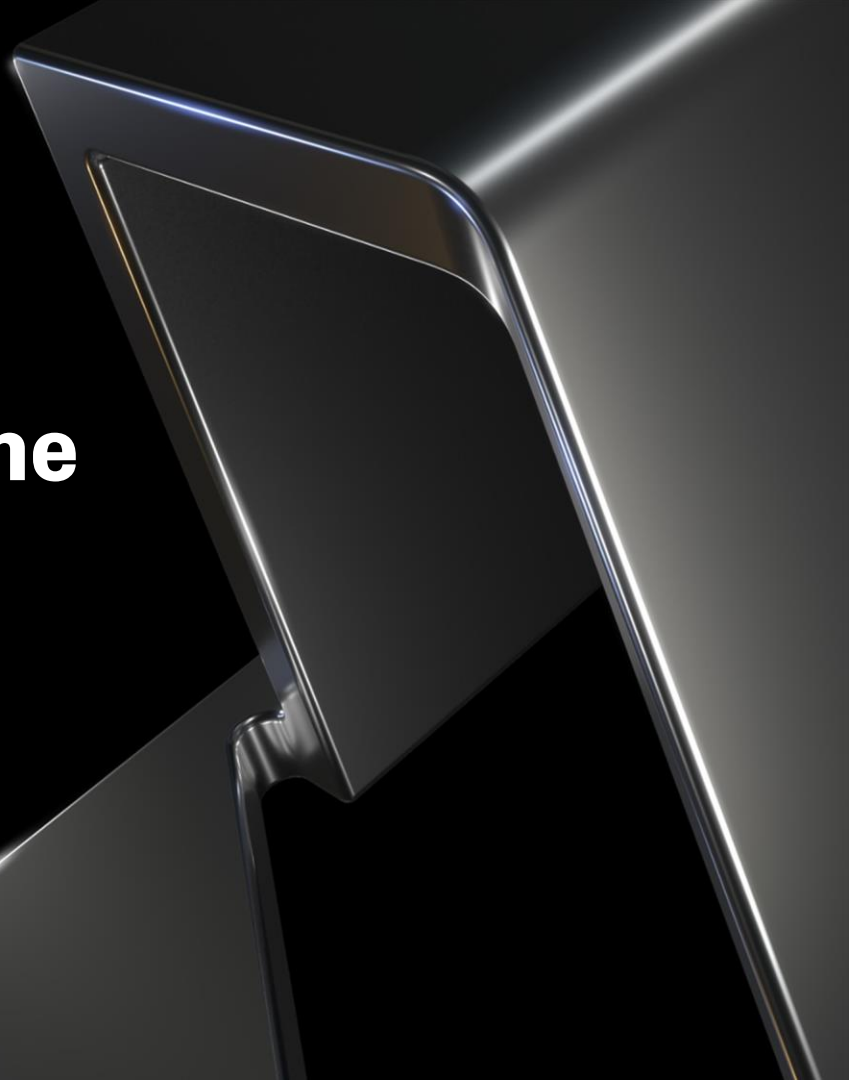
AUTODESK UNIVERSITY

TUM Boring – Building the world's fastest TBM

Haokun Zheng

Co-Founder, Project Lead & Chairman | @tum_boring



Today’s speaker

Haokun Zheng

- 20 years old
- Undergraduate Computer Science Student at Technical University of Munich
- Co-Founder, Project Lead & Chairman @ TUM Boring

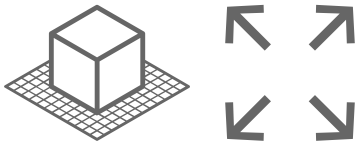
TUM BORING
INNOVATION IN TUNNELING

The problem

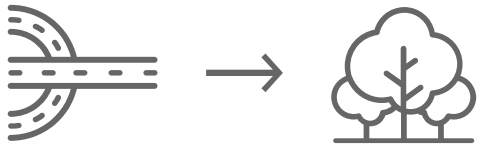
In a year, Los Angeles residents spend almost 7 full days just sitting traffic.

Our Goal: Revolutionize & enhance urban mobility

The importance of tunnel infrastructure



Three-dimensional infrastructure provides necessary capacity to match the growing population density



Tunnels can relieve existing street infrastructure, thereby reducing soil sealing

Tunnels enable modern mobility concepts such as Loop and Hyperloop

Not-a-boring Competition 2021

NOT-A-BORING COMPETITION

Las Vegas

- Announced by Elon Musk in July 2020
- **Challenge: Design and Build a Tunnel Boring Machine that bores tunnels faster than a snail crawls**

Competition Tunnel requirements:

- 30m (98ft) length
- 500mm diameter
- 1,5m (5ft) deep

Fastest team to complete the tunnel wins

The TUM Boring Team

TUM Boring

The 2021 Team of the Technical University of Munich

TUM BORING
INNOVATION IN TUNNELING

60+

Students

From 16 different countries

24

Years

Average age

16+

University Faculties

Represented by our team members

14

Months

From project inception until finished machine

Project Patron

Prof. Dr. Thomas F. Hofmann

President of the Technical University of Munich

“ (...) I am convinced that we will succeed and I wish our team the greatest possible success. All of TUM is behind you 100 percent!”

