Budapest University of Technology and Economics

TWO-DISC MACHINE

Made by:
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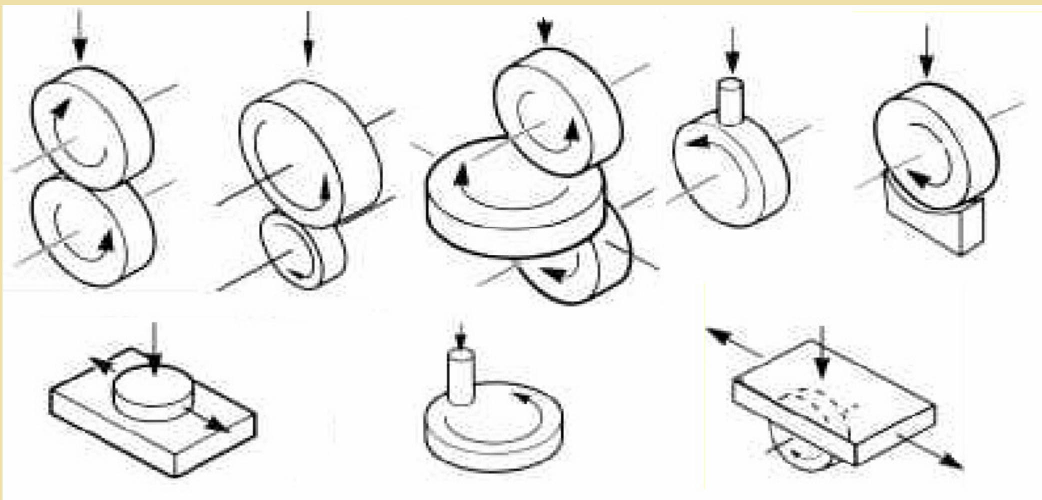
Introduction:

The process of a Tribological system is complex, and it's hard to describe theoretically.

Experimental equipments are usually used to understand **frictional** and **wear behaviour, carrying capacity** and **lifetime** in sliding and rolling applications.

Using speciements with simple shape:

- Advantages: easy, economical and precise production of geometry (plain, cylinder, cone, ball, etc.)
- Contact relations: sliding, rolling, **sliding&rolling** (constant or changing direction in moving)
- Commonly used speciement-pairs: pin-on-disc, ball-on-disc, four ball, block-on-ring, pin-on-plate, **two-disc**, …



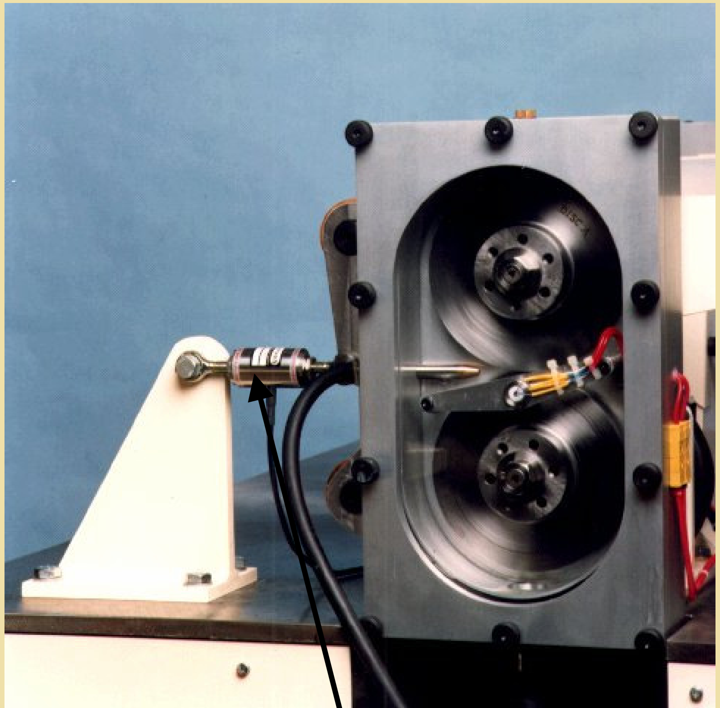
We use model tests to study:

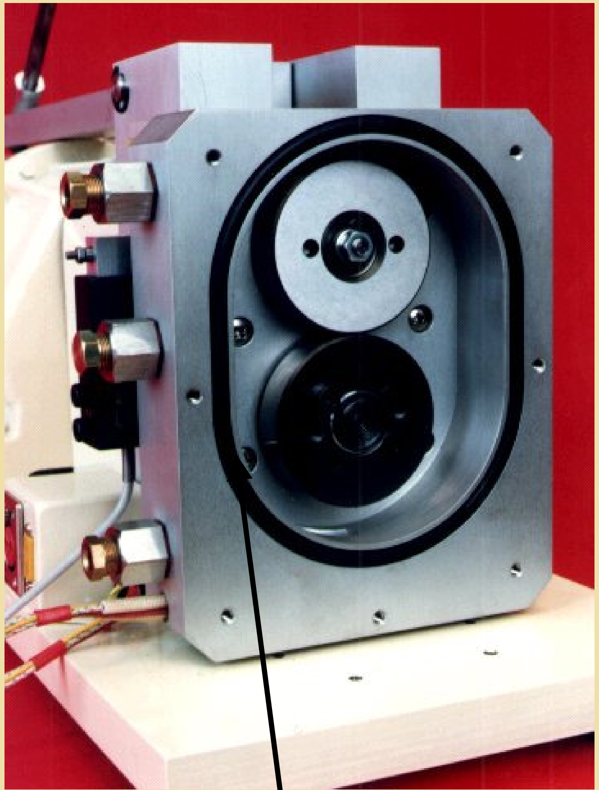
- surface fatigue
- wear
- and to evaluate the coeff. of friction between specimens.

