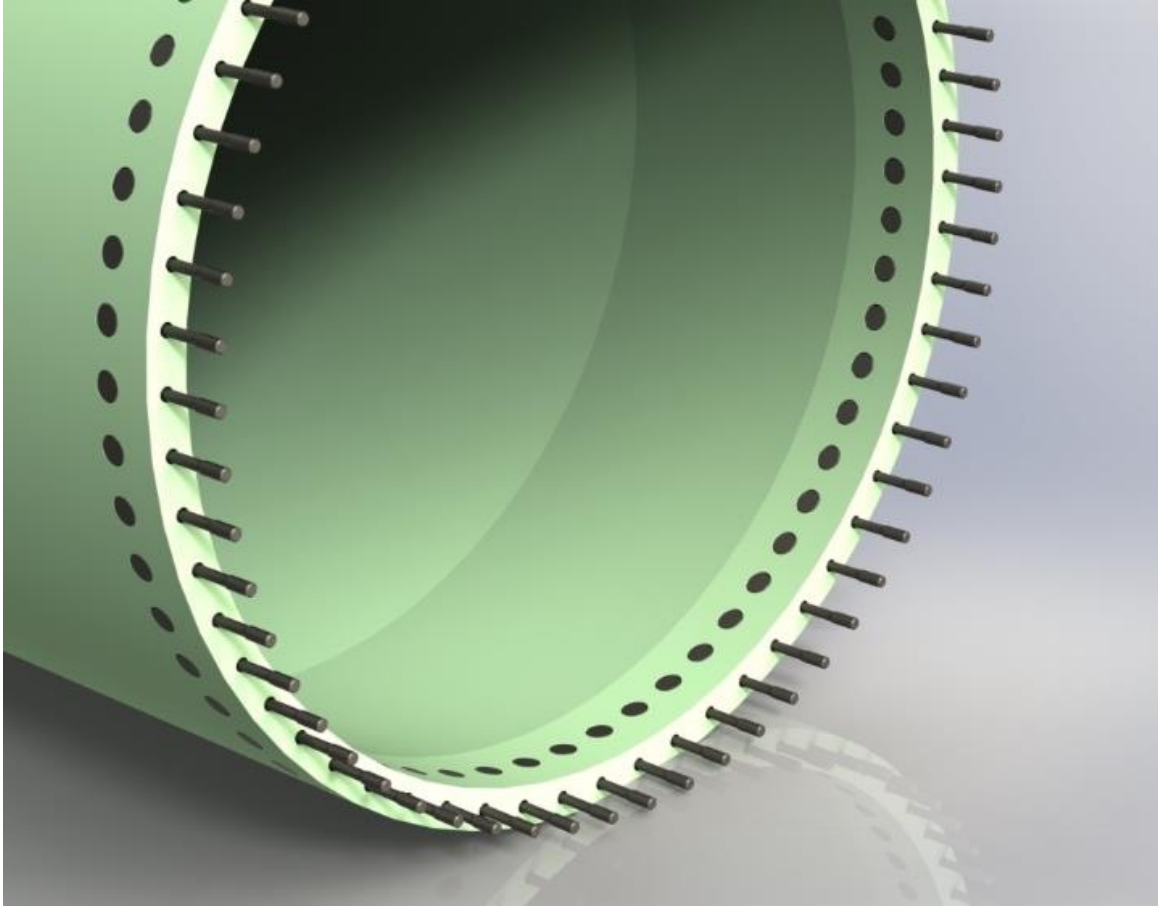


# ADC.Bushing

## The advanced Hub Connection

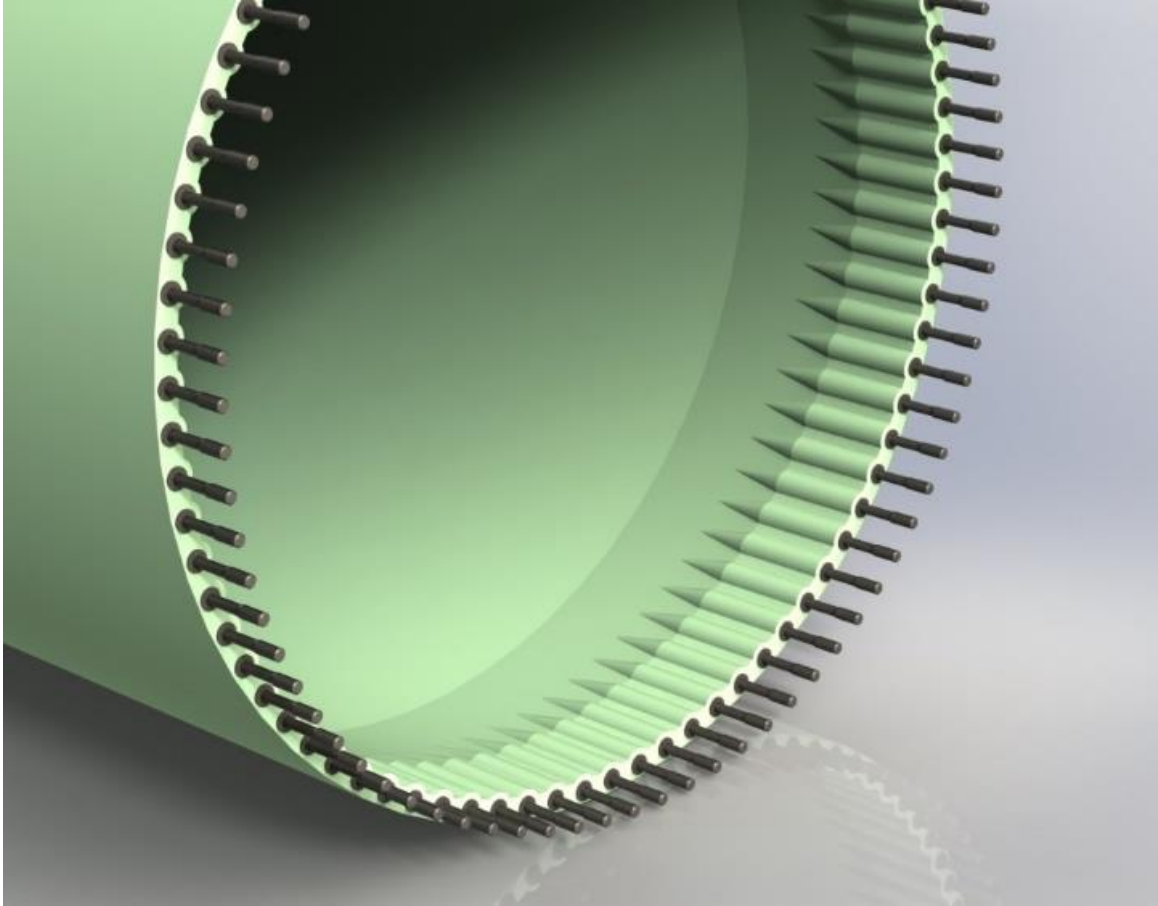
# Current Blade root connection T-Bolt



## Production process

- GFRP Layup
- Milling and drilling