Strong industry support

Many leading industry partners follow and support us on our journey to Las Vegas, enabling us to participate with a competitive machine.

AUTODESK.
Make anything.™

Autodesk as a corporate partner and sponsor has played a major role in supporting us financially as well as through in-kind support.

High media attention

We have been featured in all major German Newspapers

Süddeutsche Zeitung

Frankfurter Allgemeine
ZEITUNG FÜR DEUTSCHLAND

Handelsblatt

Münchner Merkur

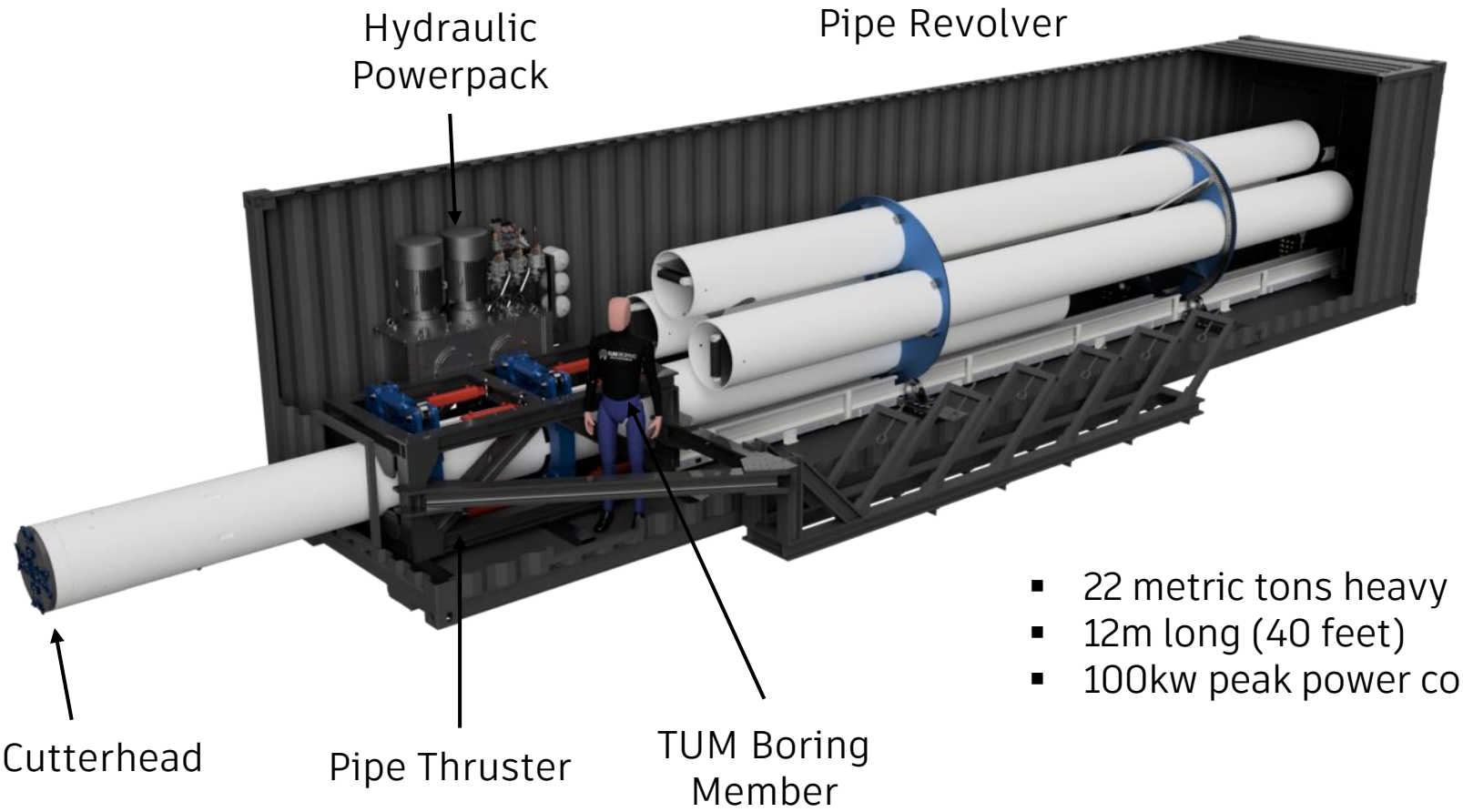
BUSINESS INSIDER

BR

Accumulated readership of over 10,6 Mio per issue
Over 700 000 organic impressions through our Website and Social Media Channels


