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Interface LCA BIM

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Research hypothesis

- Consider buildings‘ environmental assessment methods as an starting point →it will try to be extrapolated to civil constructions
- Constructions’ Life Cycle Stages to be considered:

Research hypothesis

Life Cycle Stages (UNE-EN ISO 14040-14044)

Source: (Ecophon, 2015)

Research hypothesis

- Product stage (A1-A3)
  - A1: Raw material supply
  - A2: Transport to the manufacturer
  - A3: Manufacturing
- Construction process stages (A4-A5)
  - A4: Transport to the building site
  - A5.1: Installation in the building
  - A5.2: Energy usage
- Use stage (B1-B7)
  - B1: Use
  - B2: Maintenance
  - B3: Repair
  - B4: Replacement
  - B5: Refurbishment
  - B6: Operational energy use
  - B7: Operational water use
- End-of-life stage (C1-C4)
  - C1: De-construction, demolition
  - C2: transport to waste processing
  - C3: Waste processing for reuse, recovery and/or recycling
  - C4: Disposal

Life Cycle Stages (UNE-EN ISO 14040-14044)

Research hypothesis

- Consider buildings‘ environmental assessment methods as a starting point →it will try to be extrapolated to civil constructions
- Constructions’ Life Cycle Stages to be considered: A1 → A3
- Environmental assessment following “Building Material and Component Combinations”
- Reduction of embodied impacts since design decisions →Environmental Assessment Value Design

Communicated results 2015-2016

Papers in Conferences

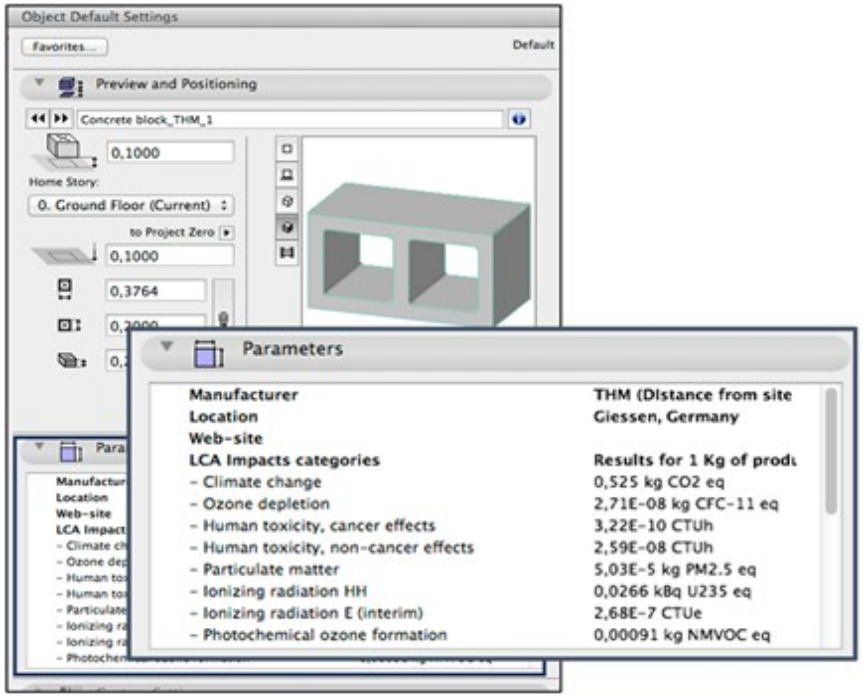
- "16th International Conference on Computing in Civil and Building Engineering (ICCCBE 2016)" (Osaka, Japan)

Date:	6th-8th July 2016
Submitted paper:	"Integrating BIM and LCA. Comparison of different Approaches for the Integration of Lifecycle Information in a Digital Planning Process"
Co-authors:	Joaquín Díaz and Georg Reitschmidt

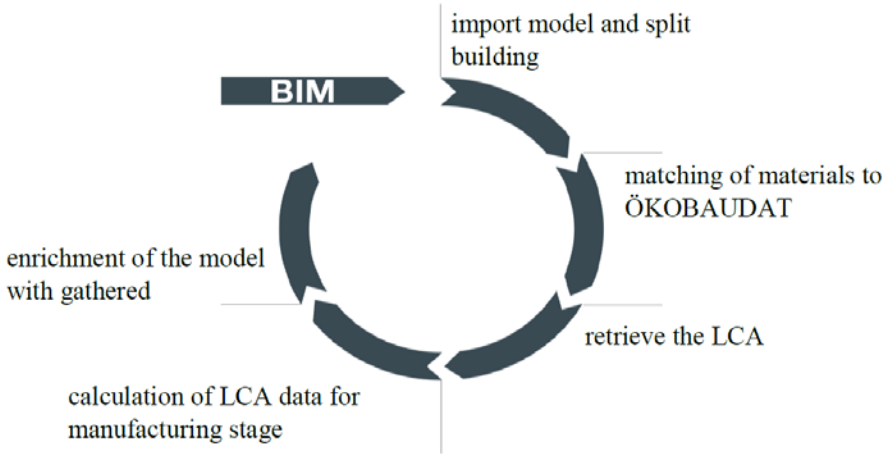
Communicated results 2015-2016

Papers in Conferences

- "16th International Conference on Computing in Civil and Building Engineering (ICCCBE 2016)" (Osaka, Japan)