- Crossbolt and studbolt

# Current Blade root connection Bushing

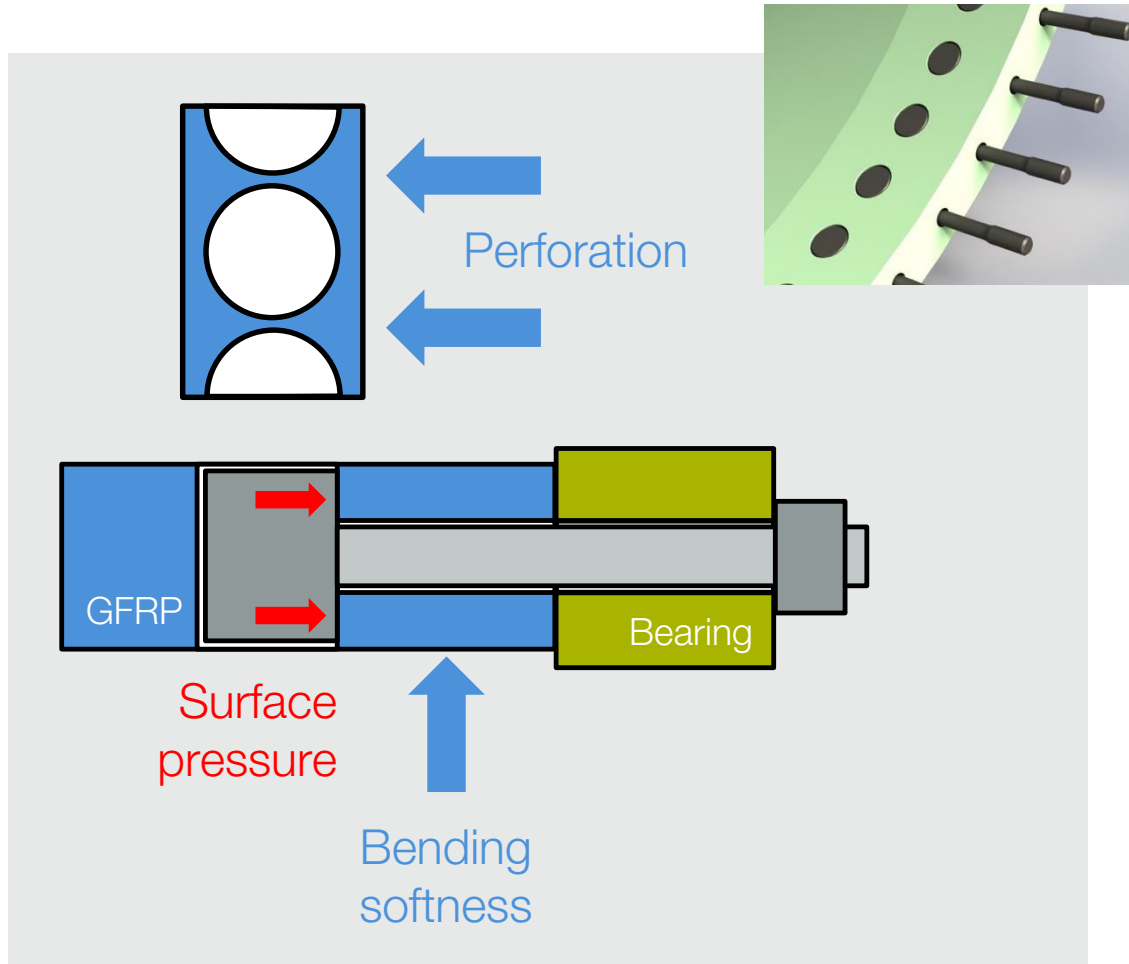


## Production process

- Positioning of each single bushing via template in main mould
- Infusion together with shell laminate