The friction coefficient can be calculated, if we know:

- the rotational speed (n_1)
- the load (F_1)
- the geometry (⬂d_1)
- the torque, acting on the shaft (M_1)

Two-disc machines (from industry): (PLINT Tribology Inc.)





Infrared sensors for measuring the contact temperature

Sealed equipment, lubrication applicable

double-side driving

single driving (one side)

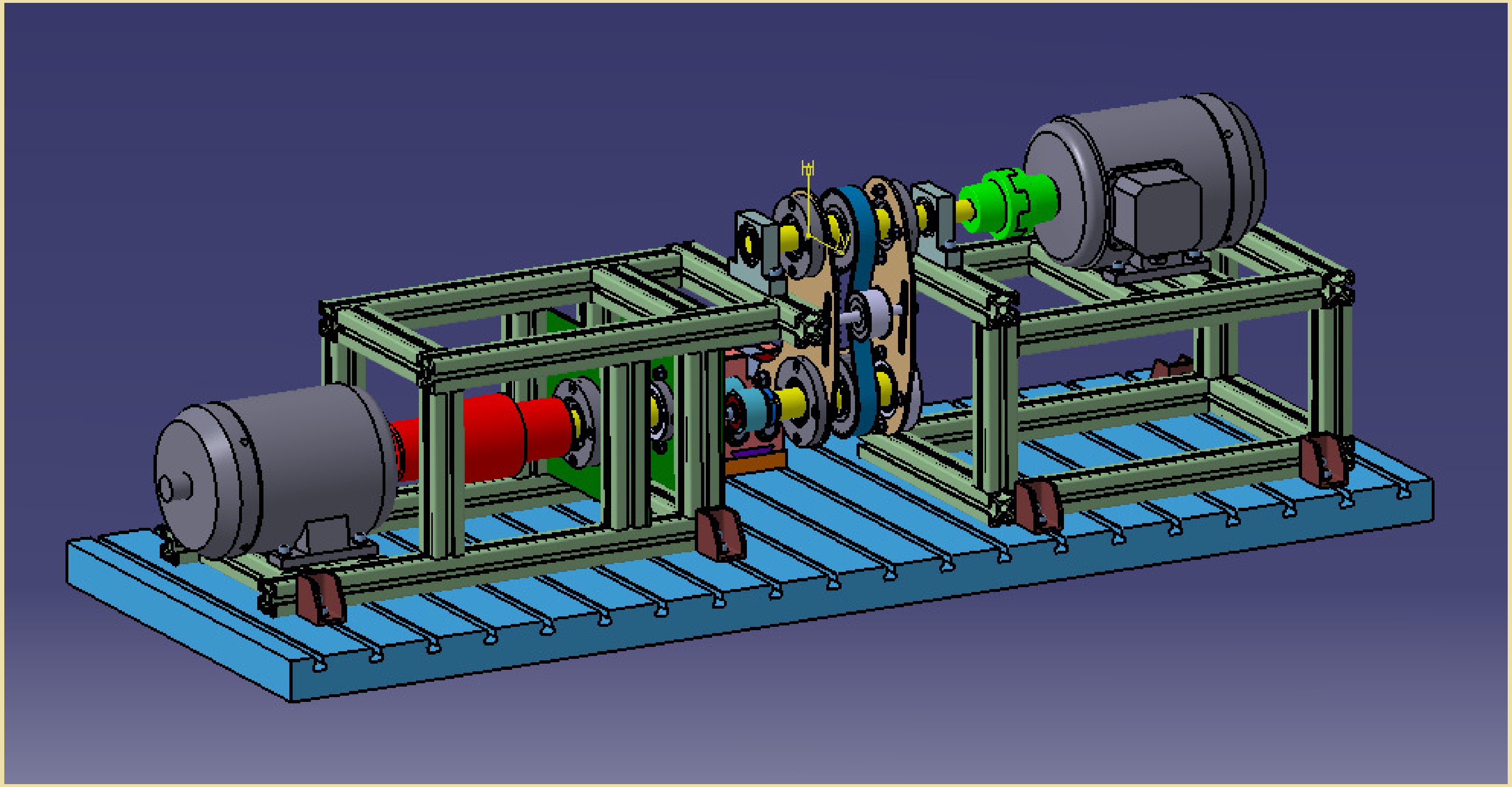
Design conditions:

- Load = 2000 [N]
- Specimen diameter = 50 [mm]
- max. coeff. of friction = 0,8
- max. width of specimen = 50 [mm]
- max. revolution = 1000 [1/min]
- max. slip = 10 [%]

Design aims:

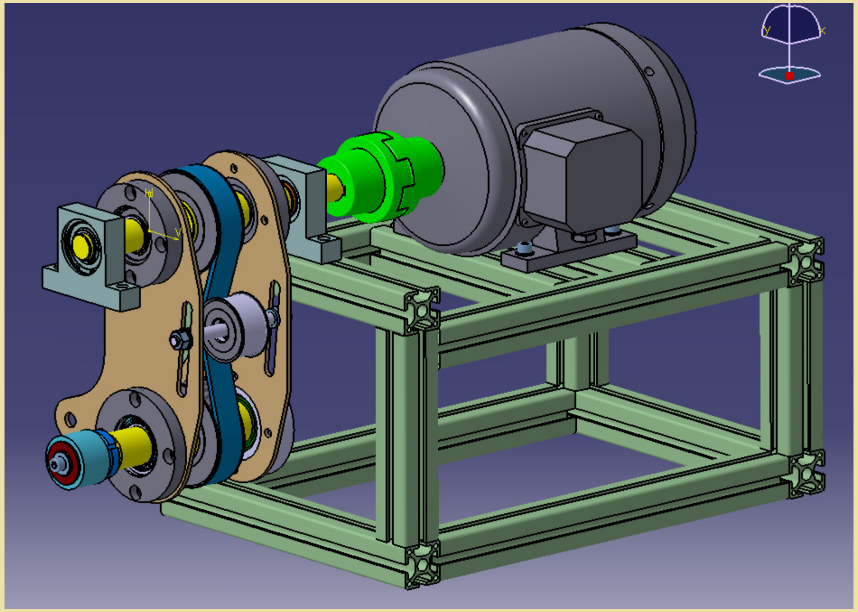
- To use standardized elements (nuts, screws, bearings, bearing-housing, Seeger-rings,…)
- To use Alu profiles for the rack
- Easy to change the specimens
- To use Different specimen are being measured
- To be able to measure and set the revolution
- To be able to measure the frictional moment
- To be able to measure the contact temp
- Easy to mount

