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DOI

[10.1145/3083157.3092884](https://doi.org/10.1145/3083157.3092884)

Publication date

2017

Document Version

Final published version

Published in

SCF'17 Proceedings of the 1st Annual ACM Symposium on Computational Fabrication

Citation (APA)

Verlinden, J., & Bekker, A. (2017). Architecture through the looking glass: Augmenting Fabrication in the built environment. In *SCF'17 Proceedings of the 1st Annual ACM Symposium on Computational Fabrication* (pp. 1-2). Article a10 Association for Computing Machinery (ACM).
<https://doi.org/10.1145/3083157.3092884>

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Architecture through the looking glass: Augmenting Fabrication in the built environment

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Figure 1: Impression of augmented fabrication of a WAAM bridge.

CCS CONCEPTS

- **Human-centered computing** → Mixed / augmented reality;
- **Computing methodologies** → *Simulation tools*;

KEYWORDS

Augmented reality, design support, additive manufacturing

ACM Reference format:

Jouke Verlinden and Anne Bekker. 2017. Architecture through the looking glass: Augmenting Fabrication in the built environment. In *Proceedings of SCF '17, Cambridge, MA, USA, June 12-13, 2017*, 2 pages. <https://doi.org/10.1145/3083157.3092884>

1 AUGMENTING FABRICATION: CO-LOCATING DESIGN IN THE BUILT ENVIRONMENT WITH AR

To make most out of manufacturing of the future, we need to engage stakeholders through technologies that blend the digital and physical. Through so-called Augmented Fabrication, computational precision and digital manufacturing are combined with user skills/intuition.

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SCF '17, June 12-13, 2017, Cambridge, MA, USA
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ACM ISBN 978-1-4503-4999-4/17/06...\$15.00
<https://doi.org/10.1145/3083157.3092884>

One of such approaches is the use of co-located design in the built environment: through wearable AR systems such as the Microsoft HoloLens, multiple stakeholders can conceive and consider several interventions to improve functions of a city.

The benefit of an embodied interaction with computational support is essential here: the 3D scanned situation presents a canvas for superimposing designs and key performance indicators, and allows tangible and social interaction.

We are currently prototyping such an environment for 3D printing bridges in the city.

2 WIRE AND ARC ADDITIVE MANUFACTURING

Larger-scale production has been considered since the past decade [Buswell et al. 2008], in particular for concrete and plastics. Wire and Arc Additive Manufacturing (WAAM) is a technique in which a shape is fabricated by welding layer upon layer with a robotic arm, until a desired three-dimensional shape has been formed [Dong et al. 2015]. This technique yields potential in decreasing material consumption due to its high material efficiency and freedom of shape. We investigated how environmental effects could be assessed for additive manufacturing technologies for the production of large-scale products by means of a Life Cycle Assessment, resulted in a comparison with other 3D printing techniques with metals cf. Table 1 [Bekker et al. 2016].

Table 1: Power and cost estimation per kilogram printed metal.

	power (Kwh)	Cost
WAAM	5,2	\$98
EBM	38,4	\$524
DMLS	62,9	\$772

These and other data can be used to interactively display a score-card while a catalogue of parameterized designs could be instantiated, based on the 3D scanned environment.

3 ACKNOWLEDGEMENTS

This investigation was executed at the 3D Building FieldLab, funded by the Amsterdam institute of Advanced Metropolitan Solutions (AMS), in partnership with MX3D.

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