# T-Bolt

## Pros and Cons



### Pros

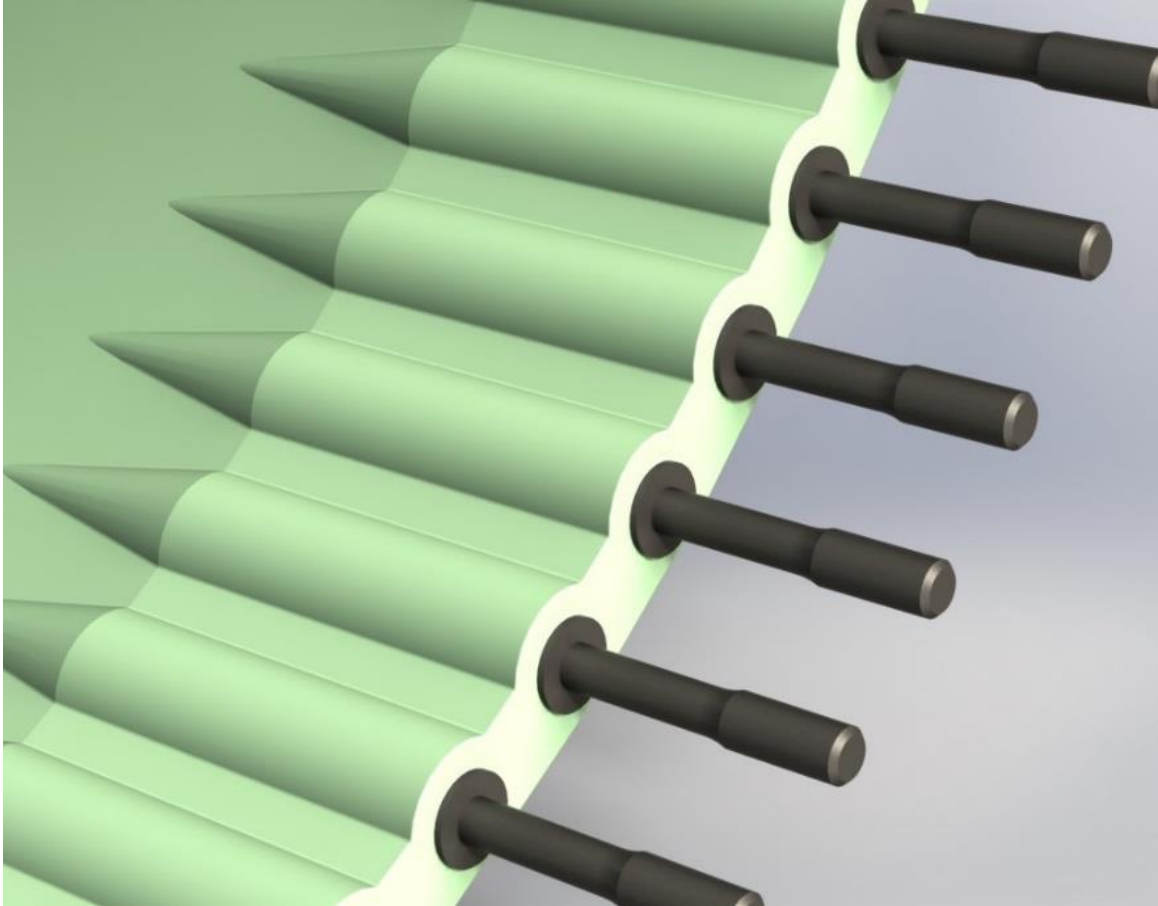
- Simple
- Cheap
- Accurate (CNC milling)
- Self-made solution

### Cons

- Technically a catastrophe
- Limited number of bolts
- Heavy GFRP part needed

# The bushing solution

## Pros and Cons



### Pros

- more bolts possible
- High force transmission
- Less GFRP

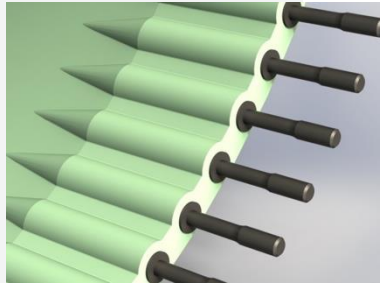
### Cons

- Technically not ideal
- Heavy and long bushings
- High accuracy and complex to install
- Expensive

# Is it possible to combine the advantages of both systems?

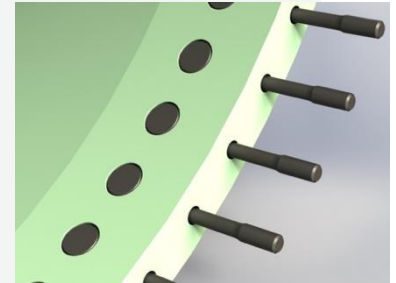
## Advantages Bushings

- More bolts
- High force transmission
- Less GFRP



## Advantages T-Bolts

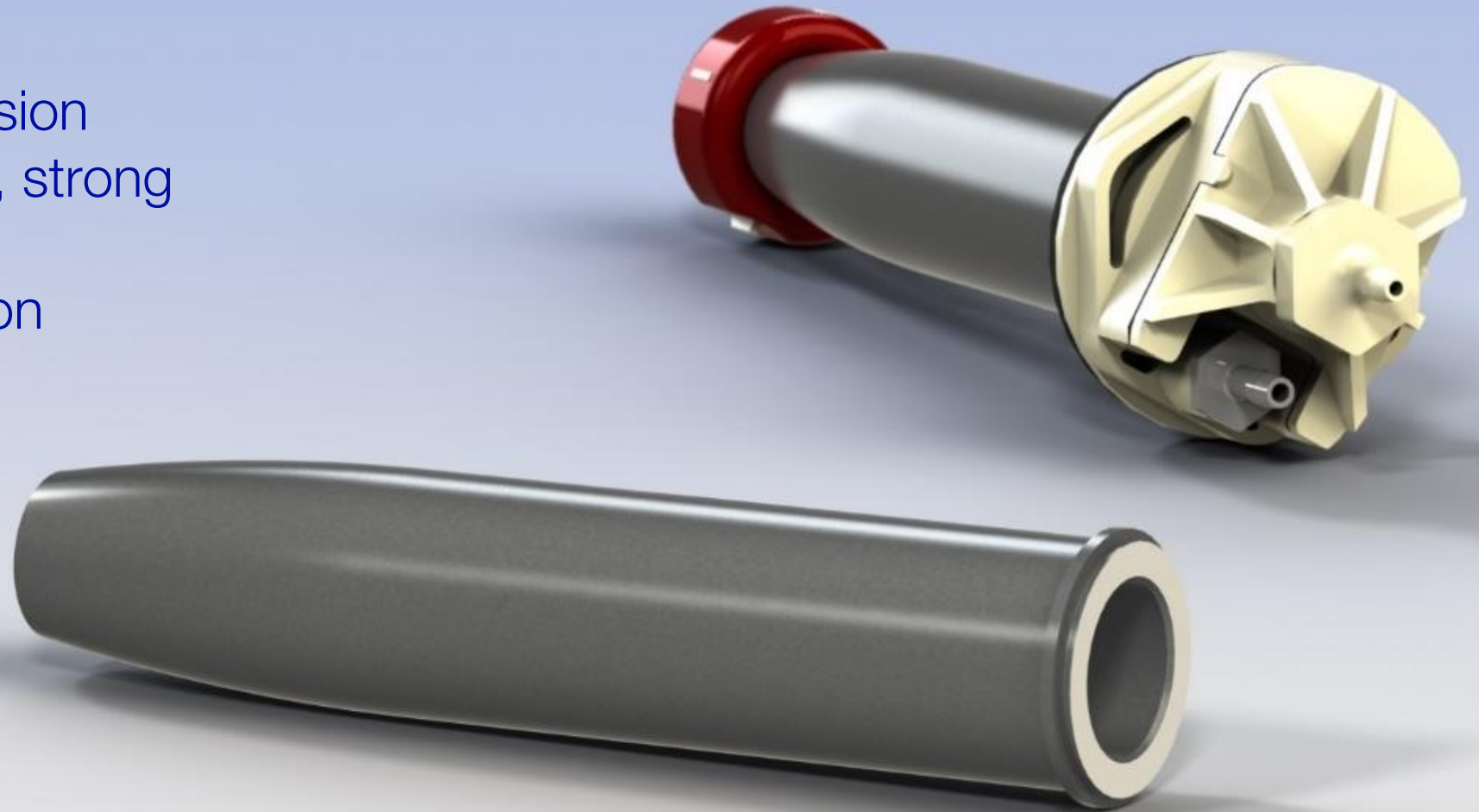
- Simple
- Accurate due to CNC
- Cost efficient
- Self-made solution