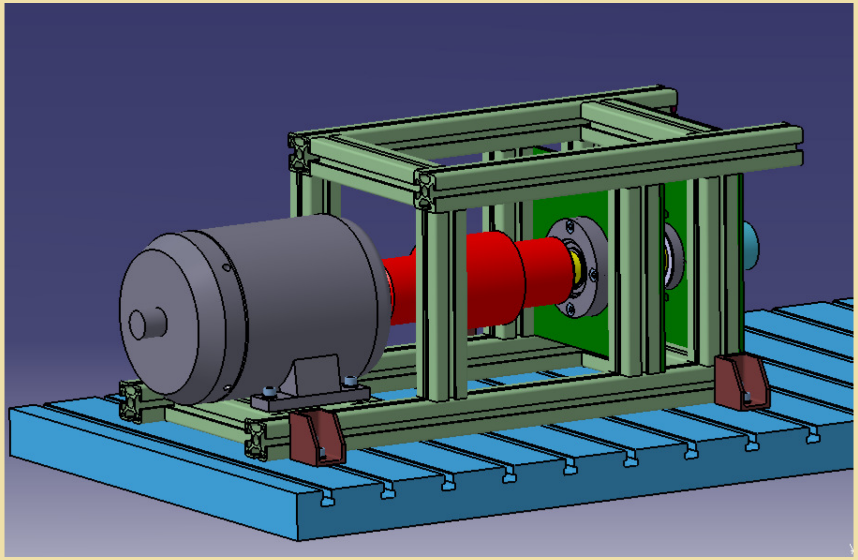
The designed machine:



Two separated parts:

I. Moving unit with the tilting arm

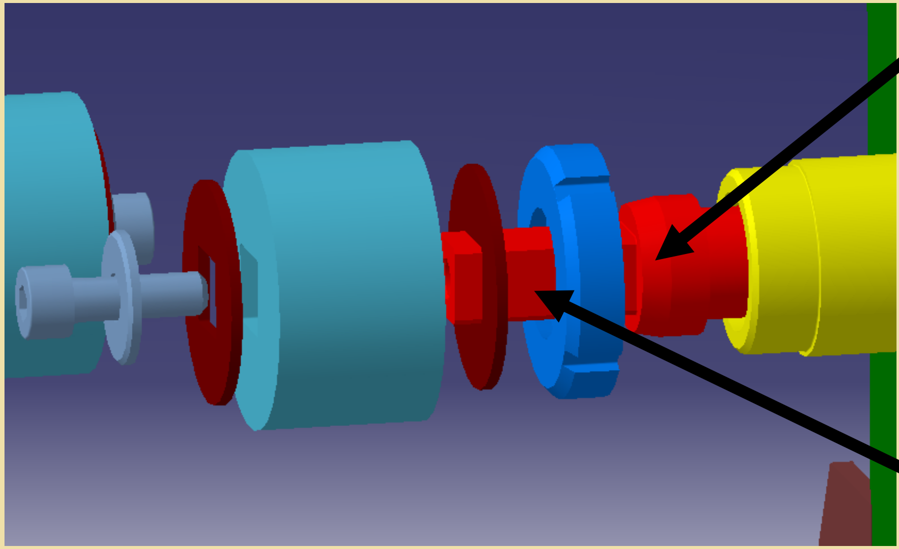




II. Stationary unit fasten to the base

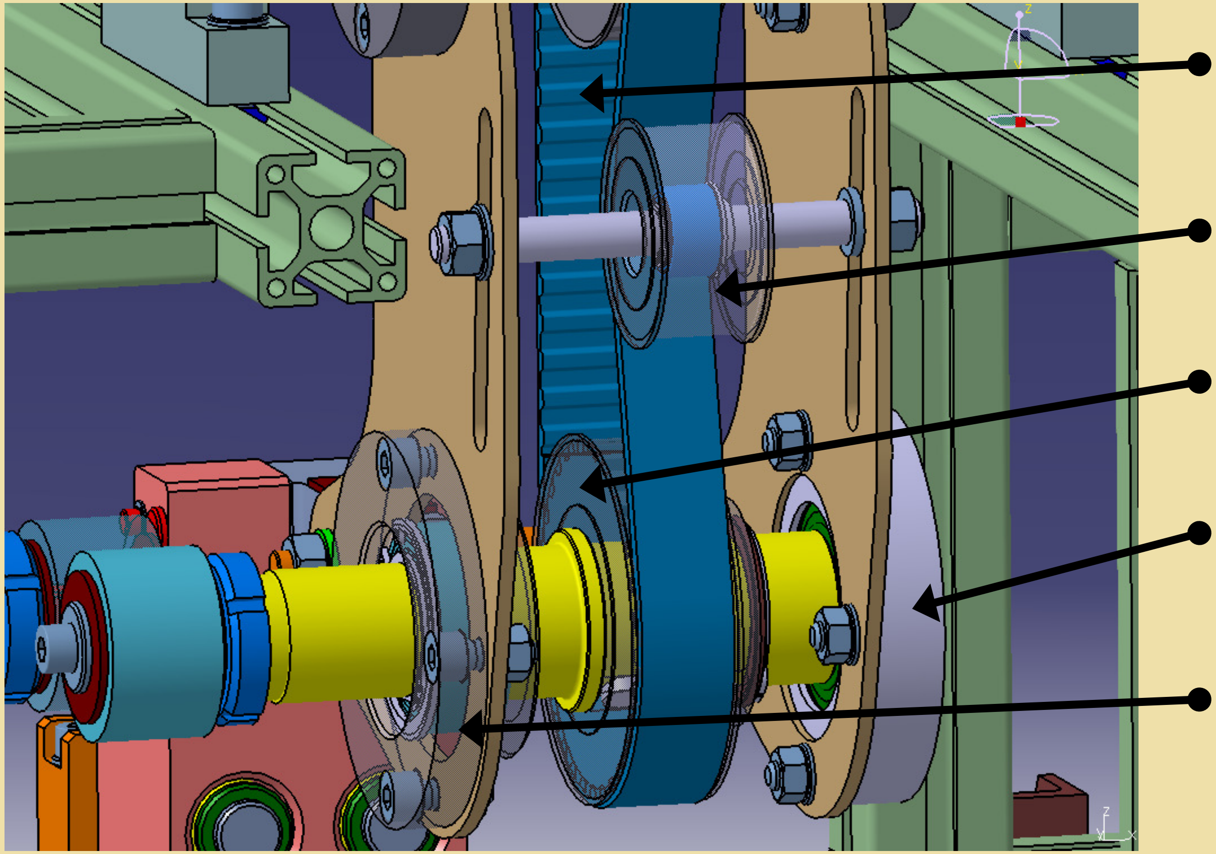
Parts of moving unit:

Speciement clamping



- Mounting from one side
- Cones are fasten the shaft against axial moving
- First the specimen mounting and after that the specimen-shaft
- Fixing by non-circular profile

Parts of tilting arm:



Timing belt

Fastener roller

Pulley

Rear bearing

Front bearing

Timing belt:

Type: AT 10

Width: 25 mm

Length: 1120 mm

SIEGLING BELTING

Bearing units:

MISUMI

MISUMI Group Inc.

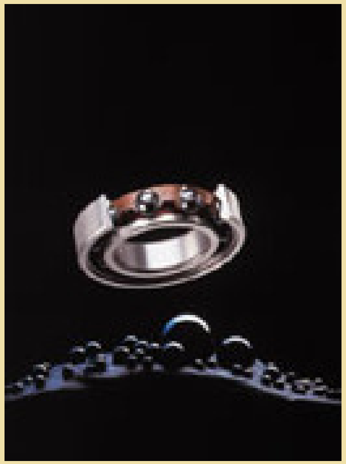
Type:

2 db BGCRB (6006_2RS)

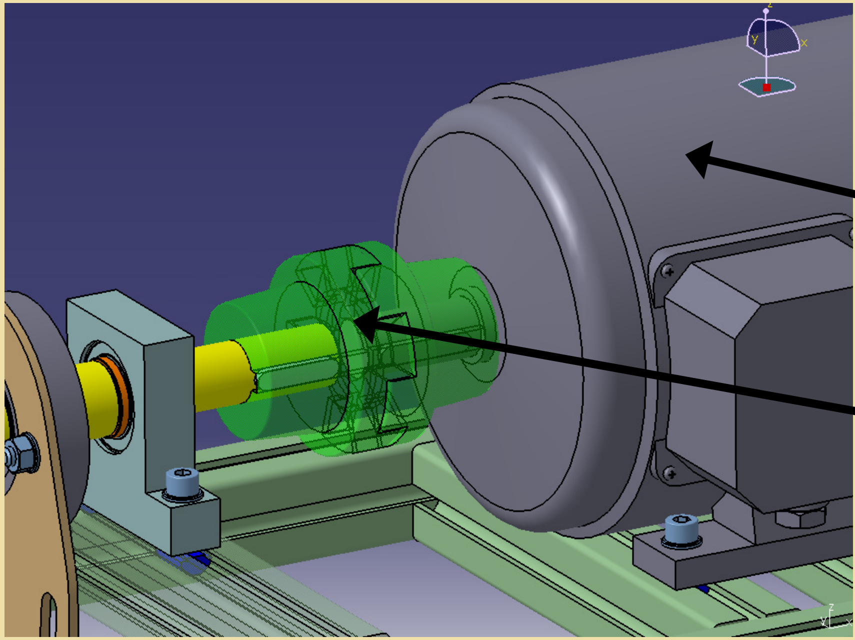
2 db SBACR (6007_2RS)

2 db SBACY (NA4907_2RS)

1 db NA4901_2RS needle-roller bearing



Driving unit:



3 phase assinchronous motor

Rotex coupling

3 phase assinchronous motor :

Type: M2QA_90S4A

P = 1,1 kW

n = 1400 1/min

Coupling:

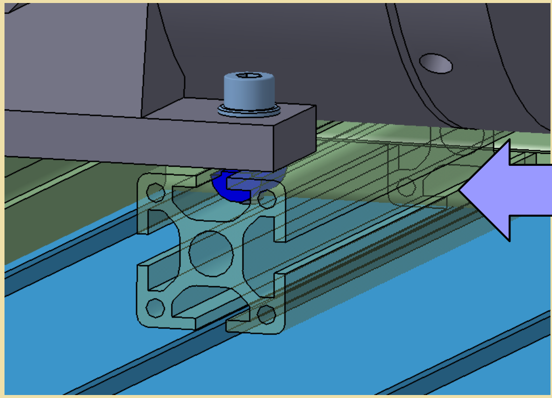
$M = 15$ Nm

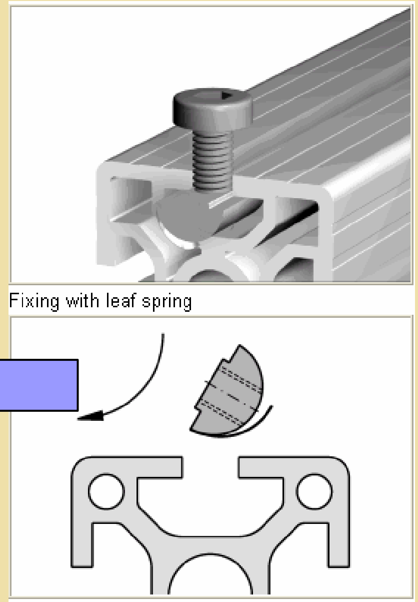
⇲d1 = 24 mm

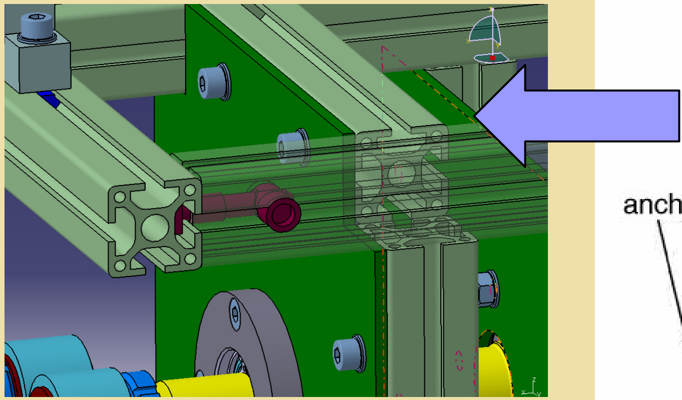
⇲d2 = 25 mm

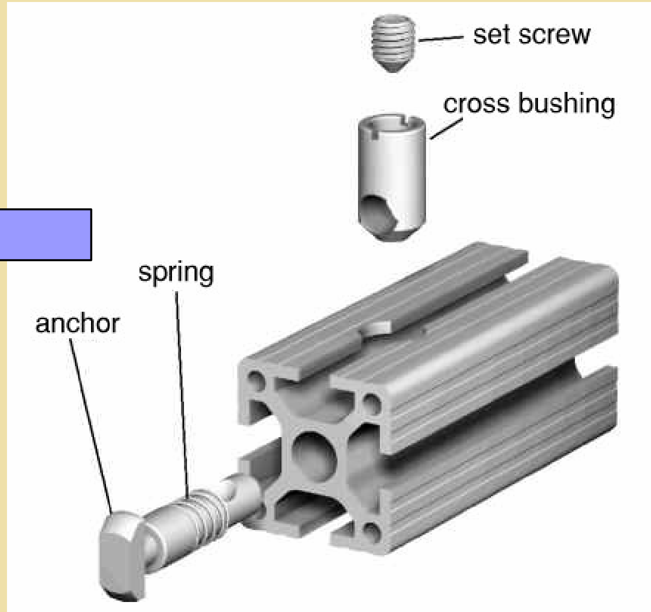
Frame structure of the test rig:

Clamping elements









Torque meter:

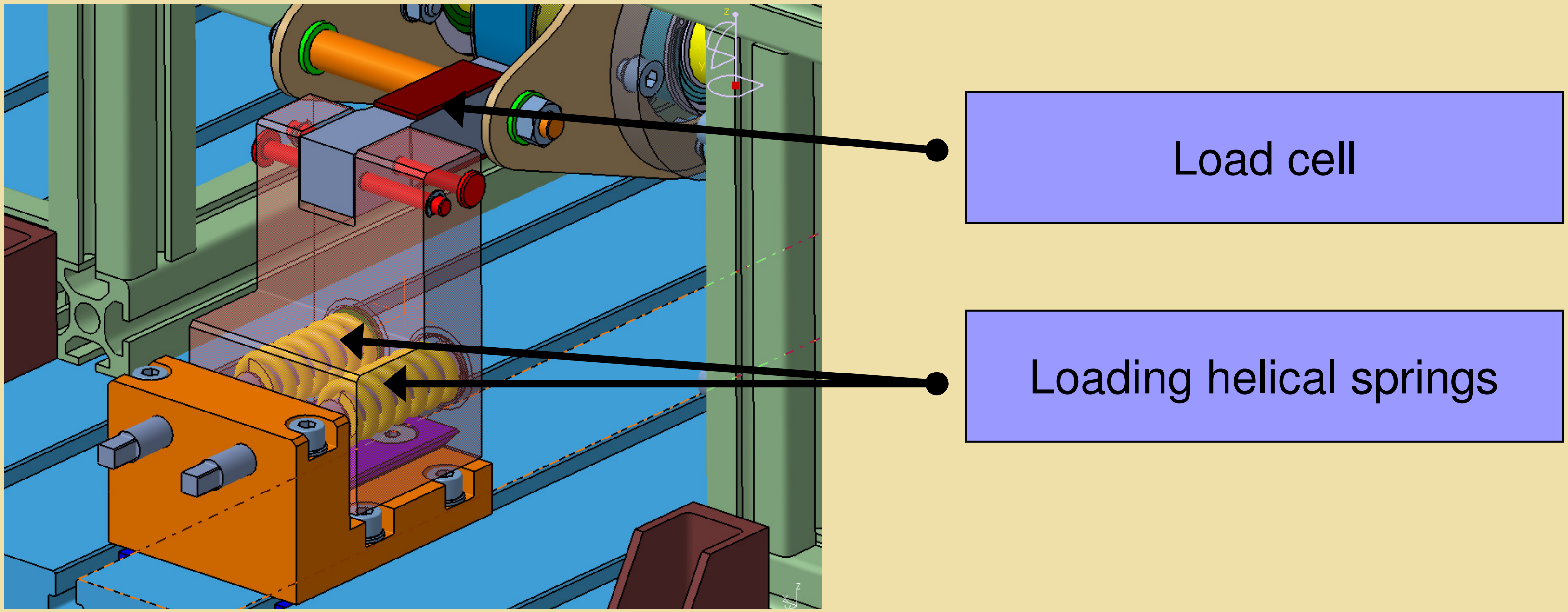
Type: RADEX_NC_22/20

Max. measuring range: 20 Nm

Working temp. range: 0..55 °C

- Integrated revolution measuring
- Minimized internal power loss
- High measuring frequency
- Widely applicable