Our Machine

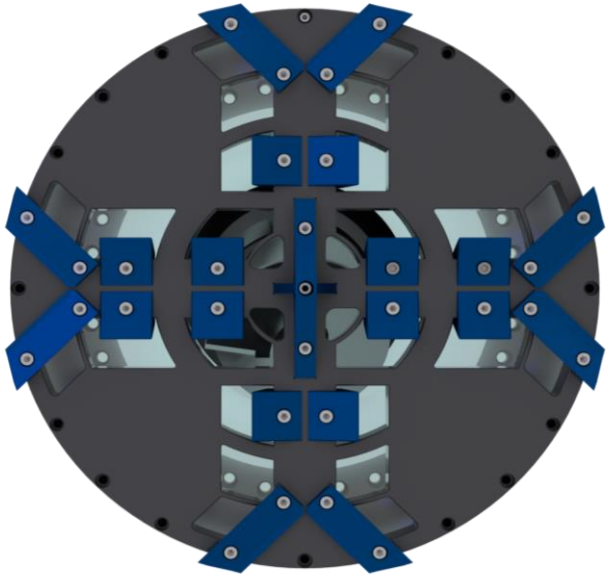
Technical Concept



- 22 metric tons heavy
- 12m long (40 feet)
- 100kw peak power consumption

Technical Concept - Cutterhead

- Peak Torque of 10.000 Nm at ~30 RPM
- Optimized for Las Vegas geology
- Full electric drivetrain

