Contextual Scale

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Preface

When initially starting to look into the concept of scale, our first thought was to do a quick google search and get the definitions out of the way. In our architectural heads, scale is something completely ordinary, almost essential to understanding the world. Every idea, every project, every illustration has a scale. That is why we were really surprised when we discovered that scale (the architectural concept of scale) is nowhere to be found in google's list of definitions of the word. You have scale as in a thick layer of skin, scale as each of the small, thin horny or bony plates protecting the skin of fish and reptiles, and you have scale as in a flaky covering or deposit on either teeth, inside a kettle or on a heated metal. Why is it that a concept that seems so self-evident to us, is not even on the general public's list of definitions of the word. Is it because it just isn't relevant to most people? Surely there must be some cases where scale is essential to the non-architect.

This essay is written as an investigative foundation for our diploma project about scale and infrastructure at Bergen School of Architecture in Spring 2024. We want to research the potential role of the architect in a case non-typical to our profession, namely hydropower. The aim is to analyze and test the architectural tools used in ordinary architectural investigation, and evaluate the potential outside our discipline.

As complexity in buildings and design has increased, our roles as architects become more demanding in terms of multidisciplinary knowledge. The complexity in technology, materials and other involvement has led to a vast specialization of many professions and a dependence on other disciplines. The architect is no longer the grand master of a building site, or a planner that does it all. What is the potential of the architect today?

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1. Introduction

The architectural concept of scale is something that everyone knows, maybe not in detail, maybe not consciously, but everyone has some understanding of what scale means. Scale has to do with the physical size of our surroundings, our things and even us. It has to do with the meaning of these things in relation to each other, and it has to do with arranging and making sense of the world around us. According to Charles Moore and Richard Allen in their book Dimensions, whenever the word scale is used, something is being compared to something else. It is as if scale is central in the relationship between all things everywhere.[1]

For architects however, scale is a very intentional concept used frequently to facilitate every aspect of their work. We always talk about different variations of scale. Human scale is usually objects or phenomena in relation to the human body or human perception. To explore details, construction or a specific relation to the human senses for example texture, sizes of details or tactility we usually work in 1:1 or other small scales like 1:5, 1:10 or 1:20. To explore and develop objects or buildings in relation to the human body and size we usually work in 1:50. To document a simplified version of a single project or building we usually work in 1:100. 1:200 is most commonly used to develop an overall design. To analyze large scales like the surroundings of a project, we work in 1:500. To map out monumental scale or super scale we work in 1:2000 or larger. If we want to show and understand miniature objects or phenomena, we work with scales like 5:1 or smaller.[2] All scales are related to the size of the objects or situations we want to investigate or communicate. The particular simplification helps us to visualize different concepts. Even though scale can mean so many things, what is consistent with scale for architects is that it is a tool firstly used to understand, and secondly to explain or communicate.[3]

1 (Moore & Allen, 1976)

2 (Jaque, 2020)

3 (Schulz & Schulz, 2015)

2. Problem Statement

Scale is a concept invented to allow the human brain to understand and categorize our surroundings. It is a tool that helps us construct a physical or mental image of our world. In the case of hydroelectric power, the construction ranges from the smallest of particles to some of the largest built networks on earth. This is what makes hydroelectric power plants so interesting when talking about human perception and scale. This assignment will look closer into the concept of architectural scale in the context of renewable energy and people.

How can architectural scale trigger potential on different levels in renewable energy projects? And what effect does architectural scale have on how humans interact or perceive hydroelectric power plants?

"Design is not about looks like and feels like, but how it works. Design is thinking made Visuals."