Parts of loading unit:



Load cell:

Type: SSB_AJ_250

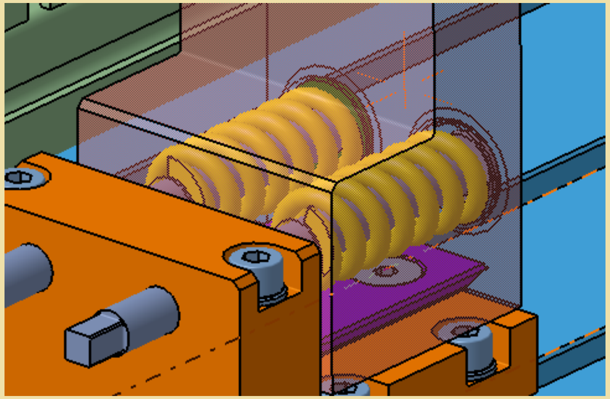
Range: 0…2500 N

Working temp. range: -55..90 °C

Typicals:

- Sealed
- Temperature compensated
- Accuracy < 0,01 %
- Small geometry
- Easily connected

Helical spring



DIN 2098 standardized:

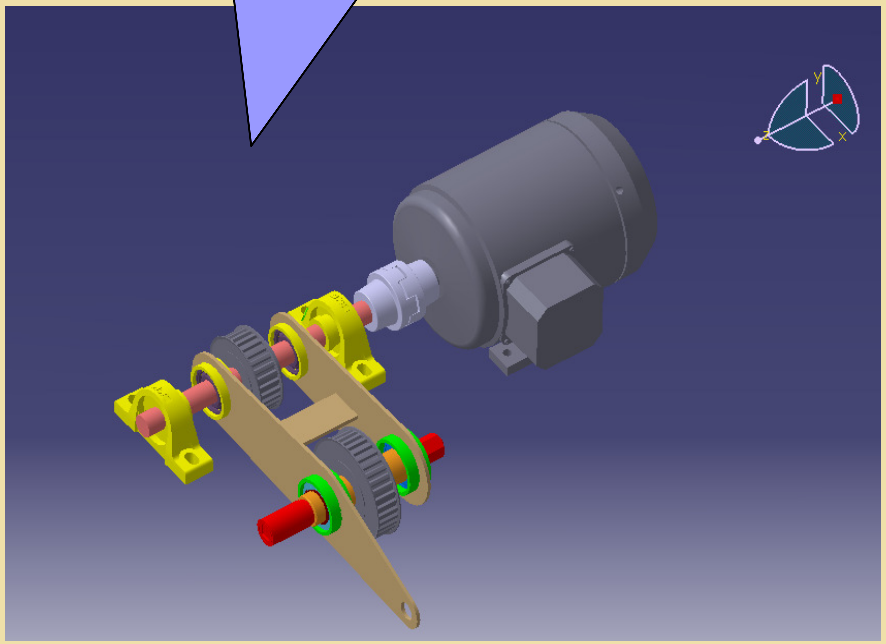
Dimensions:

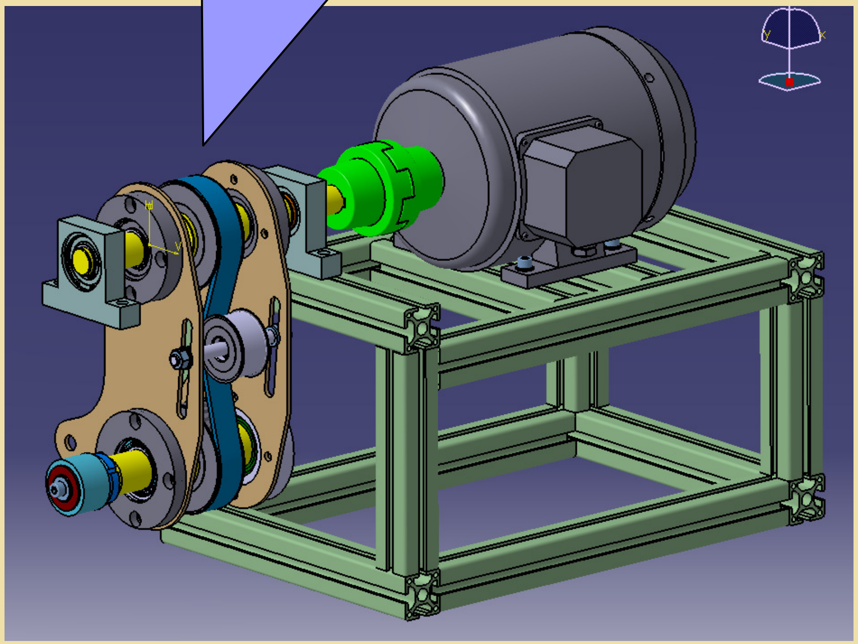
DIN 2098 – 5x25x80

Comparing the first and the final design:

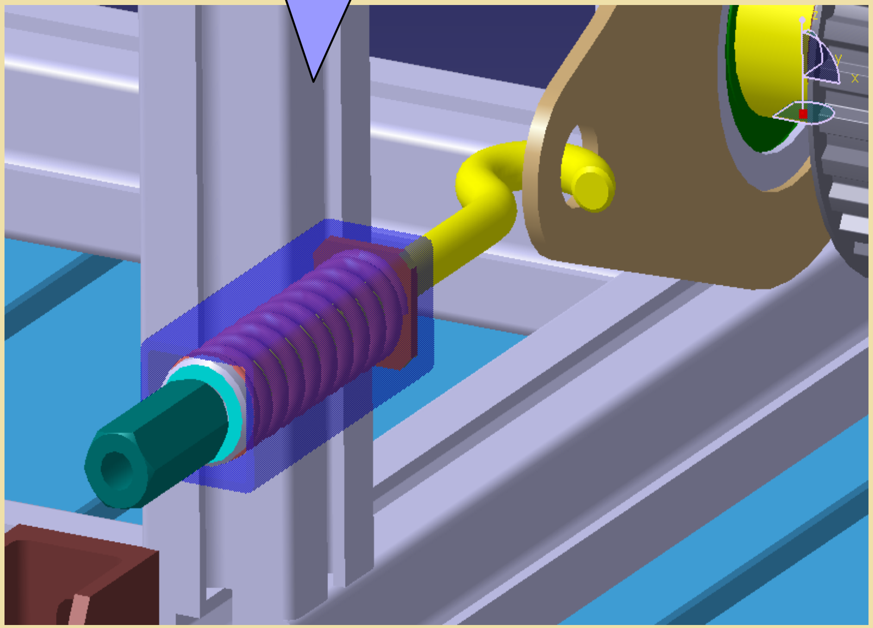
- Welded ring
- Y bearings
- Load applied at the end of the arm
- Stiffening rib

- Bolted joint connection
- Deep groove ball bearings
- Loading unit is better
- No stiffening rib
- Belt tension roller applied