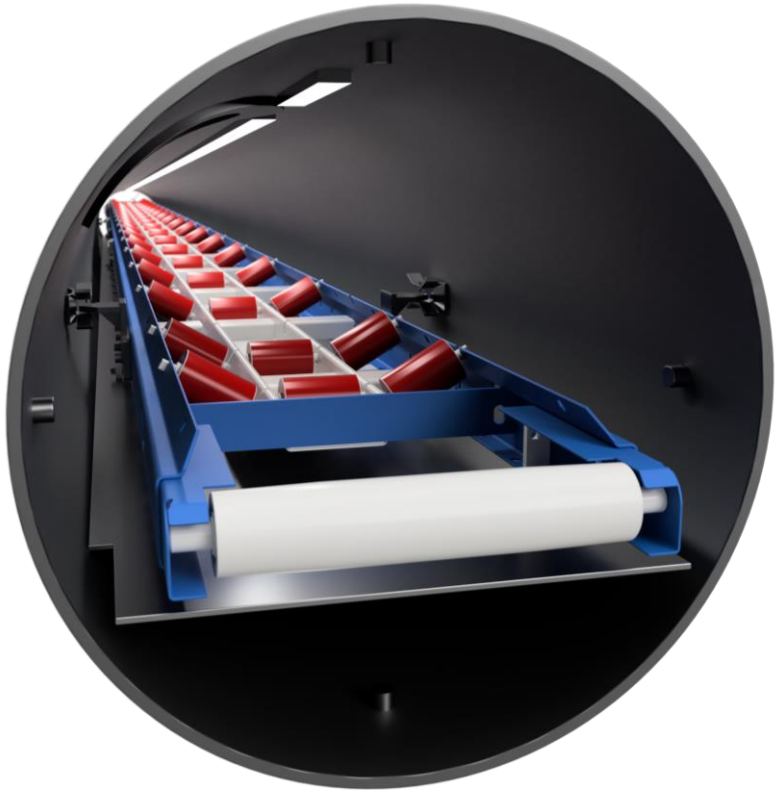


Technical Concept – Pipe Thruster

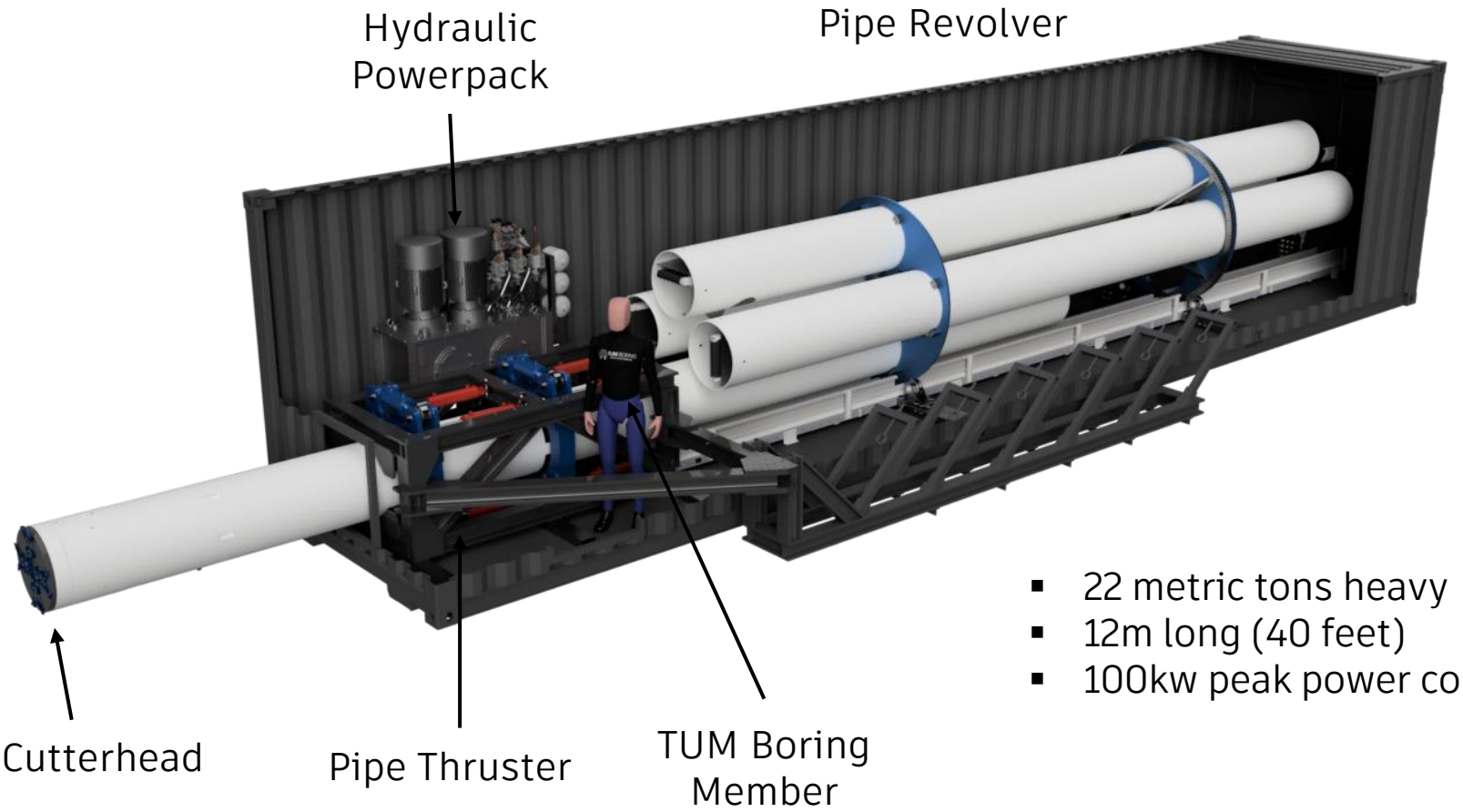
- Pushing forces of up to 100 metric tons
- Feed rate of up to 1m/min
- 2 Hydraulic circuits enable a continuous tunneling process

Technical Concept – Material Removal

- 55m of conveyor belts (180ft)
- Material flow rates of up to 8kg/s
- Low power consumption electric drivetrain



Technical Concept



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- 12m long (40 feet)
- 100kw peak power consumption