3. The importance of hydropower

In Norway hydropower is the backbone of all power generation. Today, 1769 hydroelectric power plants generate around 88% of the total annual production. Water inflow combined with built capacity forms the foundation for the potential generation each year. However, how much flows into our facilities varies from season to season and year to year.[1] If Norway is to meet UNs Sustainable development goal number 13 to “take urgent action to combat climate change and its impacts”, we have to discuss how we can maintain and develop this large network of infrastructure in the future.[2] We believe that architects with their tools and specific understanding of scale can contribute to this discussion.[3]

Hydropower is merely energy taken from water that is transformed into either mechanical or electrical power. Even before electrical energy was discovered, hydropower played an essential role in providing humans with more potential to complete tasks. Hydropower has long been the most important renewable energy source in the world, and is currently responsible for 16% of the energy production world wide. [4]

1 (NVE, 2023)

2 (FN-Sambandet)

3 (Rainer, 1990)

4 (Blatter, 2020)

4. Hydropower and scale

To experience the smallest scale hydropower operates at, you have to reach far into the realm of physics. Electrons with a size so small that it is invisible and ungraspable for the human eye and brain. Positive and negative charges and movement of particles. It is a concept so small and so incomprehensible that we are dependent on the concept of scale to even be able to understand it in detail.

In his book “The visible and invisible”, the french philosopher Maurice Merleau-Ponty, tries to explain how humans strive to understand new and intangible concepts again and again using new words and new techniques.[1] We try our best to take the most well known concepts, analyze them and bring our own conclusion. The same is to be said about hydropower. We use science, mathematics and scaled models of atoms and power grids to understand and grasp concepts too big to comprehend. What does these representations implicate? How do we as humans relate to scale? And do we even understand these concepts even if we try to explain them?

The electrical grid is everywhere around us all the time. We go to bed in the evening, and the last thing we do before we go to sleep is to plug in our phone.

While we are sound asleep the electrical grid still works for us. It heats up our homes so it’s nice to wake up, it provides us with light in the bathroom in the morning, and ensures that the milk for our cereal is cold. On the way to work, the street lights are working, the buses are driving, and when we arrive at the office we can easily make ourselves a fresh cup of coffee. It is a constant flow of energy, that we don’t devote a single conscious thought to before it stops working. To us it is one of the most frequently used systems, but we only see a very small part of this incredible infrastructure at the same time. It stretches all the way from the outlets in our home to large constructions on the other side of the continent.

1 (Merleau-Ponty, 1968)

5. Hydropower and experience

Before analyzing possible problems and untapped potential related to scale as a tool in hydropower it is important to define what infrastructures we are talking about. We have divided this infrastructure into two parts. The first part is created by humans, and the second part exists naturally.

The parts of the electrical grid created by humans can be divided into several scales of varying size. We will travel from home where electricity encounters the private consumer to the dam in nature where human intervention begins. [1]

1:1, 1:5, 1:10 & 1:20

The outlet on the wall serves as an individual connection point that allows each person to plug into the grid whenever they please. Usually this is the most comprehensible part of the network. We feel it and we interact with it. Sometimes if we plug in a chord at night we get a glimpse of the power that is present there at all times. A little spark might jump out of the wall when there is thunder and lightning. This little magic event is fascinating, but also a bit scary. We have no control over the electricity when it leaves this carefully constructed and safe system. These outlets have different variations of low voltages depending on the use.

1:100 & 1:200

However, we only see and feel a small part of our home system. Everything else is carefully hidden out of sight, organized by an architect or an engineer. Sometimes we think that “Arh this outlet is in the wrong place”, “I always have to bend down to plug in my charger” or “I should have had an outlet on my kitchen counter”. Inside the wall there are small cables that distribute electricity to different outlets around the house. If there is a storm, we usually know how to fix it if a fuse blows. All the cables in the wall are connected to a central fuse box. Inside the fuse box we can see all the different circuits that provide each room with electricity. The fuse box is connected with cables through the wall and receives medium voltage

1 (Blatter, 2020)

from the local distribution network.