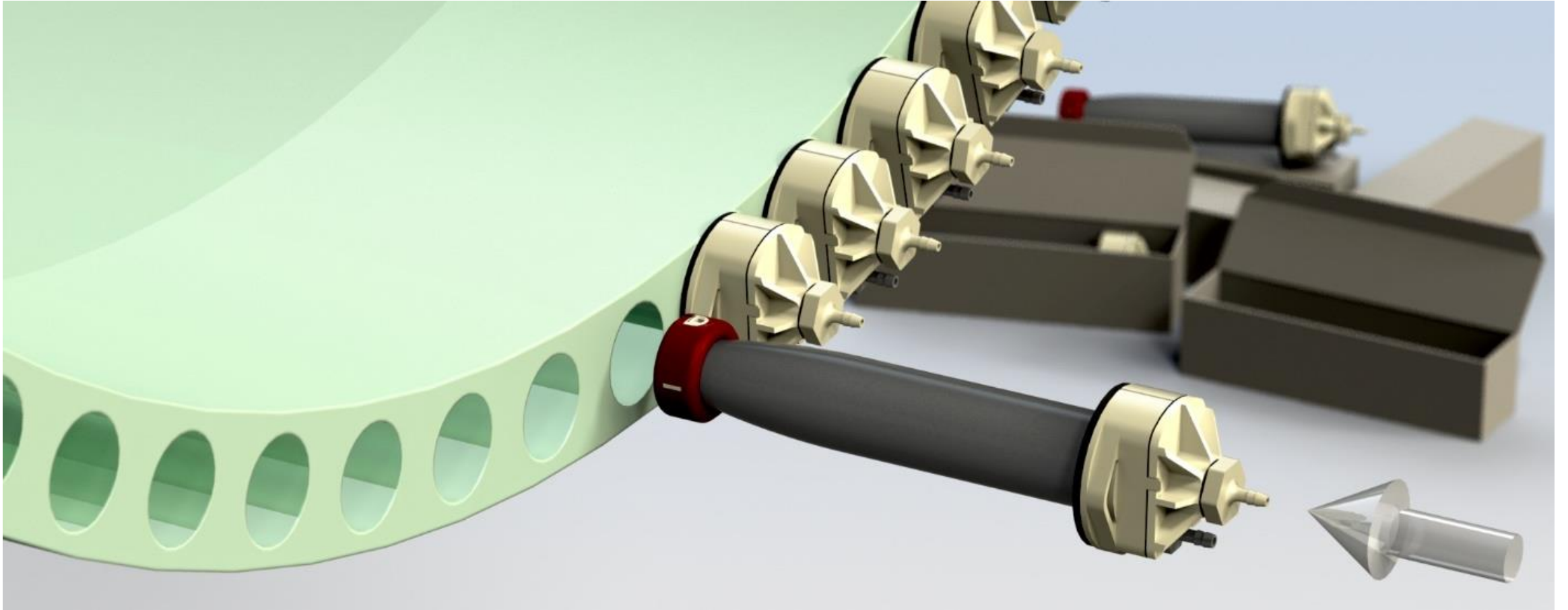
Yes!  
with the...

