Western nations, particularly the United States, have viewed the world as “cowboy economists.” That is, viewing the world as an abundant, limitless producer of resources available for use. However, in actuality, that is not the case and so a new world view is required in order to live more sustainably. The answer is to view the world as “spaceman economists.” Contrary to cowboy economists, spaceman economists view the world as a closed system with a limited number of resources. Therefore, spaceman economists are aware of how their consumption affects their environment. Dematerialization represents a way to change traditional views of consumption and the built environment. By integrating the concepts of dematerialization into architectural practice, architects can lead the paradigm shift from the unsustainable cowboy economy to more the sustainable spaceman economy.

Conceptualization of Dematerialization

Dematerialization in architecture can be thought of as an editing process, where the different forms of dematerialization are the steps towards reducing the impact of the built environment on the planet. The first step is to evaluate which buildings and building typologies are still relevant and abandon those which have become obsolete. Next, members of a community should reevaluate the nature of necessary buildings, and architects should attempt to meet multiple needs with one structure or space. Lastly, designers should find innovative ways of reducing the quantity of materials needed in the built environment and engineer buildings to operate more efficiently. These steps can be taken in series or individually to strive towards

dematerializing the built environment, but perhaps in the future, this will become the standard process of maintaining building stock.

Abandon Obsolete Elements of the Built Environment

To begin with, the relevance of existing structures and typologies should be evaluated, and elements of the built environment whose functions are being served by other means can be abandoned. An example of this type of dematerialization is the telephone booth. Before the prevalence of cell phones, cities and towns had public phone booths along the streets and in the buildings throughout the city so that people could make phone calls away from their homes. However, now that most people have cell phones, there is no longer a need for phone booths, and so they are elements of the built environment which can be abandoned without replacement.

Change the Nature of Buildings, Combine Multiple Purposes

For buildings and typologies which are still relevant to society, architects, engineers and planners should look for ways to combine the purposes they serve into fewer buildings. Mixed use development, for example, combines residential spaces with commercial spaces into fewer, high-rise developments. Thus high density areas of cities are already changing the nature of building and city planning, but there is more which can be done. In a single office building for example, offices, conference rooms and cafeterias could be combined into a single large open space with moveable partitions and mobile furniture so that the space can easily be transformed throughout the day to meet the specific needs of the occupants.

Reduce the Quantity of Resources Used

An essential element of dematerialization is to reduce the amount of resources used in the built environment. Tendencies towards over consumption are at the root of the current ecological problems. Even if obsolete buildings are eliminated and fewer buildings can be uses to serve more purposes, dematerialization in architecture cannot be achieved without reevaluating the quantity of resources consumed. Part of the spaceman economy is an acknowledgement that there are limited resources available, and what resources there are must be used wisely and selectively.
One way to reduce the amount of resources in the built environment is to use high quality, durable, and reusable materials, and to manufacture those materials with future purposes in mind so that they can be easily transformed and used again.

Improve Building and Material Performance, Do More with Less

Another essential element of dematerialization is the optimization of the elements of the built environment. As science and technology continue to advance, so must buildings and their performance. This approach can be seen in a number of different building strategies. For example much thought has gone into the study of prefabrication in recent years as a way to manage and minimize the use of building materials. Another place this can be seen is in emerging efficiency standards and the emphasis on conservation of the resources that go into the maintanence on operation of a building for its entire lifecycle.
Rematerialization as Dematerialization

Rematerialization

Rematerialization is more than just recycling materials. Rematerialization can be thought of as upcycling, where the quality of material stays the same or improves when it is reused. Unlike recycling, where the quality and quantity of material input is higher than that of material output. The primary goal of rematerialization is to use high quality materials which have been designed and manufactured for reuse. Unlike recycling, where materials need to be reprocessed before they can be reused, implementing rematerialization would required that materials be designed and manufactured with future purposes in mind so that materials can be 100% recoverable. A database, like Intelligent Materials Pooling , which contains information about materials regarding their material components and the reusability of those materials could be used to assist in the implementation of rematerialization.

Intelligent Materials Pooling (IMP), a concept developed by Michael Braungart and William McDonough, is a data collection system which treats materials and production methods like the elements of an ecosystem. That is, there are no real inputs and no real outputs, just “throughputs.” In a usable form, IMP is a collaboration between businesses and separate industries to share production knowledge as well as material resources. Companies report their manufacuring processes,

Fig. 04 Conceptual diagram: Rematerialization

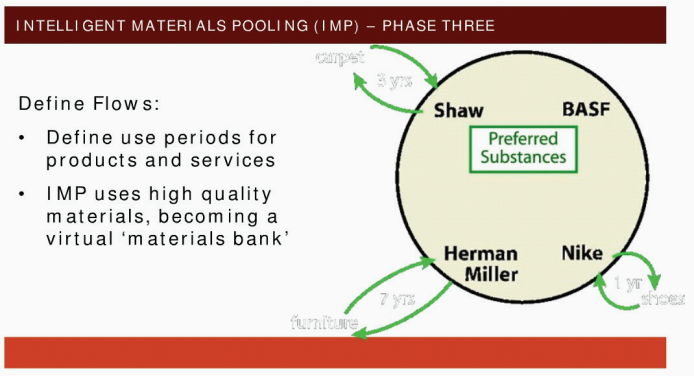

Fig. 05 Conceptual diagram: Intelegent Materials Pooling

the materials they use, and life-cycle information, which is then compiled into a large, shared database or materials bank. This shared information can be used by companies to make more better material selections and consider potential future purposes and reuses. The ultimate goal of IMP is to eliminate waste by sharing information so that businesses, designers, engineers, etc., can rematerialize resources again and again.