Project timeline

From Project Inception in July 2021 to the Competition in September 2021

July 2020

Project inception & Start of Design Phase

Recruitment of 60 people

Feb 2021

Start of Assembly

Qualification for Competition Finals as one of 12 out of 390

May 2021

Start of Testing

Successful digging of 30m test tunnel

Aug 2021

Shipment of the machine to Houston

Machine leaves Houston for Vegas after final preparations

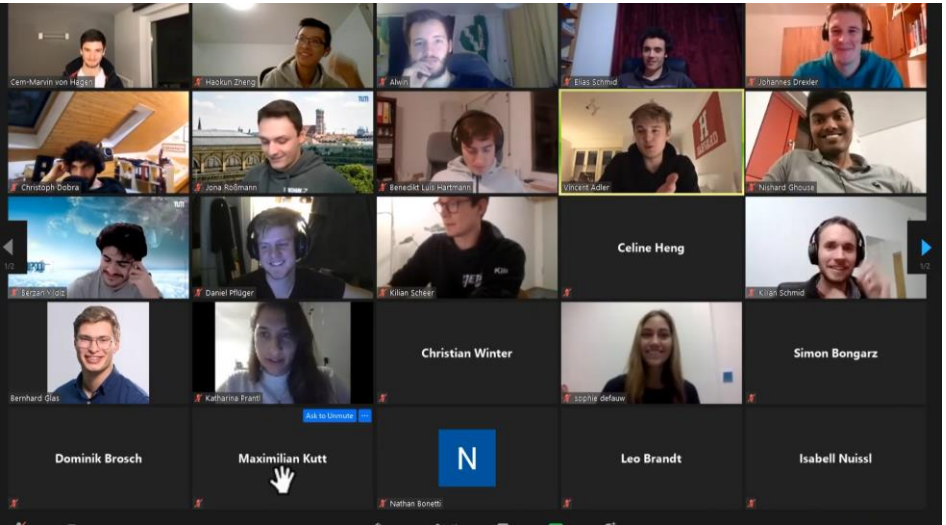
Project Inception

How everything started

Our first prototype

How everything started

Our first prototype

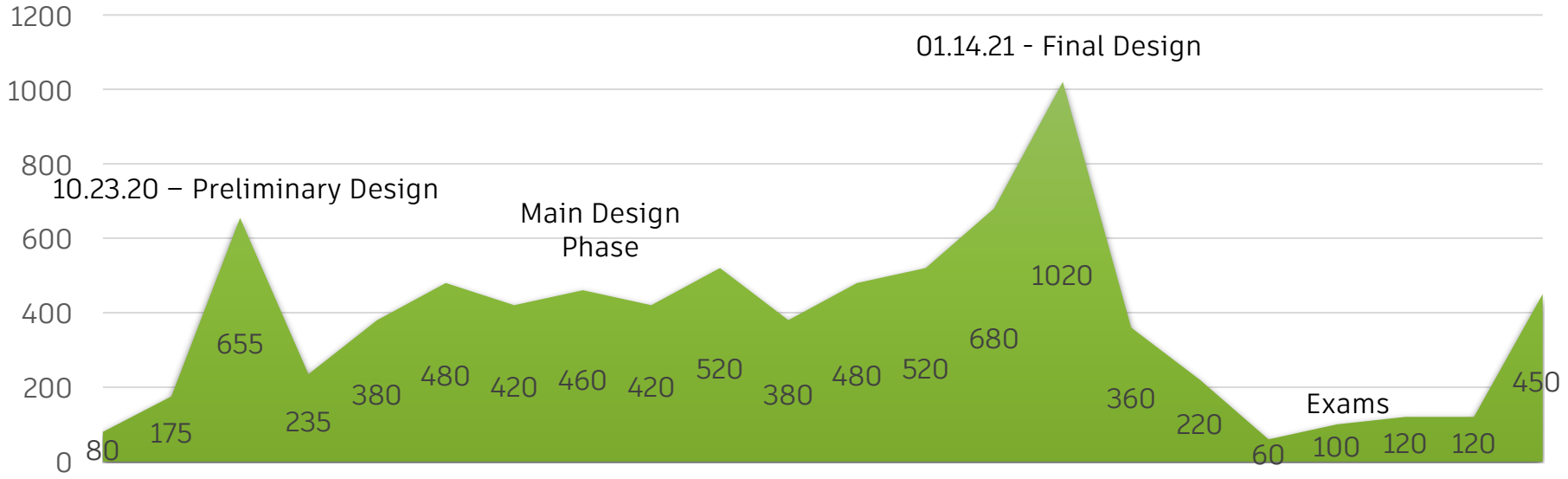

Cem-Marvin von Hagen
Haokun Zheng
Alwin
Elias Schmid
Johannes Drexler
Christoph Dobra
Jona Roßmann
Benedikt Luis Hartmann
Vincent Adler
Nishard Ghouse
Berzan Yildiz
Daniel Pflüger
Kilian Scheer
Celine Heng
Kilian Schmid
Bernhard Glas
Katharina Franti
Christian Winter
sophie defauw
Simon Bongarz
Ask to Unmute
Dominik Brosch
Maximilian Kutt
N
Nathan Bonetti
Leo Brandt
Isabell Nuissl

Weekly hours spent in Fusion 360

Over 20 TUM Boring Members are working with Fusion 360 on a daily basis

Our machine consists of 10000+ Parts (Bodies) (Counted via count function in the full assembly 10072)