# ADC.Bushing System

Perfect load transmission  
→ Light, short, strong  
Simple to install  
High vertical integration  
Cost effective



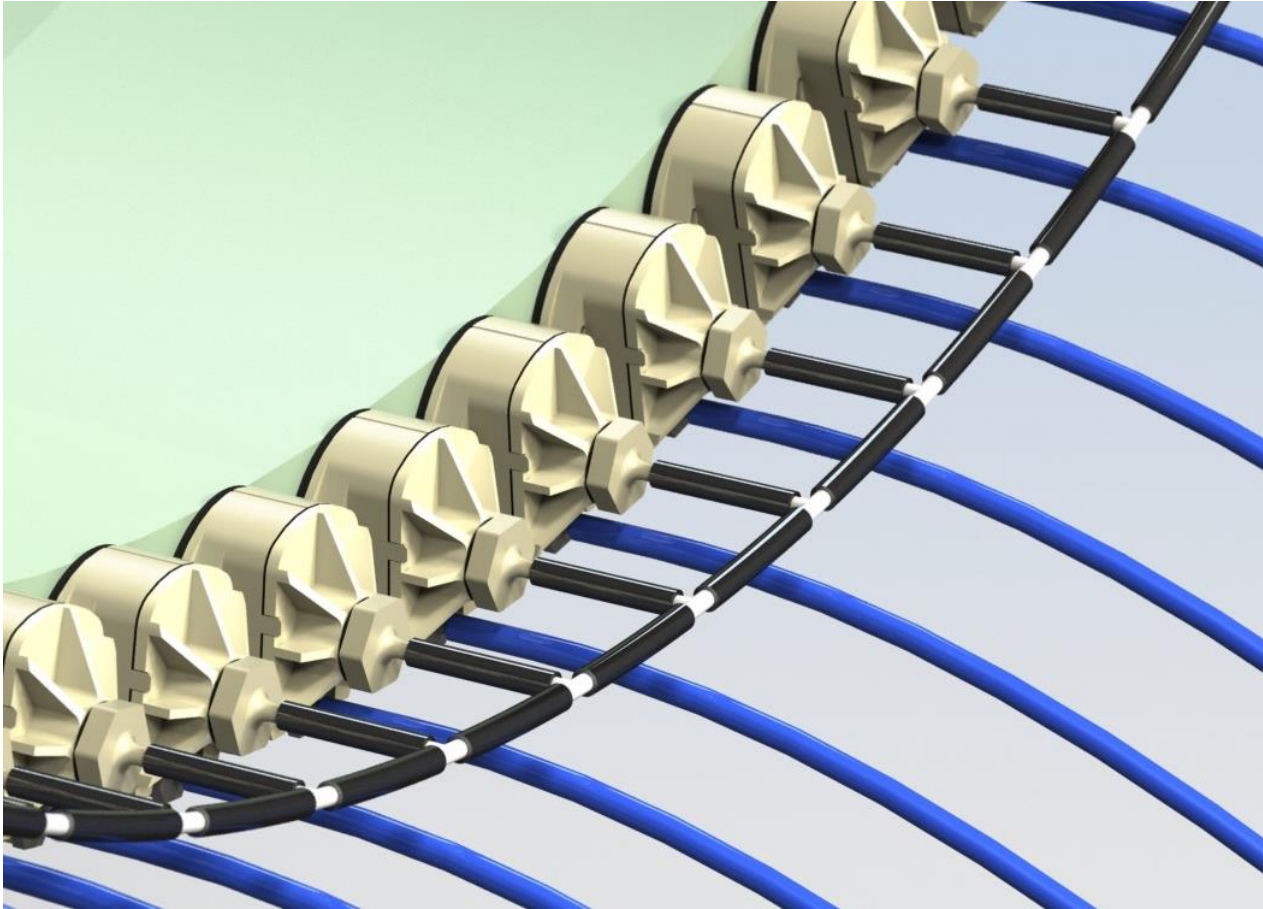
# Installing ADC.Bushings



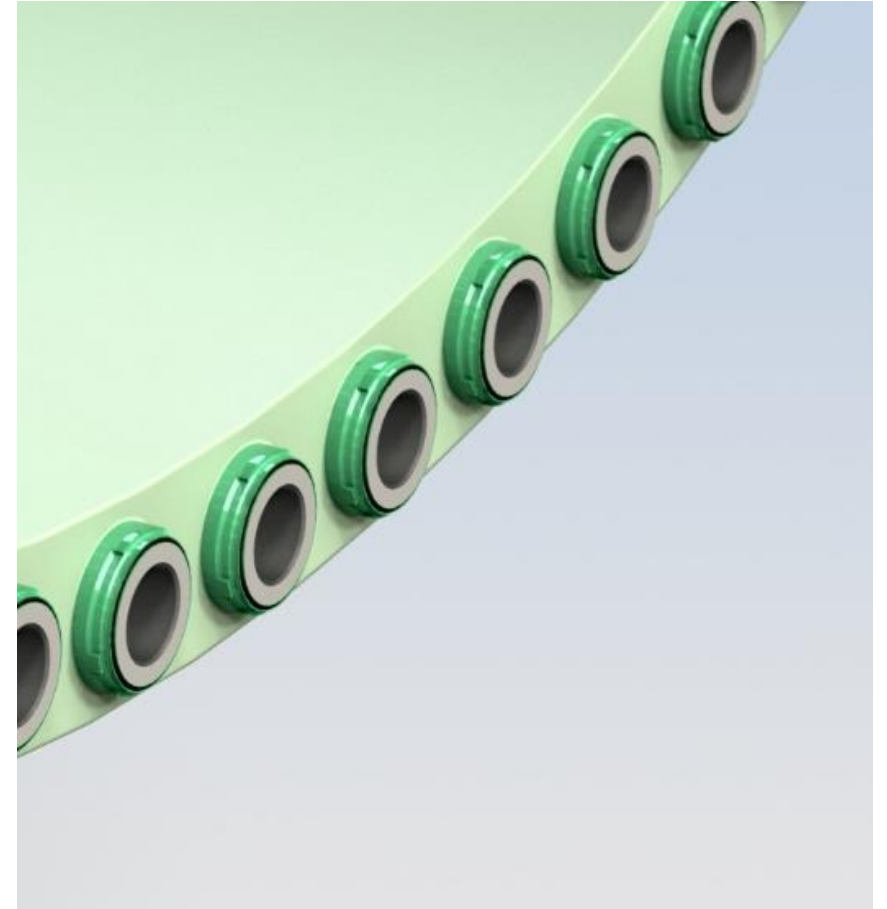
Simply insert the Bushing System into the predrilled holes



