

DIE MÖGLICHKEITEN DES 3D-DRUCKS

ERFAHRUNGEN AUS DER ENTWICKLUNG DER PORTALROBOTER UND
AUSBLICK AUF ZUKÜNFTIGE ANWENDUNGSGEBIETE



Agenda



Facts and Figures 2019

Güdel Group AG

Headquartered in Langenthal

Switzerland 



65

years of tradition



Family business

in its third generation



more than **1,200**
employees worldwide



about **330**
Mio CHF revenue

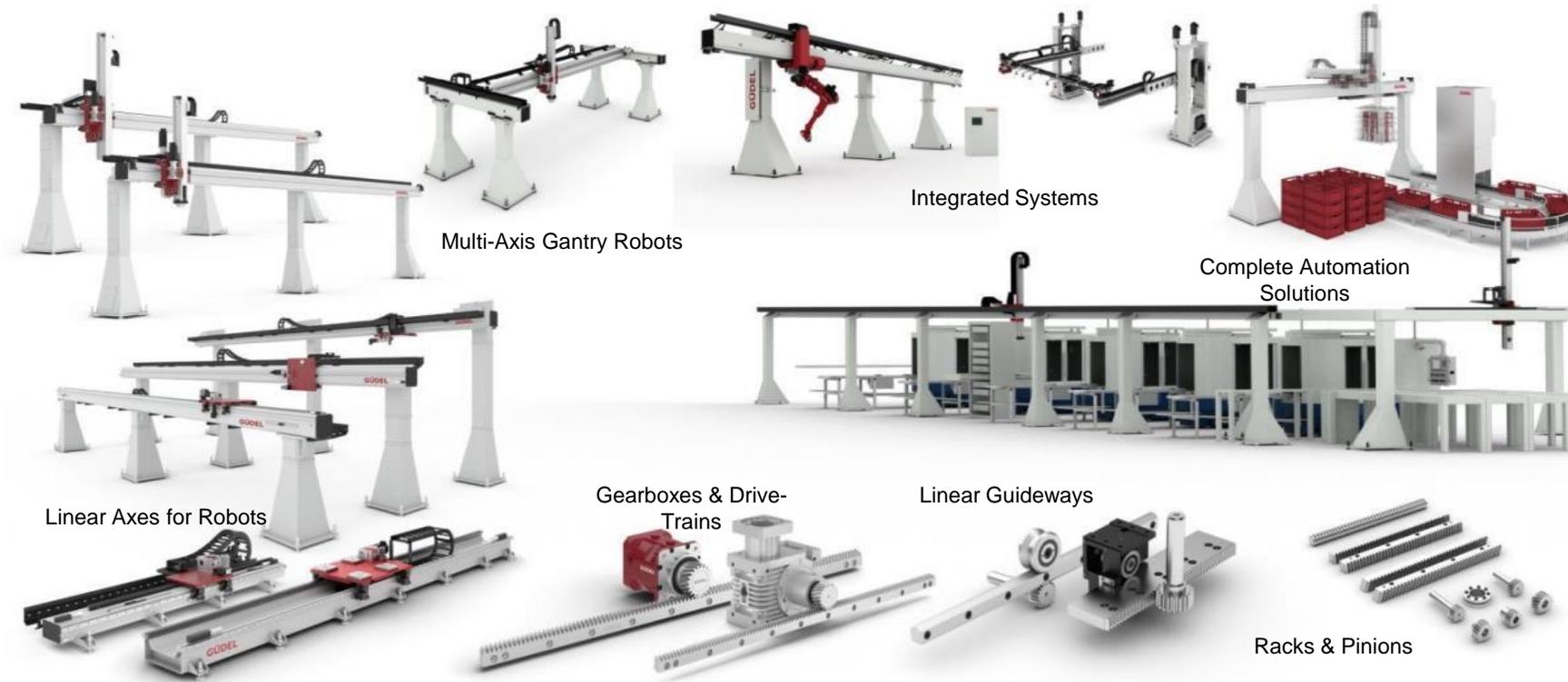


more than **30**
locations worldwide



Product Portfolio

From Components to Automation Solutions

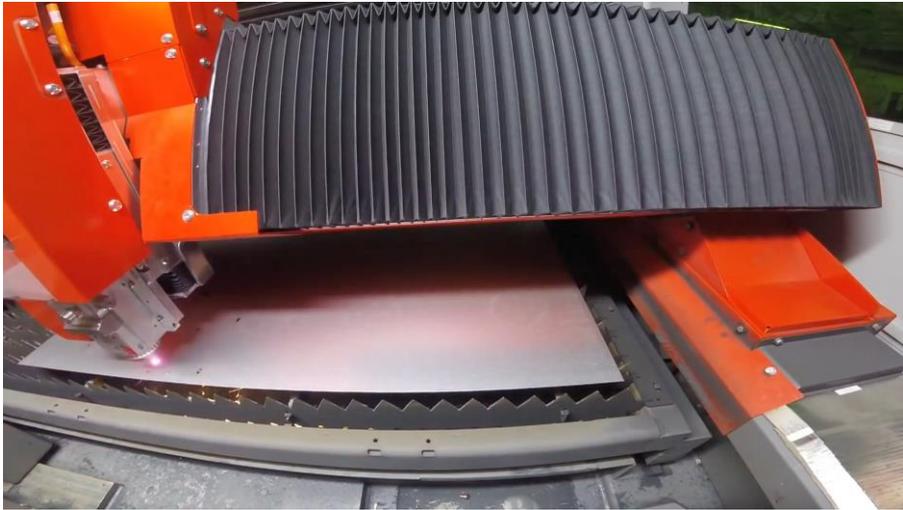


Product Portfolio

Applications



COMPONENTS



ROBOTICS



TURN-KEY SOLUTIONS



State of the art

Projects worldwide

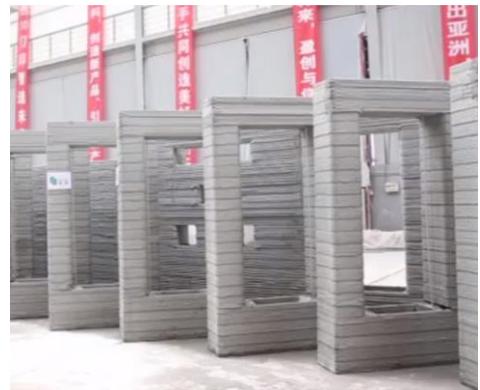
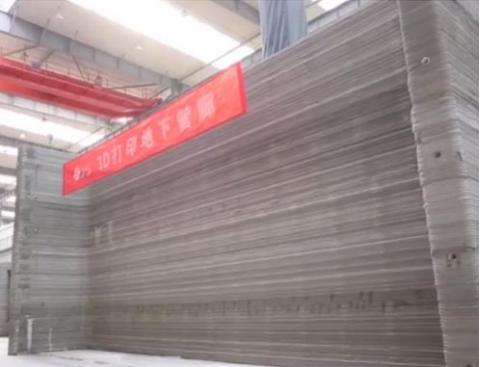