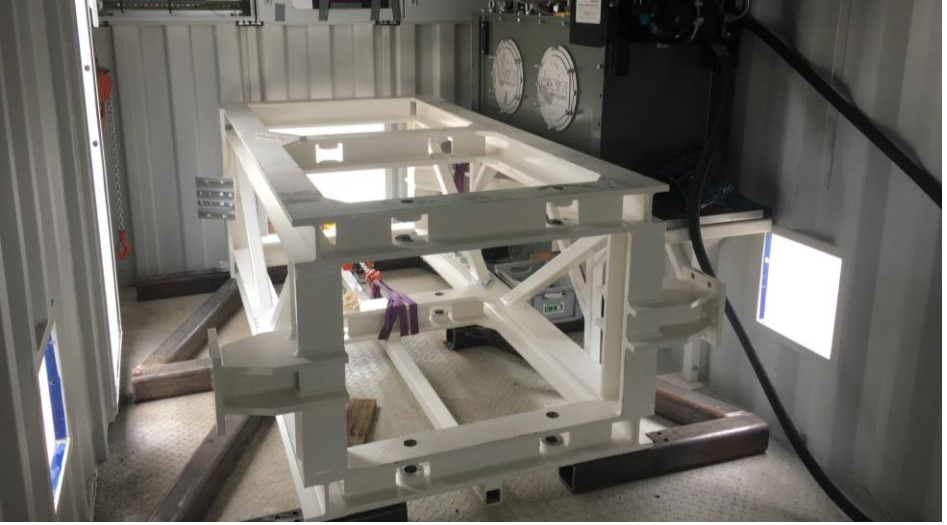
> 6500 accumulated hours spent in Fusion 360 since September 2020