# Vakuüm-Infusion



A self controlling shoot-and-forget process



done

# Installation tool

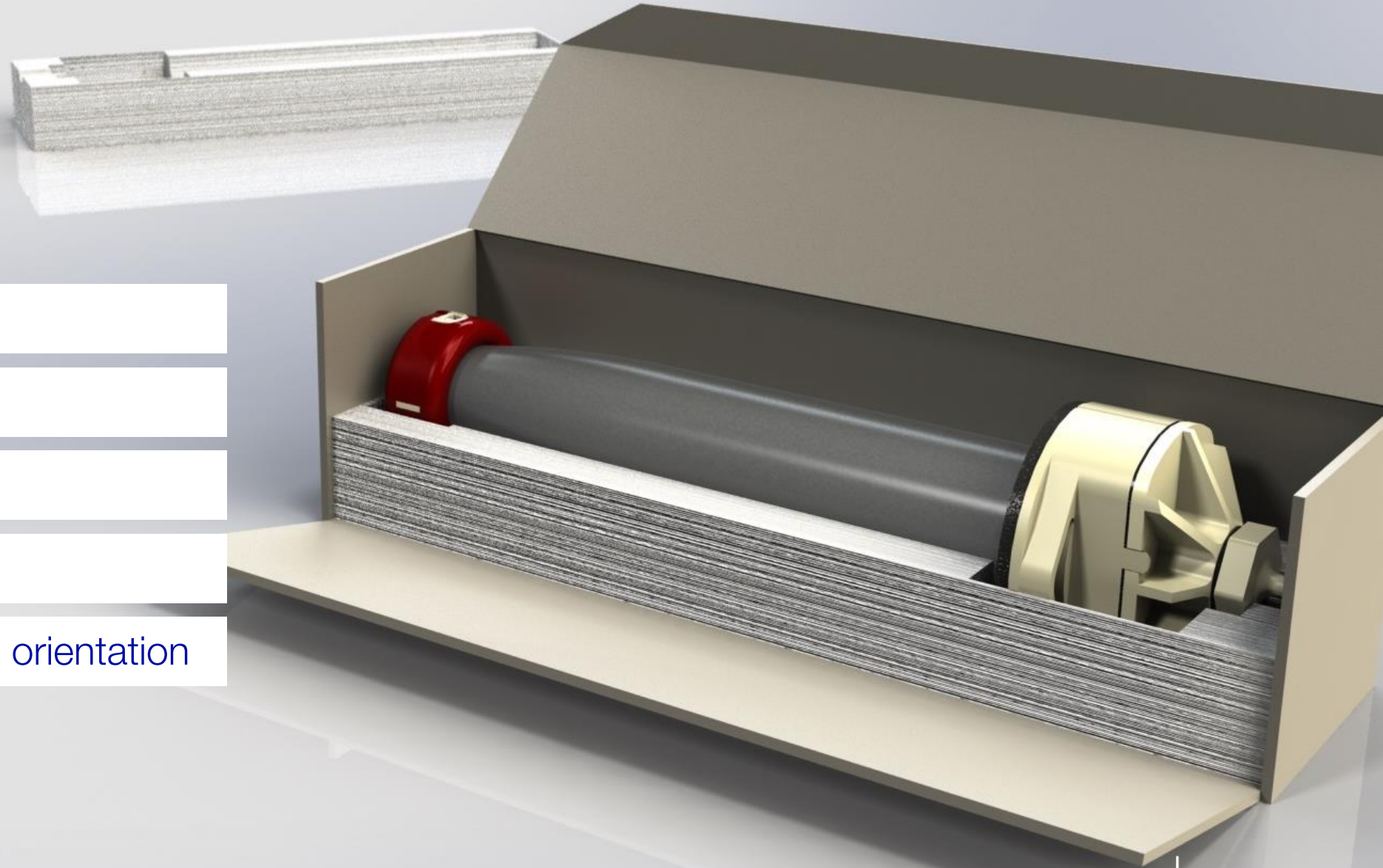
Easy to use

Self-centering

Self-fixing

Self-sealing

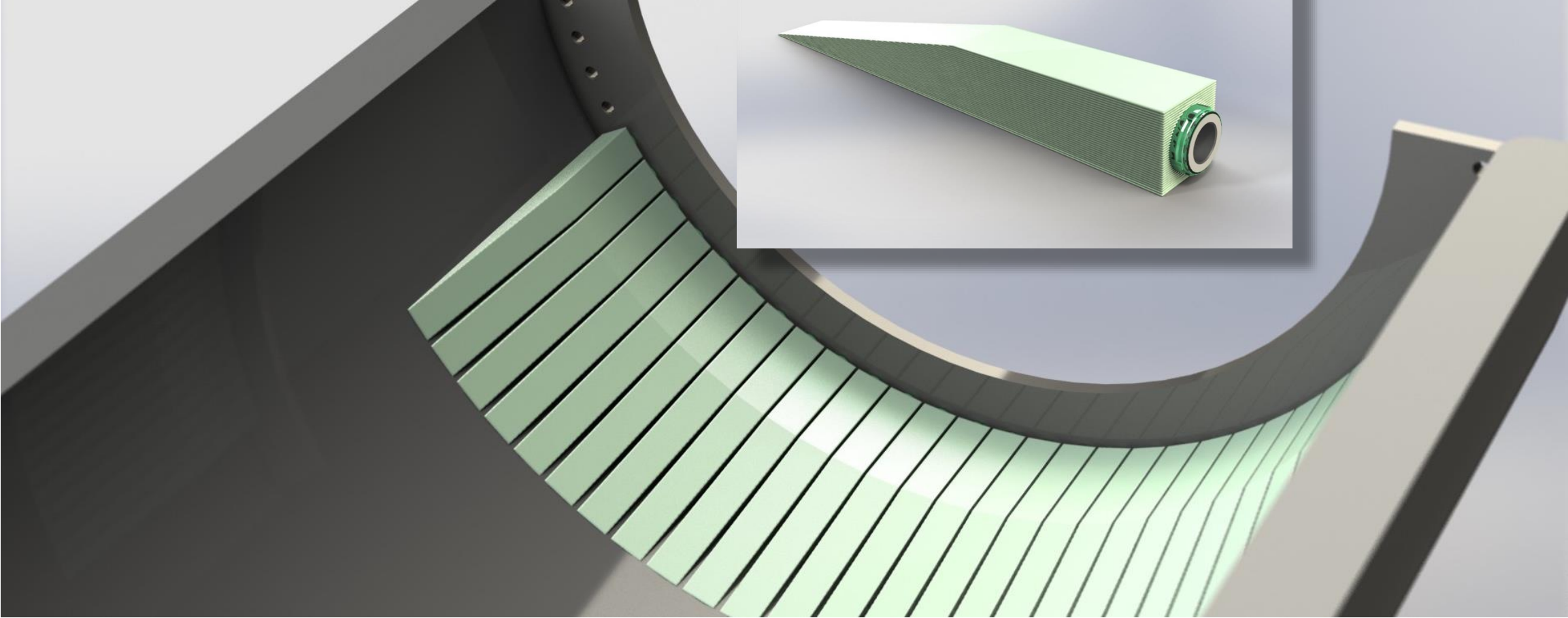