Flexibility

Designing for flexibility in a space ties into the earlier approach of changing the nature of building. By taking this on as an initial concern the designer can greatly increase the lifespan of a structure by allowing the program to shift as owners and needs change. Retrofitting and remodeling buildings is a much more common practice than new construction because it is generally much less expensive and is preferable because of the lower demand on new resources. This is why beginning design with flexible future use can be so beneficial to the long-term success of a building. Ensuring that a building has a long life is often the most ecologically sound influence you can have.

Design for Deconstruction

At the same time, materials will eventually need to be replaced. A strategy for lessening the impact of replacement or eventual demolition is the practice of designing for disassembly. Designing for disassembly allows the easy sorting of materials into their component parts so that they can be easily recovered for reuse or recycling. This treats these materials as assets which are able to retain value throughout their use instead of liabilities that need to be fed into the waste stream.

Life-cycle analysis

One tool for evaluation of materials is life-cycle analysis. This is the "investigation and evaluation of the environmental impacts of a given product or service caused or necessitated by its existence." With continuing growth of a library of materials all evaluated under the same metric it becomes easier and easier for designers to compare potential materials and building systems in order to find the most responsible choices. This analysis requires the assessment of everything that goes into the use of a material including raw material extraction and processing, manufacture, transportation, use and disposal of a product, forming a comprehensive picture of the path of a product cradle to grave. This can be a valuable tool for choosing a product with a relatively small negative impact. It does have its limits though. One concern is what metrics the particular evaluation system uses to score how environmentally friendly a material is. Each system has its own bias in weighing the impacts, so the user should always be aware of where these lie. Another concern is the larger structural issue of the scope of analysis. By tracing products from cradle to grave it implies that the larger system is a linear flow of waste. It is a waste minimizer, not a waste eliminator.

Virtualization as Dematerialization

Virtualization is another approach to dematerialization in that it often leads to a reduction in the need for resources independent of whether this is the central objective. Most often the aim of virtualization is an increase in the efficiency of time and effort and a shift in the way in which data is accessed and utilized with the possibility of efficiency of resources acting as a happy byproduct. That said, there is no reason why virtualization can't become more acutely concerned with it potential as a

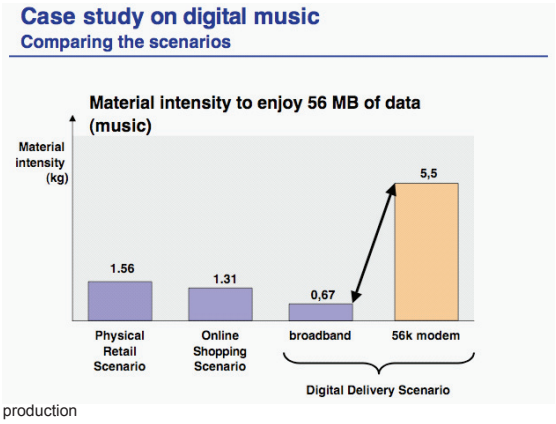

Fig. 06 Virtualization of production

solution for lessening environmental impact. There are two main aspects of virtualization, the shift of material to information and the change in the types of presence.

The shift from material to information has to do with the digitization of content and the rapid technological leaps forward in the capacity for digital data storage and transfer. Figure illustrates the way in which material intensity of a set amount of music in digital/virtual form is lower than any other method. Interestingly though, for a period of time before the technology matured, the delivery method for digital transfer was the least environmentally sound. Today we can store a whole library of information on a hard drive. This kind of emerging capability is rewriting the way that certain building typologies are thought of. Suddenly the whole concept of the library is demanding a reimagining. What was once a storehouse for material goods is now must become a new type of environment, something particular to our age.

Additionally, the ability to almost instantaneously transfer large amounts of data has led to a change in the relationship between presence and telepresence. The internet is obviously the main driver here in providing a platform for new types of interaction. New types of social and business interaction have developed which allow novel and productive interaction in this new virtual landscape. There is both great excitement and great anxiety about how this new environment will develop and what type of shifts in culture it will create.

Conclusion

Dematerialization is a poweful method for architects to help transform the built environment to reflect a changing paradigm in society. It is becoming more and more obvious that traditional attitudes towards resource consumption are unsustainable. Thus, the methods of dematerialization, rematerialization and virtualization are the means to achieve an otherwise utopian goal of living sustainably while maintaining quality of life. Dematerialization offers architects a step-by-step way to adapt to society's changing needs as they occur. By constantly reevaluating the necessity of certain buildings and building typologies, and using new and improving scientific and technological advancements to creatively reuse and redefine existing spaces, architects can design for society's needs in real time, rather than observe and react to trends after they happen. Furthermore, dematerialization gives achitects the opportunity to serve the needs of society and the natural environment simultaneously.

Endnotes

1. i. Niklaus Kohler lecture

2. ii. Wikipedia, Dematerialization

3. iii. Sustainability Dictionary, http://www.sustainabilitydictionary.com/d/dematerialization.php

4. iv. Niklaus Kohler lecture

5. v. Niklaus Kohler lecture

6. vi. Niklaus Kohler lecture

7. vii. Niklaus Kohler lecture

8. viii. William McDonough and Michael Braungart, Cradle to Cradle, (New York: New Star Press, 2002), pg ?

9. ix. Michael Braungart, EPEA

10. x. Wikipedia, Dematerialization

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3. Sustainability Dictionary, http://www.sustainabilitydictionary.com/d/dematerialization.php

4. McDonough, William and Michael Braungart. Cradle to Cradle. New York: New Star Press. 2002.

Figures