Exercises on drive sizing with Drive Solution Designer (DSD)
Start-up training

Referent: DSDTeam /SSC, as of May 08, 2018

Lenze

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	Exercise	Content	Products	
01	Determination moment of inertia	Inertia calculator	-	20min
02	Belt conveyor with S3 profile	Sizing with operating mode	SmartMotor m300	30min
03	Motion Designer	Export of profile data	-	10min
04	Spindle drive	Create motion profile, use auxiliary calculators	m850, i950	30min
05	Belt conveyor start/stop	Use of checklist, ApplicationTuner	8400StateLine, g500-B, m550	60min
06	Travelling drive 1	Create motion profile	m500, g500 CI	40min
07	Chain conveyor	Sizing with operating mode	SmartMotor m300	40min
08	Unwinder	Tooth belt transmission, field-weakening	MH, 9400	40min
09	Travelling drive 2	Evaluation of sizing, ApplicationTuner	MH, g500	30min

Table of contents (2/2) - Advanced

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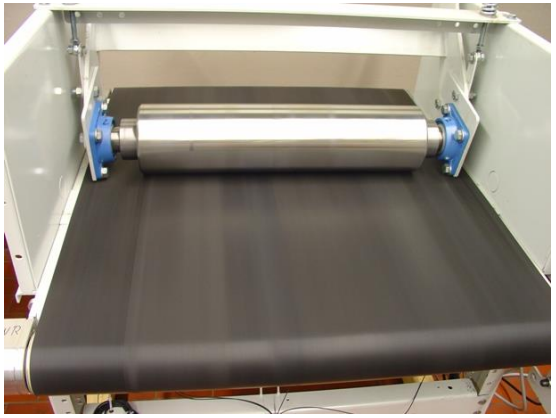
Exercise 01–Moment of inertia

A belt conveyor is loaded with a cylindrical steel pressure roll for testing purpose.

There are four cylindrical drill holes (each for entire length of pressure roll) with a diameter of 10mm each.

The drill holes are located on a radius of 50mm.



Given:

Diameter drive roll d_1 = 112mm

Diameter pressure roll d_2 = 170mm

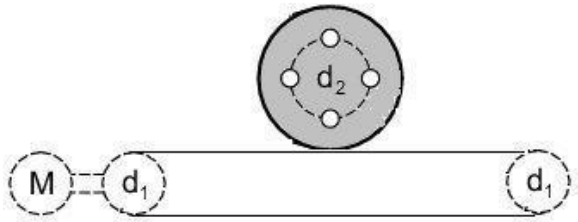
Diameter drill holes d_3 = 10mm

Radius where drill holes are located r_1 = 50mm

Length of cylinder l = 700mm

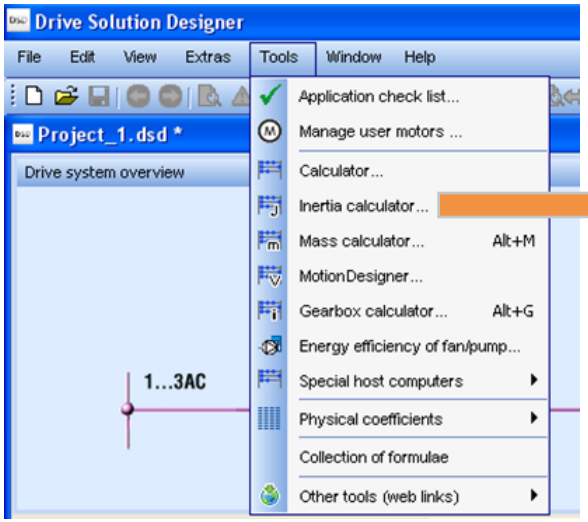
Material of cylinder = Steel

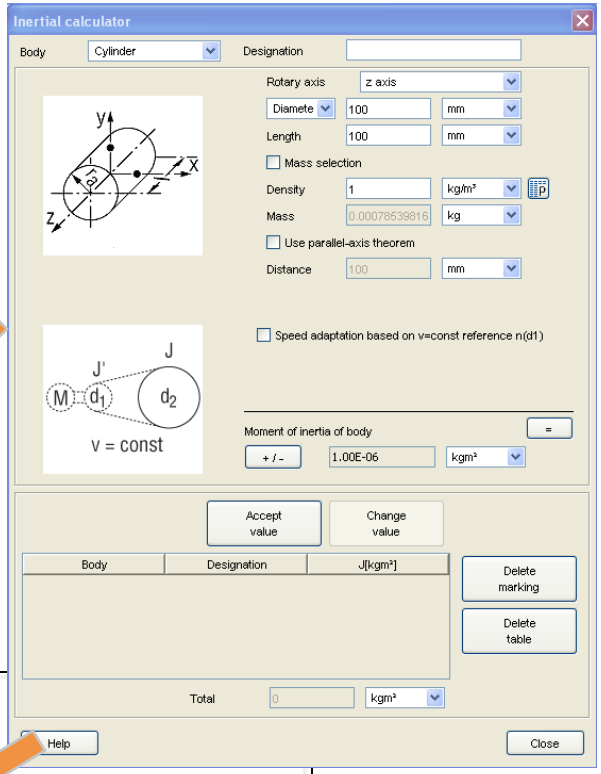
Sought-after: Moment of inertia J of pressure roll

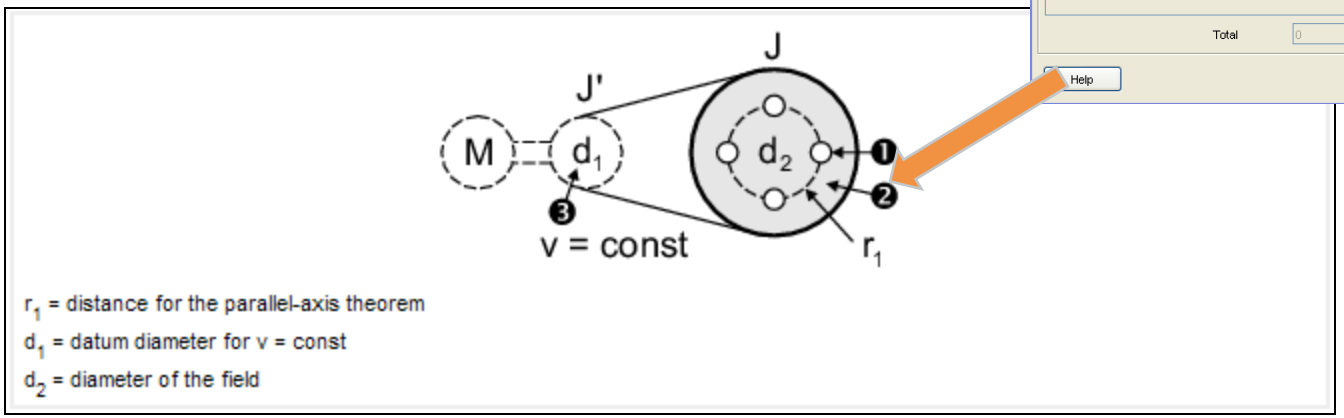


Exercise 01–Moment of inertia

Giving a clue:





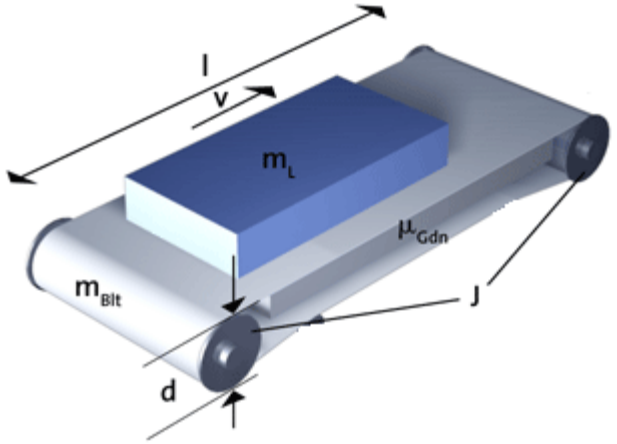


Exercise 02 – Belt conveyor with S3 profile

A belt conveyor for unit loads with a length of 10m is in S3 operation with a relative operating time of 50% for 16hours/day.