1:500

The local distribution network usually consists of medium sized cables stretched on wooden or steel poles alongside existing infrastructures such as roads, highways, train lines or rivers. The best impression we get of this system is when we drive a car or sit on a train. The cables stretch far along our route, and provide electricity to all houses that we drive by. Usually we don't think about it, it is just "there". There is also a very clear disconnect between use and structure. For me at least, these poles are just there to provide me with light on the street. Just simple lamps placed along the road. It's almost trivial. In his book The forest of symbols, Victor Turner describes the phenomena of the liminal in society. The in-between states and the effect this has on how we treat things. In some way, this electrical system can be described as being liminal. It is very present and comprehensible, but at the same time it is almost invisible. At least this is true for the parts of it that we cannot see or understand because of scale.[2] These cables transport microscopic particles in medium to short distances inside municipalities or local regions, right in front of our eyes. This distribution network supplies both private, commercial and industrial consumers directly. All these cables are connected to a power substation. The substation is a facility that receives high voltages from the large scale power transmission system and converts it to medium voltage. When we see or interact with this powerstation, that is when we begin to comprehend the complexity and scale of this system. This facility is everything but trivial. [3]

2 (Turner, 2016)

3 (Siavula)

1:10 000

The next level of the electrical grid is the power transmission system. It transports energy in large cables hanging from huge steel masts across long distances. These cables are usually placed in nature or in remote areas as they transport high voltages directly from the power plant. For humans these structures are gigantic. The distances they span are so long that you lose sense of scale. As architects we describe something as being off scale when the structure is too large compared to other relatable items in its surroundings. When walking across Hardangervidda, there are no trees, no tall mountains or hills. In these surroundings these large power masts feel even more massive. These large structures transport energy from civilization to wherever in nature we harvest energy.

Inside the powerplant there is a generator that converts mechanical power to electrical power. In our case we are looking at hydroelectric power, and normally we are talking about large turbines being turned by the movement of water through the facility. These facilities are usually more aligned with the scale of the human body, as they are designed for humans to interact with the infrastructure. If you follow the pipes leading into nature from the power plant, you reach the end of the human created network where the dam is a dynamic transition between the natural and the artificial.[4]

1:100 000 000...

Before reaching the dam the water has a wide range of journeys across the whole planet. In the introduction we mentioned that power generation is dependent on two things, the built capacity as explained above and water inflow as

4 (IEC, 2018)

will be discussed here. Water inflow is the small amount of water we are able to capture with our infrastructure. The entry of water into the power plant is actually part of a much larger network called the hydrologic cycle.

As humans, we experience weather every day. We know that water evaporates from oceans, forms clouds above our heads, and precipitates back down to earth after some time depending on different factors. We know that a change in temperature creates winds of air blowing through our hair. However this is a complex system ranging from a single water particle, to entire networks of topology across the globe, all the way to the sun heating up our oceans. This is the immense scale of the natural system that allows us to harvest the potential energy in water.

6. Landscape and infrastructure

The topic of hydropower is frequently connected to conflict or negativity. In this essay we have chosen to define conflict as the failure to align the different interests of relevant stakeholders. In addition, we see conflict as a specific way in which the relationship between the conscious human and infrastructure manifests itself. According to studies on conflicts related to development and improvement of new and existing infrastructure these cases typically have four drivers that escalate conflict. In one study from Latin America, they carried out interviews with stakeholders affected by infrastructure projects and asked what constituted the source of their dissatisfaction. The researchers tried to generalize the results and published an overview of key aspects to consider when dealing with infrastructure projects: (Watkins et al., 2017)

Environmental drivers

- Degradation
- Pollution
- Bad experiences with similar projects
- Deforestation
- Water issues
- Climate change

Social drivers

- Removal of common benefits and lack of compensation
- Reduced access to collective resources
- Change of local values
- Removal of local jobs
- Forced relocation
- Perception of hidden economic or political agendas
- No risk evaluation makes project seem unsafe

Governance drivers

- Lack of transparency in planning
- Lack of consultation of local communities
- Lack of transparency in decision making
- No or little communication
- Unrealistic expectations
- Project delays
- Lack of local participation

Economic drivers

- Government not fulfilling project requirements due to lack of budget
- Price of the finished service
- No profit distribution
- Wage dispute
- Excessive profit level

If we consider the results from the surveys above we see that there are several points that are driven by the same problem. The first and maybe most openly discussed problem is natural or social destruction. A distanced power entering local communities and removing value. This can be in the form of destroying nature, important social values or cherished buildings. The second problem is the lack of communication. This may be related to lack of local participation, lack of information or transparency. The last problem is related to financial management. This may be related to profit distribution, expenses or exploitation.