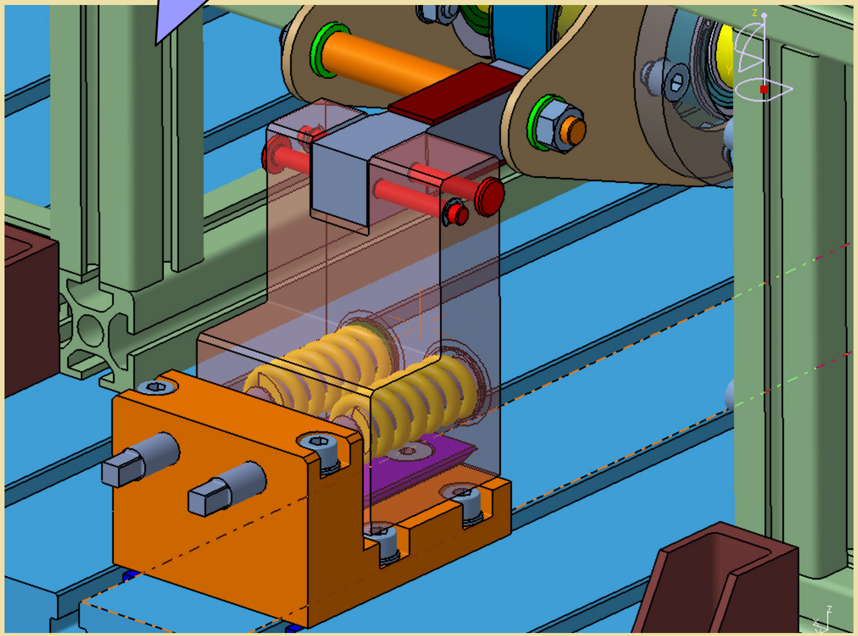




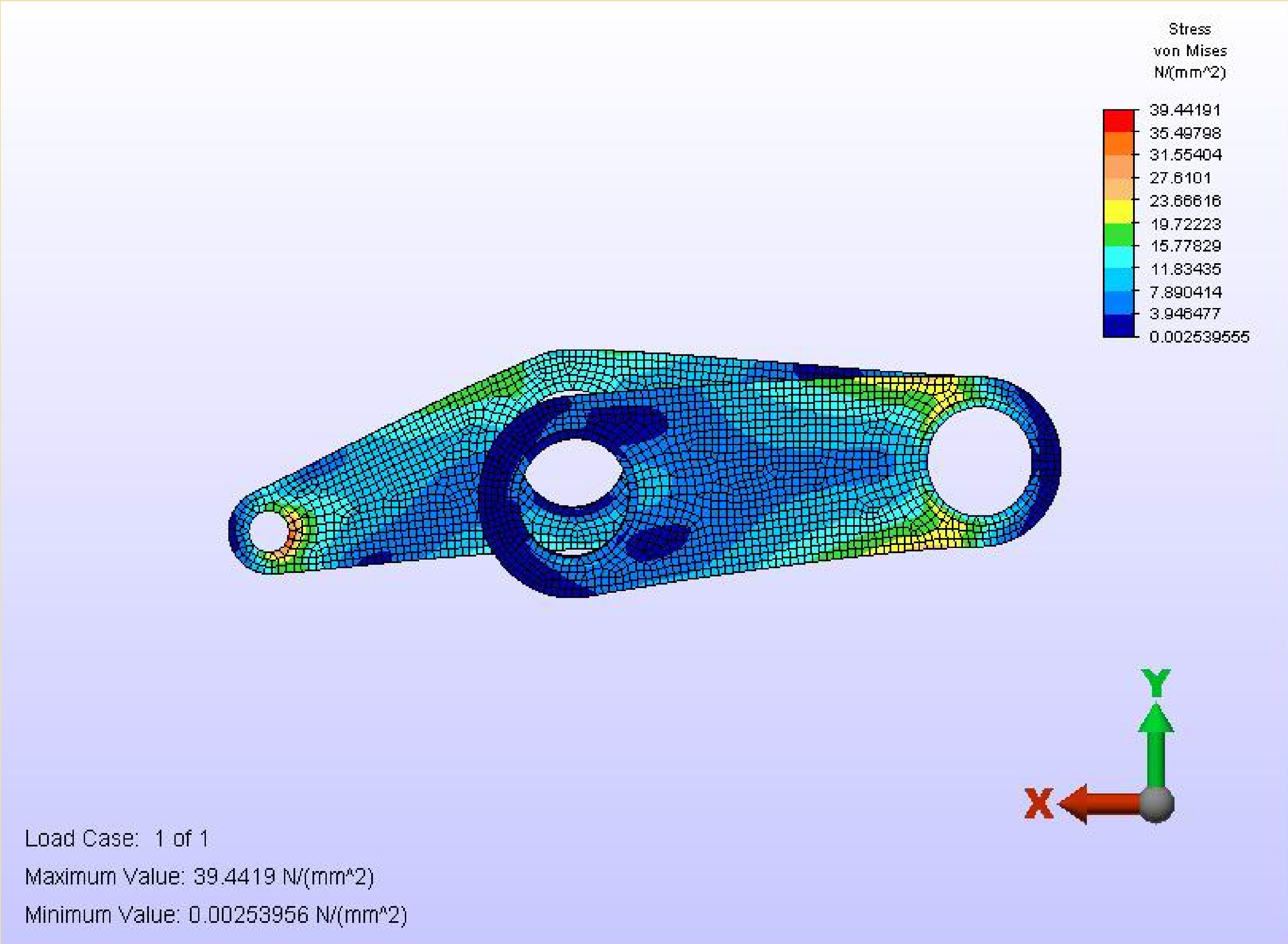
- Easy to joint solution



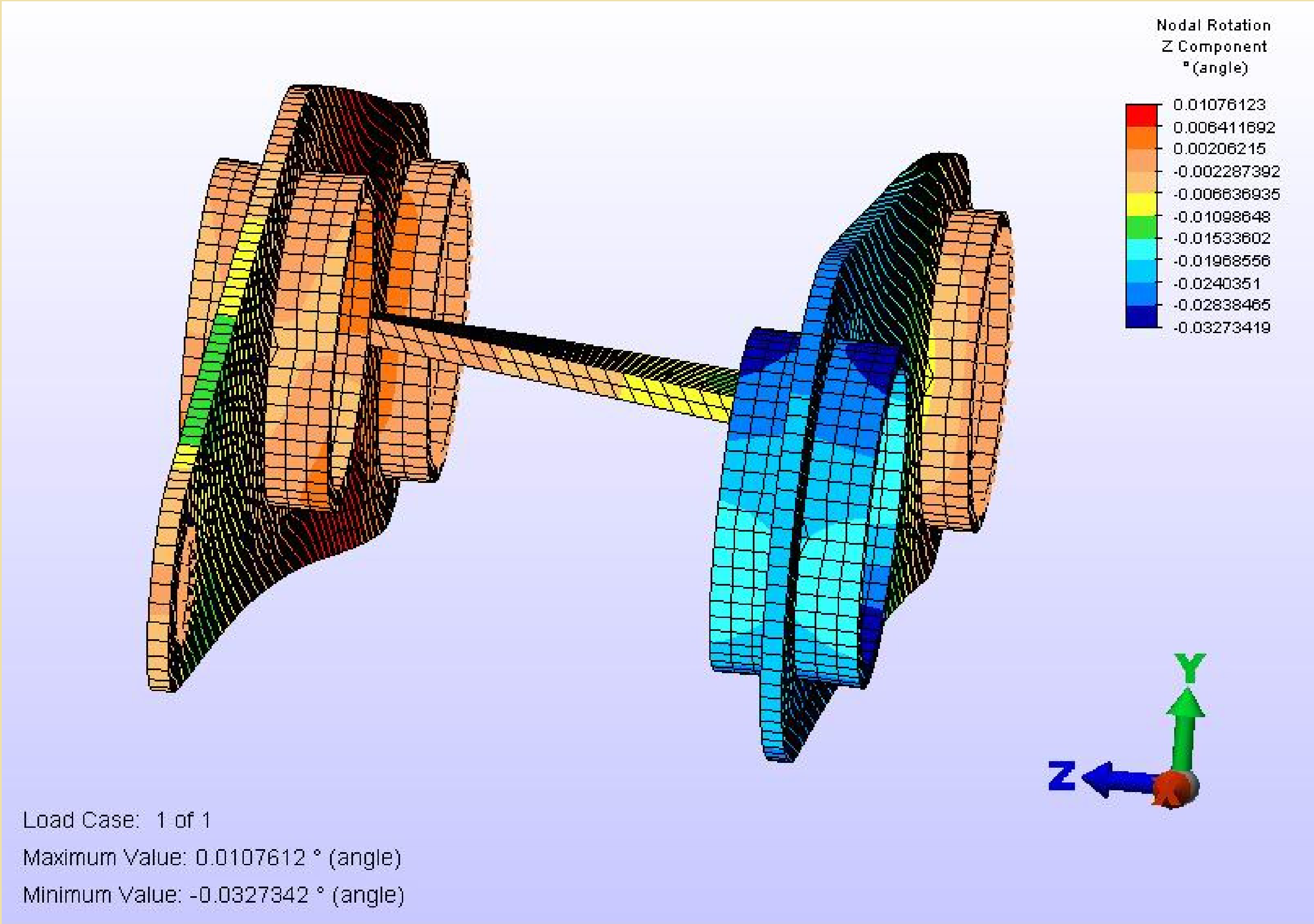
- Load application is better
- Easy to set the load (thread)
- Additional load!



FE Analysis:
Von Mises Stress



Angular distorsion (round axis Z):



Calculation:

Frictional moment - power loss

Bearing	6205
d, mm	25
D, mm	52
d_m, mm	38.5
n, r/min	1000
ν, mm²/s	294
F_r, N	2000
F_a, N	0
μ_{EHL}	0.05

- (•) Grease
- ( ) Oil spot
- ( ) Oil bath
- ( ) Oil jet

H, mm	
K_{rs}	6e-8

Calculate

W_s, W/°C	5

Calculate

Rolling frictional moment

$\Phi_{ish}\Phi_{rs}M_{rr}$, Nmm	39.7

Sliding frictional moment

M_{sl}, Nmm	19.8

Frictional moment of seals

M_{seal}, Nmm	0

Frictional moment of drag losses

M_{drag}, Nmm	0

Total frictional moment

M, Nmm	59.6

Power loss

N_R, W	6.24

Starting torque

M_{start}, Nmm	59.5

Extra info

Temperature increase

ΔT, °C	1.25