Environmental information included among the BIM-object parameters



Process of gathering LCA indicators

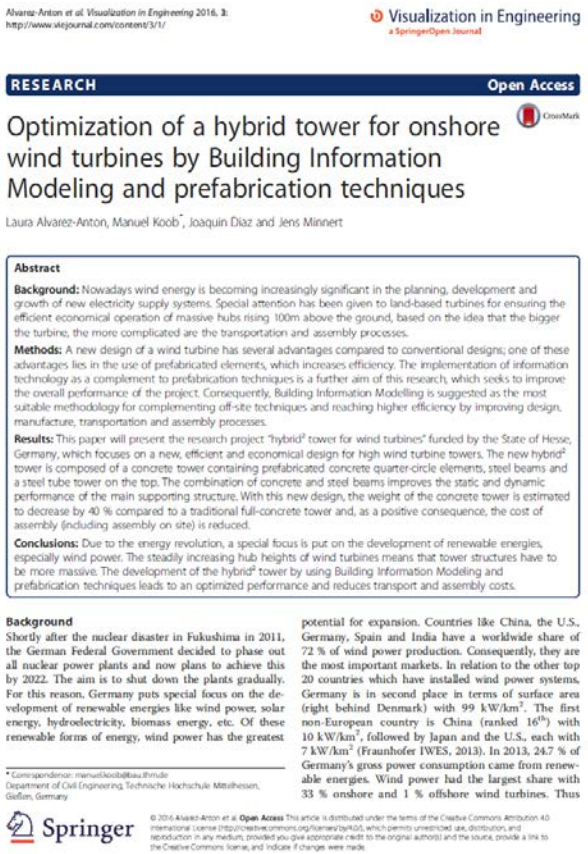
Communicated results 2015-2016

Papers in Journals

- Visualization in Engineering (Springer)

Paper: "Optimization of a hybrid tower for onshore wind turbines by Building Information Modeling and prefabrication techniques"

Co-authors: Manuel Koob, Joaquín Díaz and Jens Minnert



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Visualization in Engineering
a SpringerOpen Journal

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Optimization of a hybrid tower for onshore wind turbines by Building Information Modeling and prefabrication techniques

Laura Alvarez-Anton, Manuel Koob*, Joaquin Diaz and Jens Minnert

Abstract

Background: Nowadays wind energy is becoming increasingly significant in the planning, development and growth of new electricity supply systems. Special attention has been given to land-based turbines for ensuring the efficient economical operation of massive hubs rising 100m above the ground, based on the idea that the bigger the turbine, the more complicated are the transportation and assembly processes.

Methods: A new design of a wind turbine has several advantages compared to conventional designs; one of these advantages lies in the use of prefabricated elements, which increases efficiency. The implementation of information technology as a complement to prefabrication techniques is a further aim of this research, which seeks to improve the overall performance of the project. Consequently, Building Information Modelling is suggested as the most suitable methodology for complementing off-site techniques and reaching higher efficiency by improving design, manufacture, transportation and assembly processes.

Results: This paper will present the research project "hybrid² tower for wind turbines" funded by the State of Hesse, Germany, which focuses on a new, efficient and economical design for high wind turbine towers. The new hybrid² tower is composed of a concrete tower containing prefabricated concrete quarter-circle elements, steel beams and a steel tube tower on the top. The combination of concrete and steel beams improves the static and dynamic performance of the main supporting structure. With this new design, the weight of the concrete tower is estimated to decrease by 40 % compared to a traditional full-concrete tower and, as a positive consequence, the cost of assembly (including assembly on site) is reduced.

Conclusions: Due to the energy revolution, a special focus is put on the development of renewable energies, especially wind power. The steadily increasing hub heights of wind turbines means that tower structures have to be more massive. The development of the hybrid² tower by using Building Information Modeling and prefabrication techniques leads to an optimized performance and reduces transport and assembly costs.