7. Architects potential

The goal is to use this understanding of the scale and issues related to hydropower to analyze whether or not the architect can and should contribute.

Magic

Today, everything we cannot explain in detail is investigated based on existing scientific theories with the aim to draw conclusions about reality. If we look at certain historical perceptions of electricity they possess a sort of optimism or magic. There is the question whether we lose something by overanalyzing it. When electricity was not discovered, but was still visible through natural phenomena like lightning. Their foundation for understanding the world around them was built around religion, and the legends reflect this. In the norse era, people used superstition instead of science to fathom the incomprehensible.

Thunder was explained as the Norse God “Thor” driving his carriage across the sky to hunt down evil powers. It led the people to believe that thunder was a sign of protection and of the divine.[1]If we map out and analyze everything, we stand at risk of losing what might be seen as magic.

This was also the fear of a prominent Danish author and historian in the 18th century, Erik Pontoppidan. In his book “Norway’s Natural History”, he tried to explain all aspects of Norwegian nature through scientific means. He concludes in several chapters about the natural and supernatural that the world can be explained through research, religion and faith. He based his research on countless accounts from witnesses and books. However, his research was highly influenced by the strong belief that nature was created by God for humans, and he argues that nature loses some of its mysticism and depth when we reduce it to only facts.[2] A similar issue is discussed in Junichiro Tanizaki’s book “In Praise of Shadows’’. He talks about how something that is beautiful in the dark loses its value in hard white

1 (Steinsland, 2005)

2 (Teien Bjerkholt, 2020)

lighting.[3] Is this also true for infrastructure? Is the issue with infrastructure that people who design these structures simply overanalyze and overdesign at the cost of magic? And how can we approach a field that is so over analyzed without being at risk of removing every last bit of spark?

Perspective

The field of infrastructure is heavily dominated by engineers and scientists, one argument in favor of the interference of the architect is the addition of a different perspective.

Architects work with the visual language. One of the most prominent drivers for conflict in infrastructure is natural and social destruction. How can you successfully develop a project that is too large to understand? Is it possible to avoid natural and social damage by allowing visual composers to take part in these projects? In his book "Experiencing Architecture", Steen Eiler Rasmussen compares the effect of scale and proportion on design to the effect of rhythm and harmony in music. He argues that when something is out of rhythm or harmony, people feel discomfort. The same can be said for architecture. A skilled architect is able to use his tools to understand the building's situation, and then through architectural practice formulate a visual solution that exists in harmony with nature.[4] Adler also confirms this in her book Scale, Imagination and perception in Architecture:

"It is in the situational nature of practice that scale emerges as the crucial link between size, ethics and meaningful building. An object taken out of a situation is an ethical problem, which is why Frank and Loos satirized the tendency of total design strategies to remove works from the realm of human situations."

Maybe this is the core of the problem? What if the issue is that engineers and scientists design for function and KWH, meanwhile conflict arises as a result of infrastructure being out of harmony and out of scale with their surroundings?

Another point to note is the relation between different scales within the same structure. In Volume 3 of John Ruskin's book "The stones of Venice" from 1853, he tries to generalize the value of architecture through the example of Gothicness.[5] He argues that the main issue of the value of gothic architecture is the lack of imperfectness and soul of each building. He talks about how important the range of scale is, and how the smallest details on a facade make up the entirety of the building in the end. At first it might not seem relevant, but the issue with some of these structures might be that they only work in one scale despite existing in several. The socket on the wall only communicates with your hand, it does not tell the story of the magic that lies within. The large transmitters placed in nature right above the small local trail, does not relate to the scale of foot of the hiker at all.