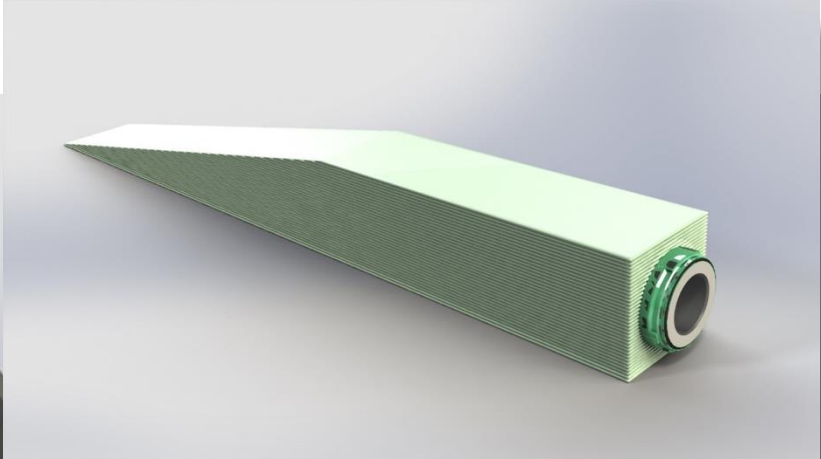
Independent installation orientation



# Optional installation method

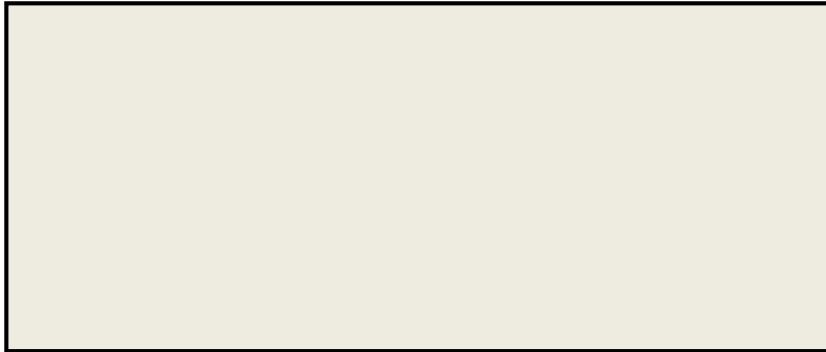
Layup (massive GFRP), saw, drill, bond, temper, install