Almost all projects are used for R&D activities

Source: Larsen & Partners

State of the art

Customer products – non-reinforced parts / not for structural applications



State of the art

Printing nozzle with automatic steel wire incorporation



Source: Sika



Source: CNC Design



Source: Sika

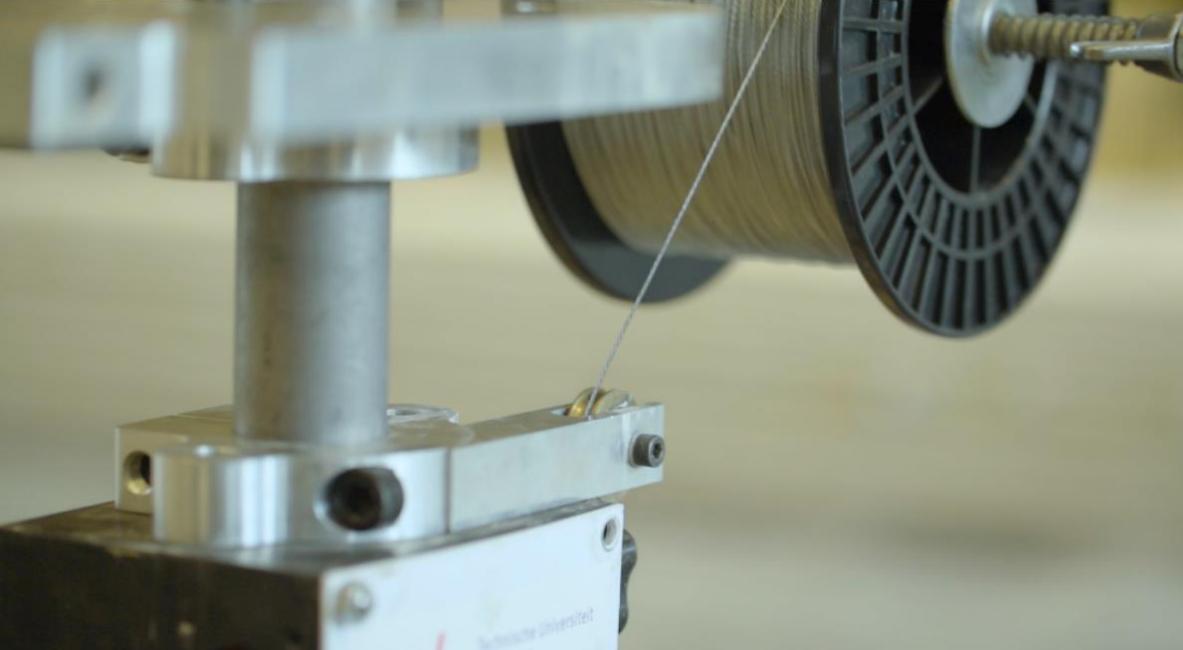


State of the art

Printing nozzle with automatic steel wire incorporation



Source: TU Eindhoven



Source: TU Eindhoven

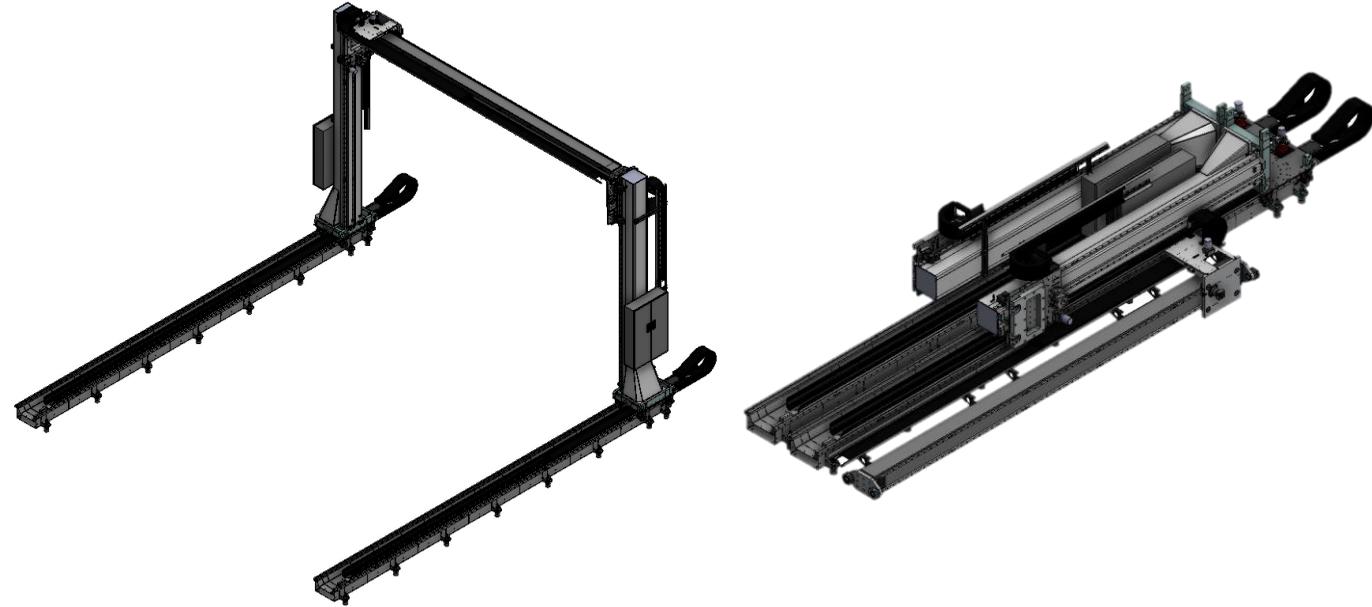


Source: TU Eindhoven

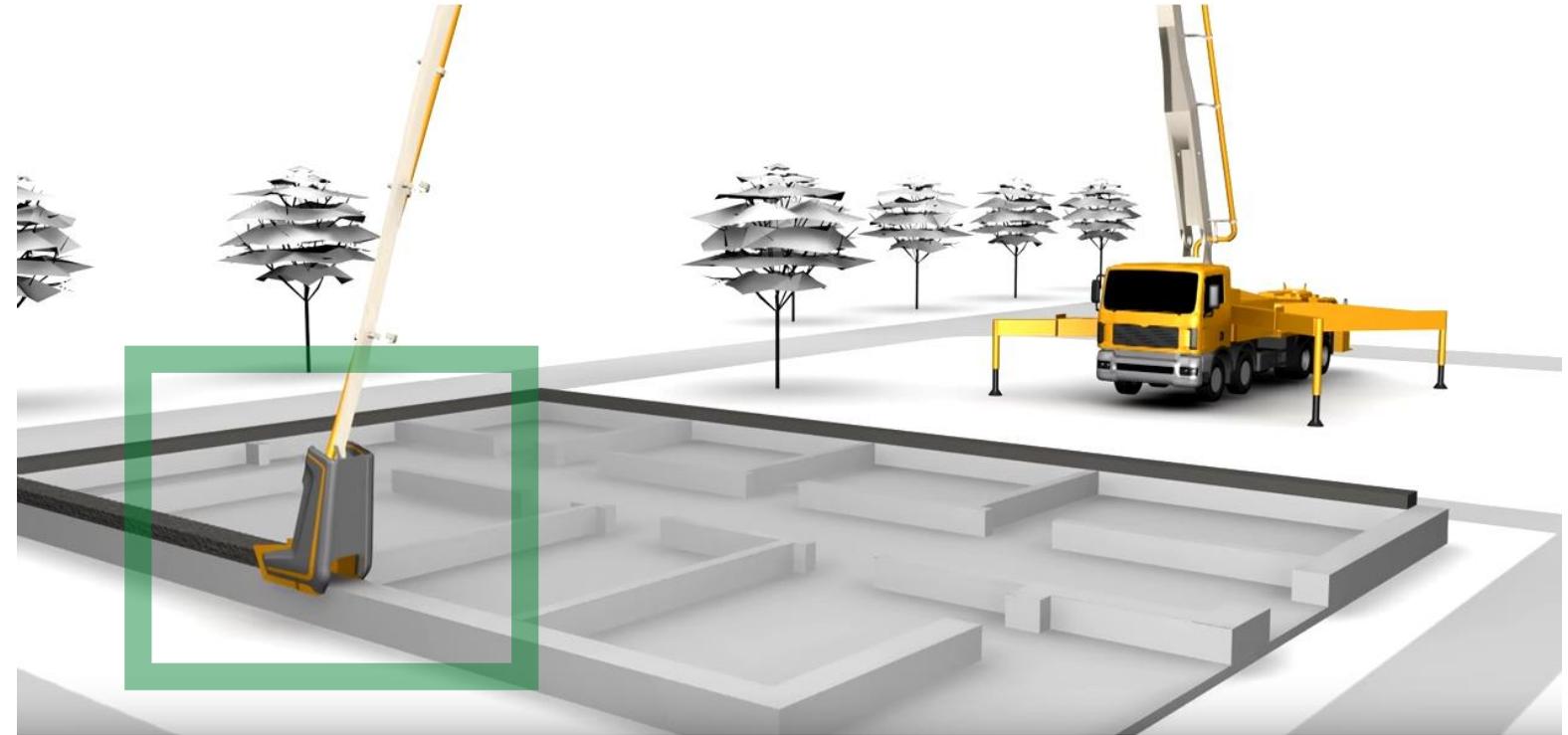
Offsite vs. onsite

Onsite printing: Weather condition challenges

GÜDEL accuracy 1mm



CONPrint 3D accuracy 100mm

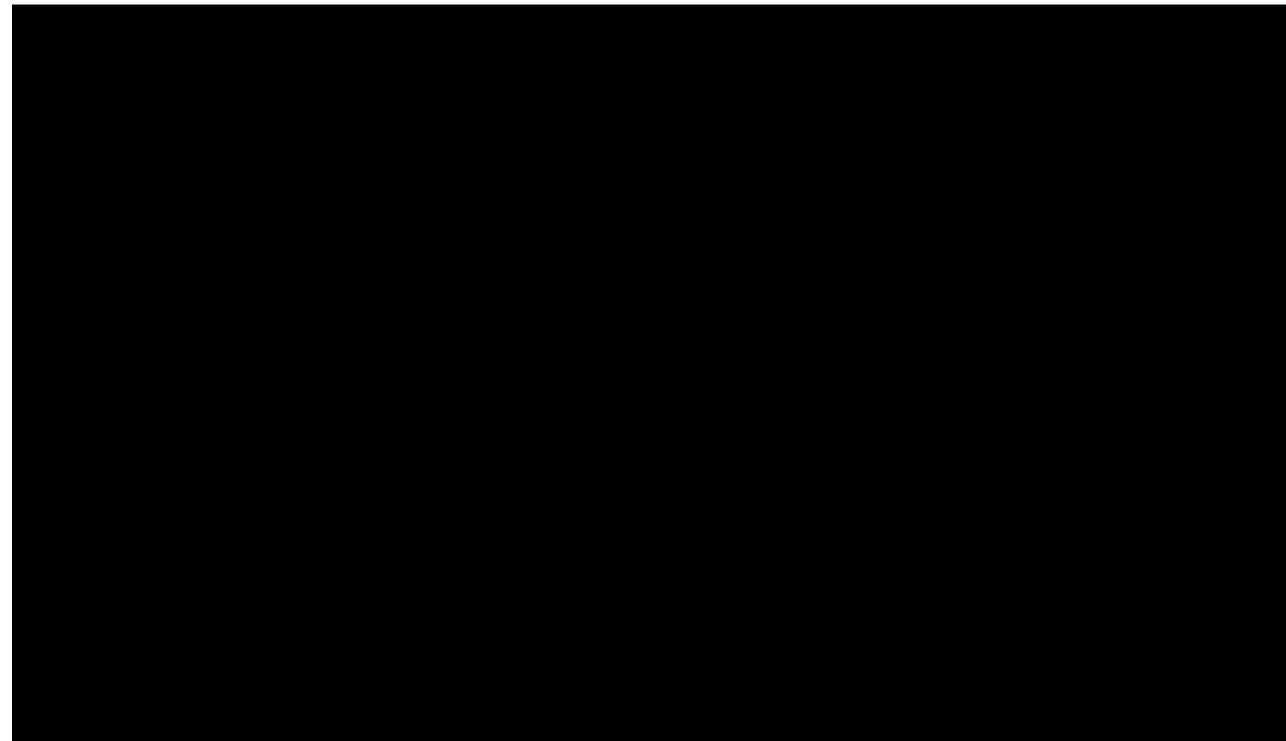