In the book "Go with the flow" Gilles Delelex writes about the impressions infrastructure gives us:

3 (Tanizaki, 1977)

4 (Rasmussen, 1959)

5 (Ruskin, 1853)

“This experience of driving on the motorway all through Europe gave me the feeling that I was like a micro-particle within a vast flow of people and signs, the statistical unit of a repetitive and programmed sequence of exchange, cutting across borders, and tying cities and countries together in a global space of flows.”1

1 (Delalex, 2006)

His observations are closely related to the feeling of being off scale. Feeling small compared to something else, feeling like the world is generic. We believe that architects have the skillset to provoke or remove this feeling through their work. How can the architect use scale as a tool to understand where conflict or negative associations arise and to use scale as a solution to these problems?

Communication

Another problem of infrastructure is related to the lack of communication. Is there a potential for the architect to act as a mediator between local stakeholders and the developer? Maybe the multidisciplinary understanding combined with the visual communication skills of the architect can help to bridge this gap.

"In helping produce the social settings where humans and nonhumans negotiate their coexistence, archiecture does not operate as a space provider but rather as an actor, a mediator, a rearticulator, as both assembler and assemblage. Architecture does not accommodate, contain or give shelter to the social. Architecture rearticulated society and design happens in the transitioning of the biopolitical and social-territoria."[6]

The architect possesses the spatial understanding and the visual tools to be able to eliminate the issues of communication. In many cases there might be a problem of "lost in translation" or accessibility of information. Due to their multidisciplinary nature, the architect can easily act as a mediator between different stakeholders. In the book "The anthropology of landscape: Perspectives on place and space", Hirsch and O'Hanlon comment on what we lose by reducing nature to a utilitarian resource. Maybe the role of the architect will be to reintroduce human interest and value to the development of infrastructure projects?

6 (Jaque, 2020)

“The vocabulary used to organize nature typically betrays the over riding interests of its human users. In fact, utilitarian discourse re places the term “nature” with the term “natural resources,” focusing on those aspects of nature that can be appropriated for human use. A comparable logic extracts from a more generalized natural world those flora or fauna that are of utilitarian value (usually marketable commodities) and, in turn, reclassifies those species that compete with, prey on, or otherwise diminish the yields of the valued species. Thus, plants that are valued become “crops,”the species that compete with them are stigmatized as “weeds,” and the insects that ingest them are stigmatized as “pests.” Thus, trees that are valued become “timber,” while species that compete with them become “trash”trees or “under bush.”The same logic applies to fauna. Highly valued animals become “game”or “livestock,”while those animals that compete with or prey upon them become “predators” or “varmints.””1

1 (Hirsch & O’Hanlon, 2003)

8. Conclusion

How can architectural scale trigger potential on different levels in renewable energy projects? And what effect does architectural scale have on how humans interact or perceive hydroelectric power plants?

To round off this essay we want to bring you back to 1:1. The context of the authors writing this essay to communicate something important about the role of the architect, scale and infrastructure.

There are many ways in which the architect can contribute in the field of infrastructure. However to conclude we have narrowed it down to two main points:

The first point is the potential of the visual language in the preservation of magic in these projects. The architect has the knowledge and tools to understand and harmonize with the surroundings of these structures. This approach to new infrastructure projects has the potential to eliminate issues of conflict related to social and natural destruction. The understanding of scale triggers the potential to develop structures that work across scales instead of only one scale.

The second point is the value of a new perspective and a different skill set. The architect has a wide range of visual tools. These tools allow us to formulate and communicate a holistic image of a situation. This approach may serve as the foundation for communication and conflict resolution between developers and local stakeholders. In order to answer the last part of our research question - how scale and architecture can affect the human perception and interaction with infrastructure, we need to use practice and discuss through our tools.

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