Highly automated and mass production possible

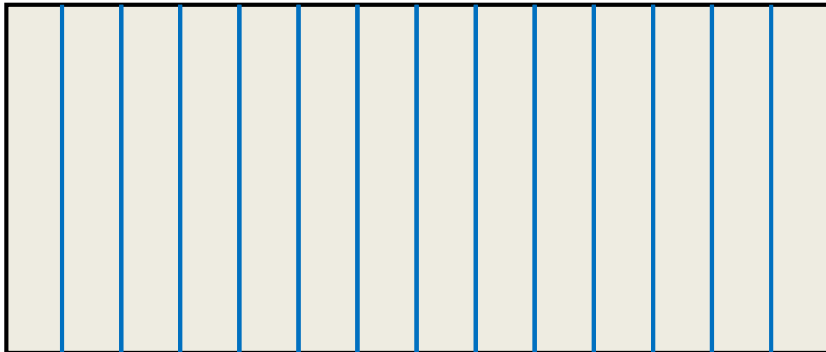


# Mass manufacturing of prefab wedges

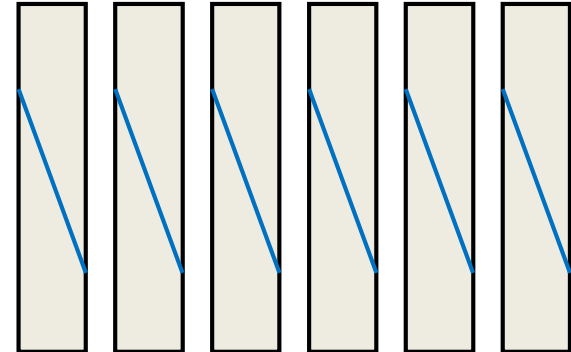
1) GFRP-Block



2) sawing



3) sawing



4) drilling

# Overall performance of the bushing system

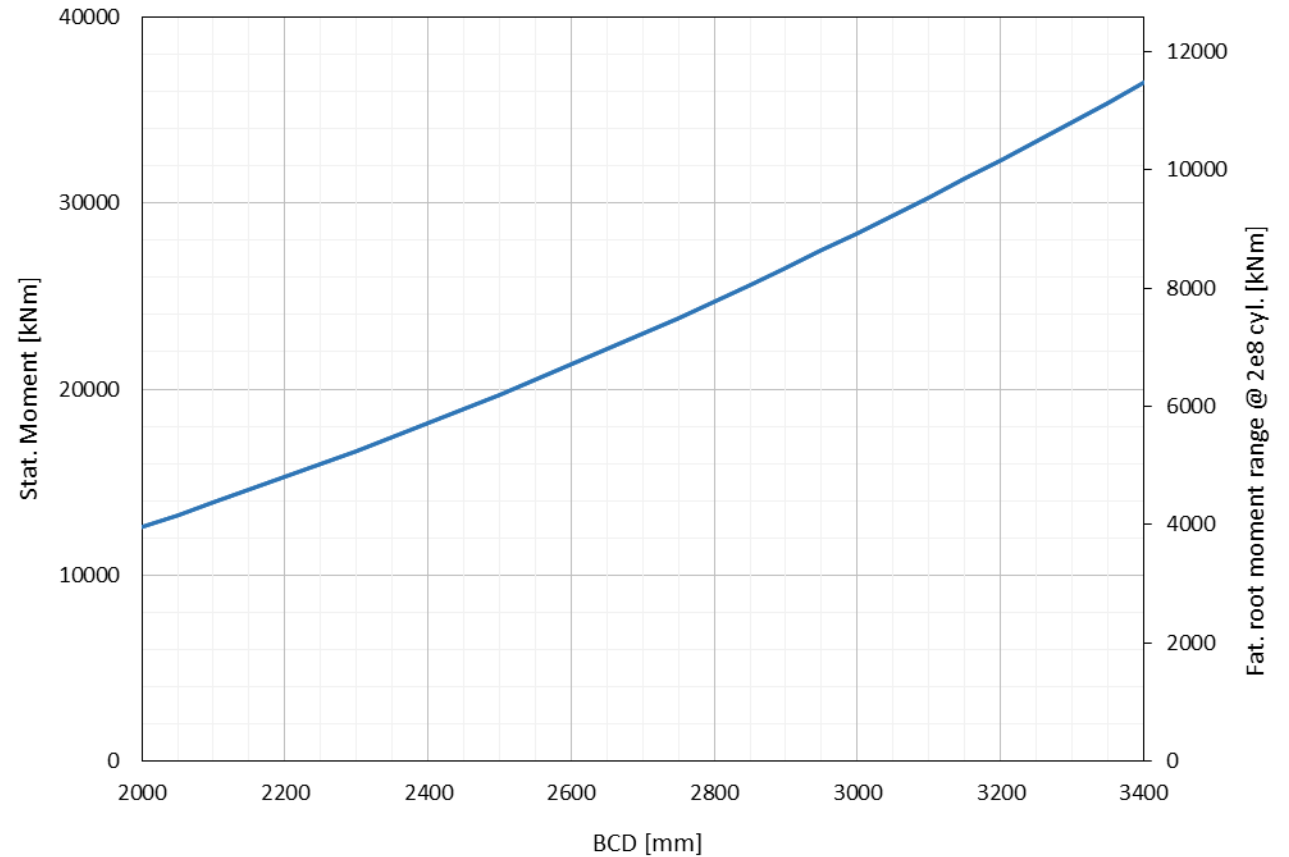
Bushing-mass	1400 g
Bushing-length	230 mm
Min. laminate-thickness	70 mm
Min. segment-width	70 mm
Borehole diameter	50 mm
Bolt-thread	M30
Resin	Epoxy base
Body material	GFRP

## Test loads

Static pull-out load	750 kN
Fatigue load	1.5e6 cyl @ 310 kN (range, R=0.1, m=10.9)

## Design loads per bolt (per GL-SF)

Static load	280 kN
Dynamic load	2e8 cyl @ 88 kN (range, m=10.9)

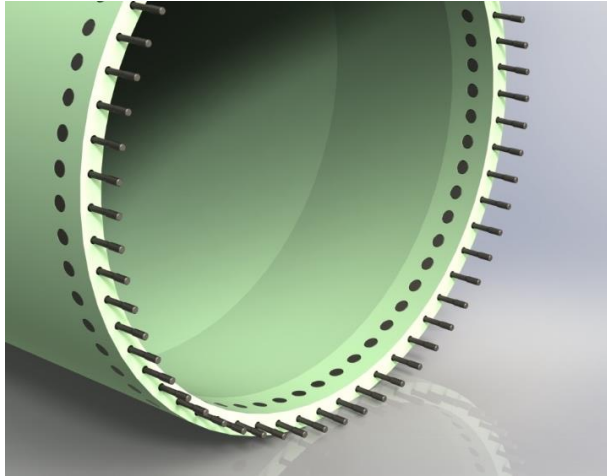


*Including a new matrix system by Hexion*

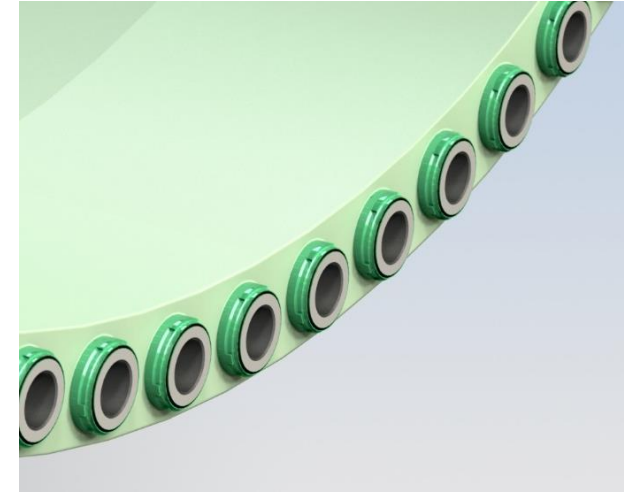




T-Bolt



ADC.Bushing



- + 33 % more bolts on the same BCD
- + 26 % higher static moment
- 36 % GFRP mass