Assembly start

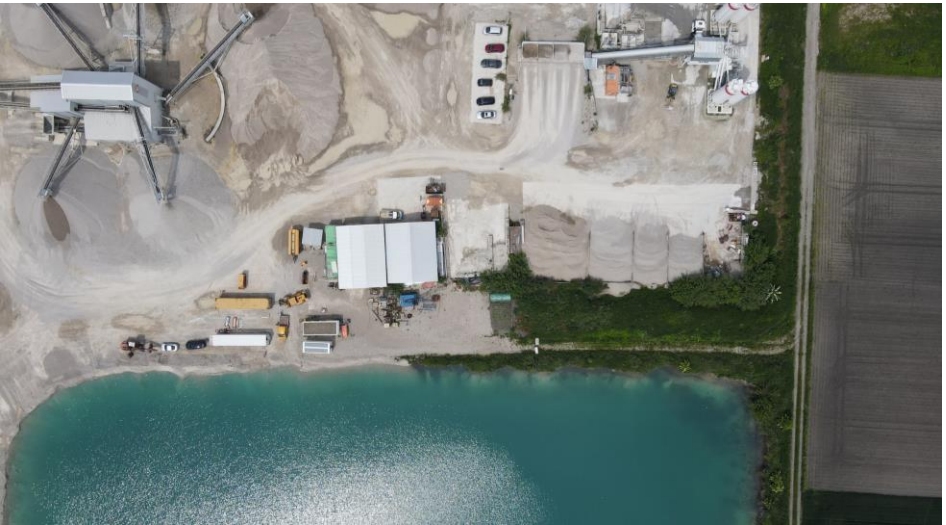

BCGU 900008 4
42S3
MAX.GR
TARE
NET
CU.CAP


Strautmann
Hydraulik



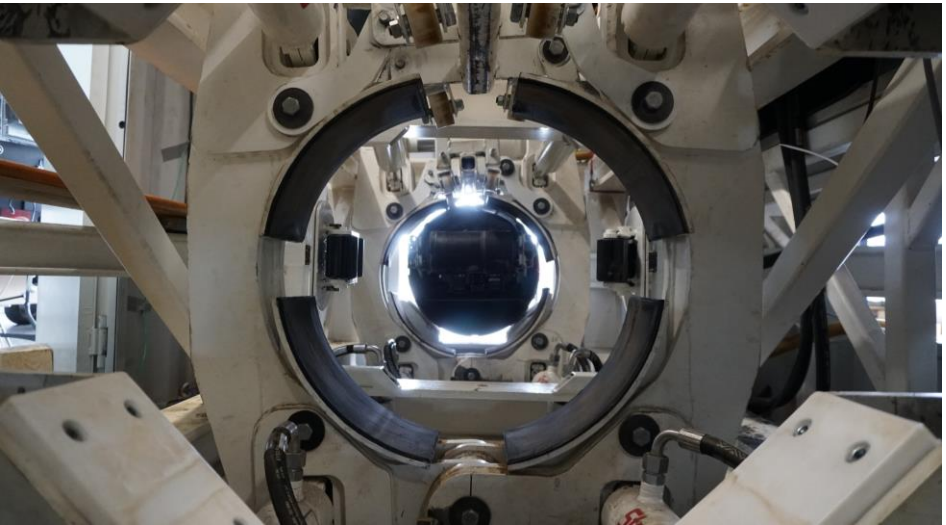
Moving to the testsite

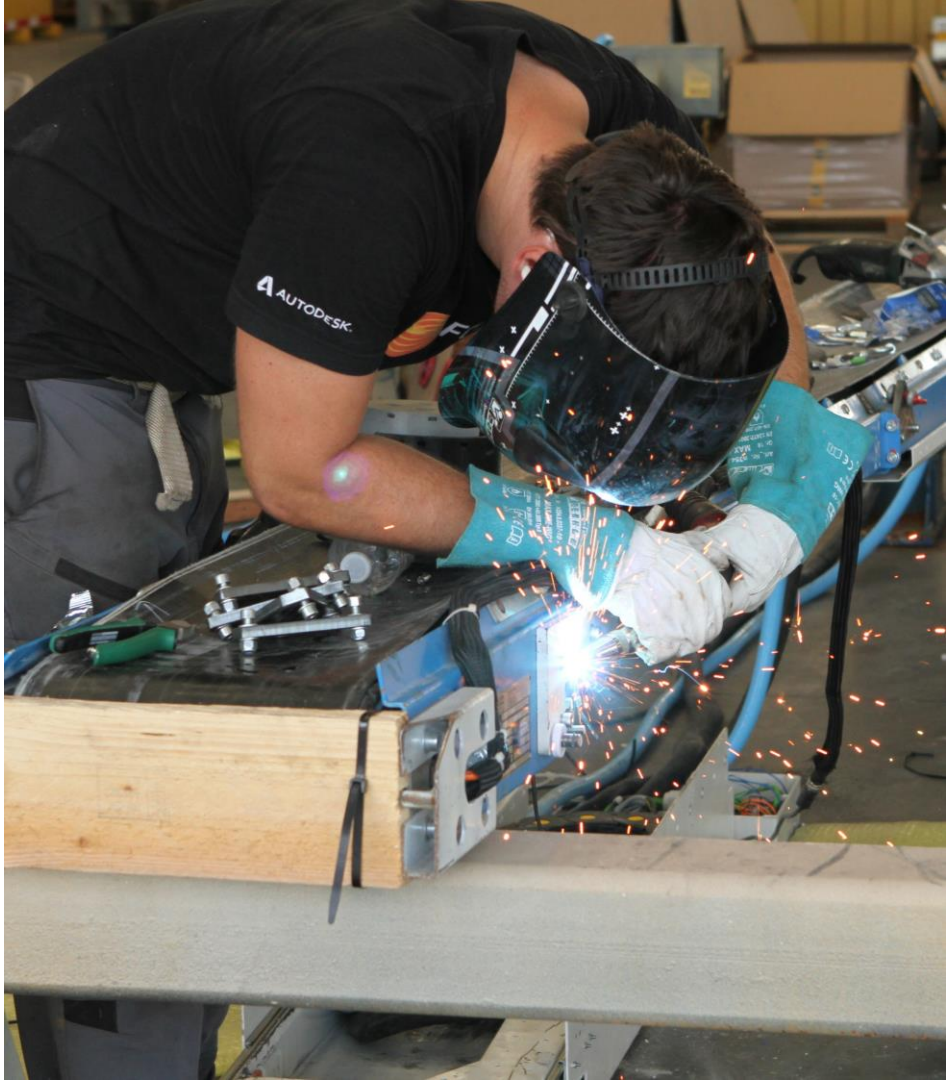

Big Move
BLOEDORN




TUM | BORIN

Machine arrives in Houston

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TUNNELING


UMBONG

Competition Finals in Vegas


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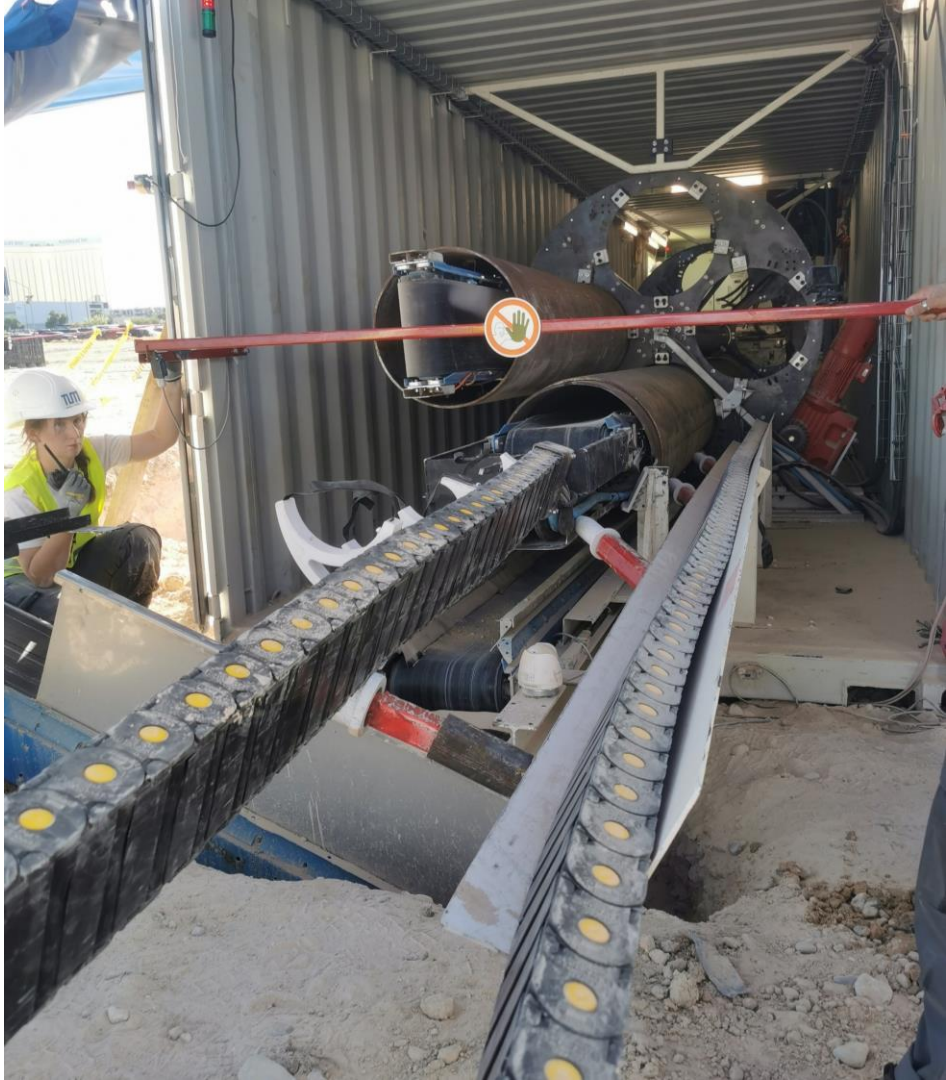



And after 6h of tunneling...

TUM Boring wins the 2021 Not-a-Boring Competition!

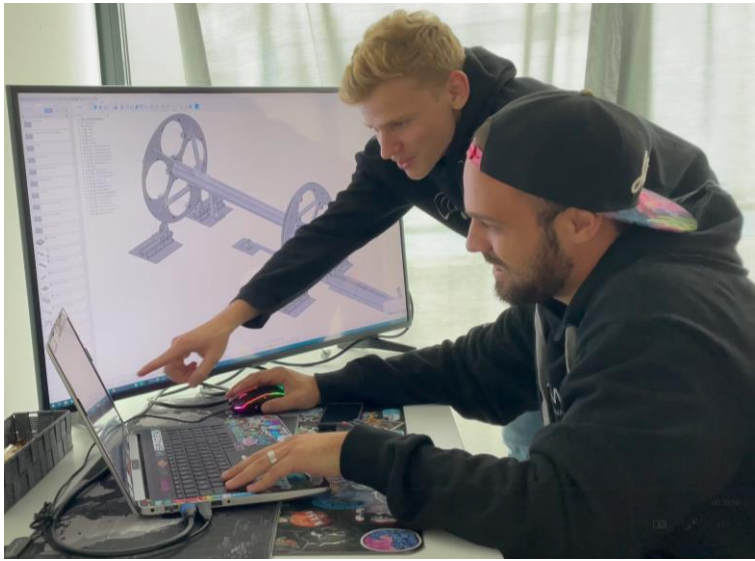

Learnings

The power of passion

- Passion and motivation can make anything possible.
- Without the sincere dedication of each individual team member, we wouldn’t have been able to even remotely get this far

Effective deployment of remote working tools

- Online conferencing and workspace communication allowed for very high work efficiency
- Fusion 360s cloud feature proved to be vital – Deploying the right software can save valuable time



The world needs more projects like this

- The learnings and takeaways from such a project are an incredibly valuable and irreplaceable addition to an academic degree
- Dedicated and passionate high intensity projects like this drive technological innovation and gather attention a dedicated technical field.

Thank you for your attention!

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TUM Boring Website: https://tum-boring.com/

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