BAUTAGUNG
GUT ZU WISSEN

Offsite vs. onsite

Offsite printing

WINSUN China



HDB Singapore



Alternative manufacturing process

Wax printing

1 Wax print

2 Surface mill

3 Concrete pour or spray

4 Wax melt off

5 Finished panel

Güdel gantry robot, FP-6



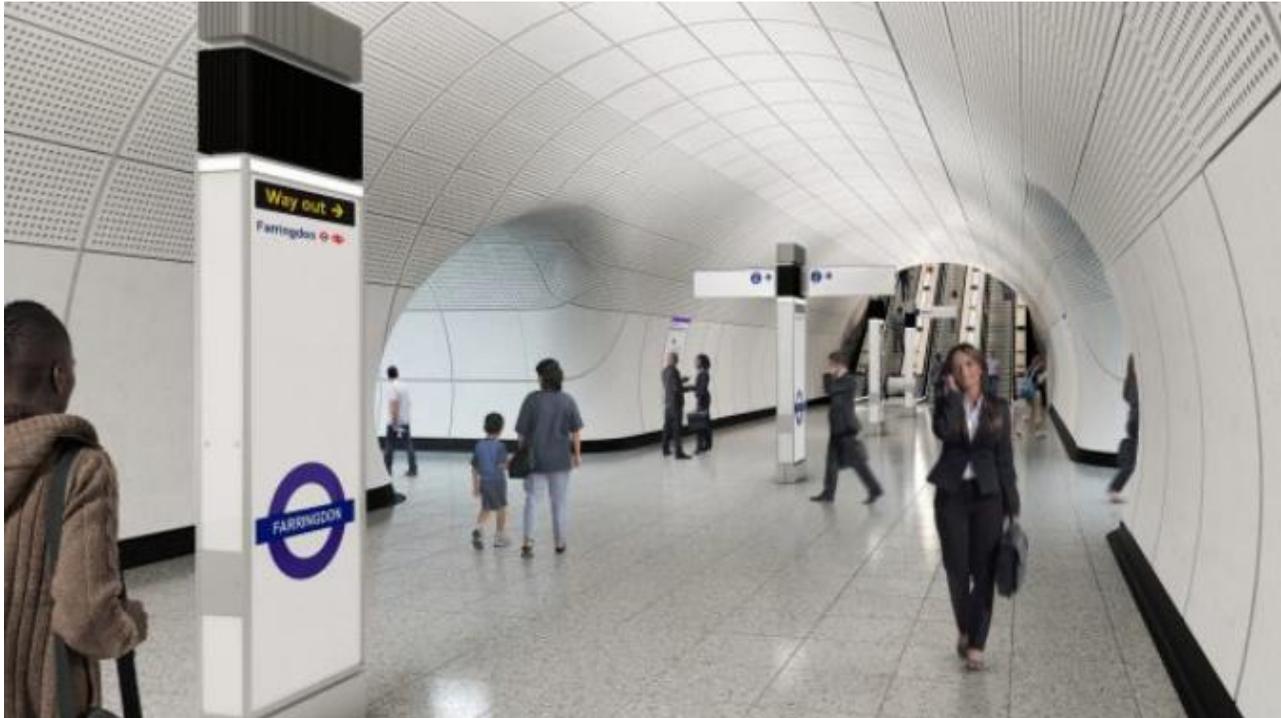
Alternative manufacturing process

Wax printing

Crossrail London



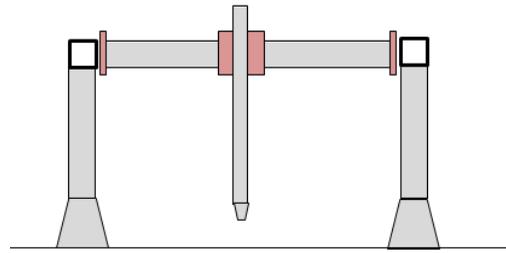
Source: Freefab



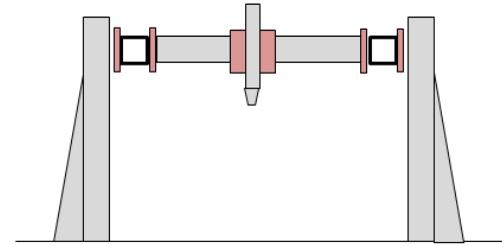
Source: Freefab

Concepts and layouts

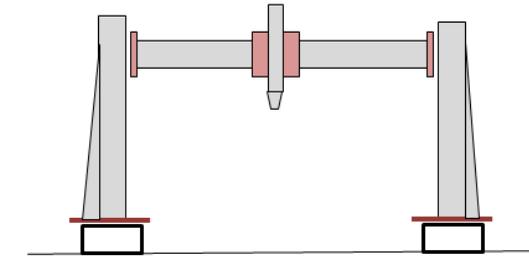
Classic area gantry



Area gantry with moving x-axis in vertical direction



Area gantry with floor axis



Alternativ Concept

Robot-gantry combination @ETH Zürich