Background

Shortly after the nuclear disaster in Fukushima in 2011, the German Federal Government decided to phase out all nuclear power plants and now plans to achieve this by 2022. The aim is to shut down the plants gradually. For this reason, Germany puts special focus on the development of renewable energies like wind power, solar energy, hydroelectricity, biomass energy, etc. Of these renewable forms of energy, wind power has the greatest potential for expansion. Countries like China, the U.S., Germany, Spain and India have a worldwide share of 72 % of wind power production. Consequently, they are the most important markets. In relation to the other top 20 countries which have installed wind power systems, Germany is in second place in terms of surface area (right behind Denmark) with 99 kW/km². The first non-European country is China (ranked 16th) with 10 kW/km², followed by Japan and the U.S., each with 7 kW/km² (Fraunhofer IWES, 2013). In 2013, 24.7 % of Germany's gross power consumption came from renewable energies. Wind power had the largest share with 33 % onshore and 1 % offshore wind turbines. Thus

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Further research

Construction elements‘ objects including their environmental information

- Working with Revit for modeling different construction elements:
    - Include environmental aspects among the parameters of Revit types
    - The environmental parameters will be linked with other object‘s parameters

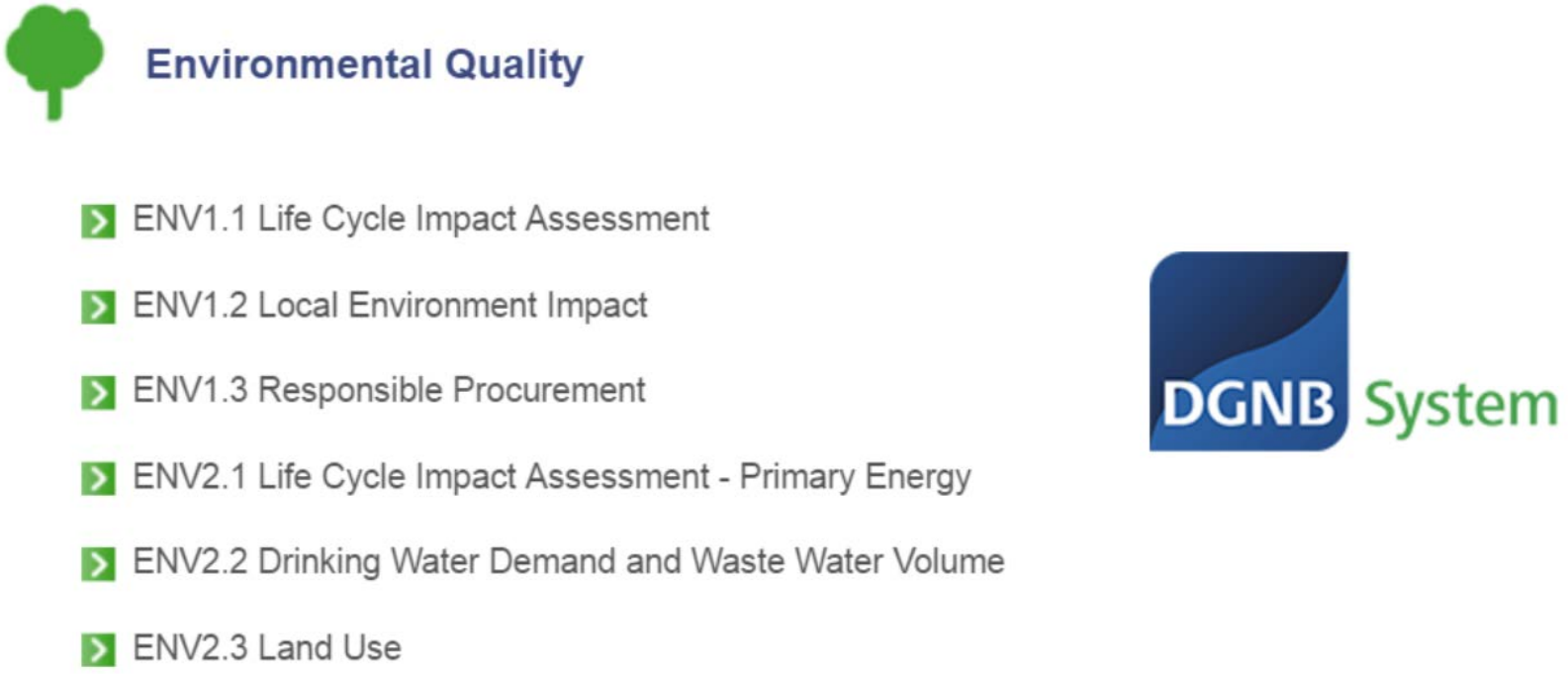
Further research

Construction elements‘ objects including their environmental information

- Advantages:
  - The environmental parameters will change from type to type → In this way the flexibility of the solution is increased
- Disadvantages:
  - Some information is difficult to be predicted in an automatic way (such as transport distances) →The environmental assessment will have some restrictions
  - The data file type can only be read by Revit → isolation concerning other BIM software vendors

Further research

- Analyze how environmental Impacts are considered in DGNB certification system → Define how to present environmental information



Source: http://www.dgnb-system.de/en/system/criteria/core14/

Thank you for your attention

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