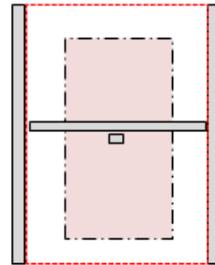
 **BAUTAGUNG**
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Concepts and layouts

Production layouts

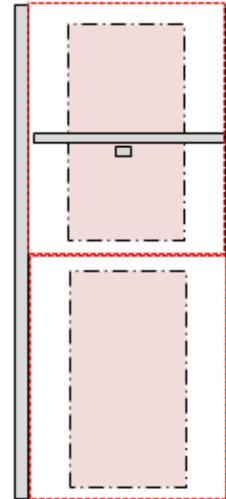
1 printing area

For labors and research centers
1 safety area



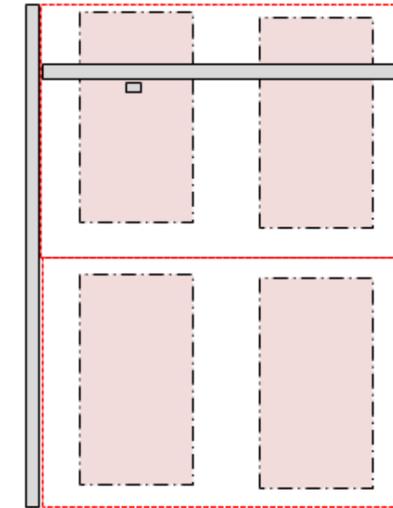
2 printing areas

Industrial production –
minimized non-productive time
2 safety areas



4 printing areas

Industrial production – required when
elongated hardening time
1-2 safety areas



Requirements & Challenges

Offsite printing

Requirements

Process



Path accuracy 1mm (ideal < 0.5mm)



Speed 1m/s Acceleration 2-4 m/s²



Tight radiuses <50mm

Robot



Long strokes



Heavy process equipment (Printing nozzle up to 100kg)



Long energy chains with heavy cables and process tubes

Challenges



Variable dosing system for concrete and chemical accelerator



How to improve smooth surface?



How to reinforce 3D-printed concrete?



Humidity and harsh environment



Chemical vapors



Need for additional wrist axes (Up to 3)



”

“Anwendungsspezifisch optimierte Roboter werden dem 3D-Druck im Bau die Türen zur industriellen Produktion öffnen“

Walter Zulauf – Güdel AG



Allgemein



- **Vorteil von 3D-gedruckten Bauteilen:** Gestalterische Freiheit / Individualität. Herstellkosten und zeitlicher Aufwand für die Schalung entfallen



- **Bewehrung:** Bauwerke und Vorfabrikate werden heute fast ausschliesslich mit Bewehrung ausgeführt.
- Bewehrung von 3D-gedruckten Bauteilen ist heute technisch (im industriellen Massstab) noch nicht gelöst.
- Der industrielle Holzbau ist dem 3D-Druck im Bauwesen heute «noch» um Längen voraus.



- **Markteinführung:** Der 3D Druck im Bauwesen wird seinen industriellen Durchbruch haben, sobald die Bewehrungstechnologie gelöst ist.

Hypothese

«Zukünftige Roboter für 3D-Druck in der Bauindustrie werden mit hybrider Prozess-Technologie ausgerüstet sein.

Beton und Stahlbewehrung werden im Wechsel schichtweise aufgebaut werden.

Mögliche Technologien für die Bewehrung sind im industriellen Einsatz (WAAM / Wire Arc Additive Manufacturing).»

Walter Zulauf, Güdel AG

Simon Flückiger, Güdel AG