The belt conveyor is continuously loaded with 35kg/m. The belt weighs 3kg per meter belt length and runs on a supporting surface. There are no supporting rollers.

The belt speed is 60m/min. Cycle time is 5min with acceleration time and deceleration time being 5s each.



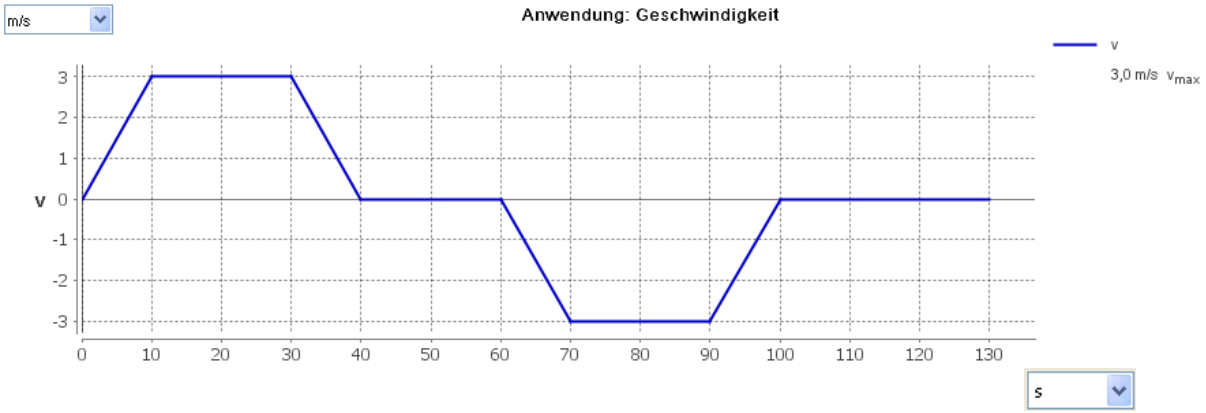
Drive roll and idler pulley:

Massive cylinder, m = 190kg, d_A = 190mm

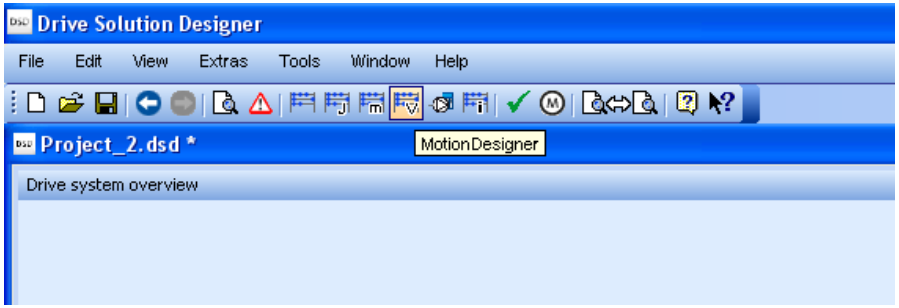
Friction coefficient: Belt/Surface: 0.3

Exercise: Sizing with SmartMotor and right-angle gearbox.

Exercise 03 – Motion Designer



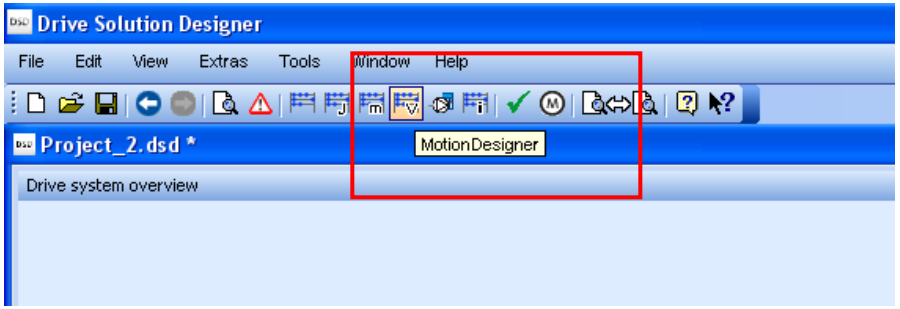
1) Enter the profile shown above in MotionDesigner. Open Motion Designer via the symbol bar



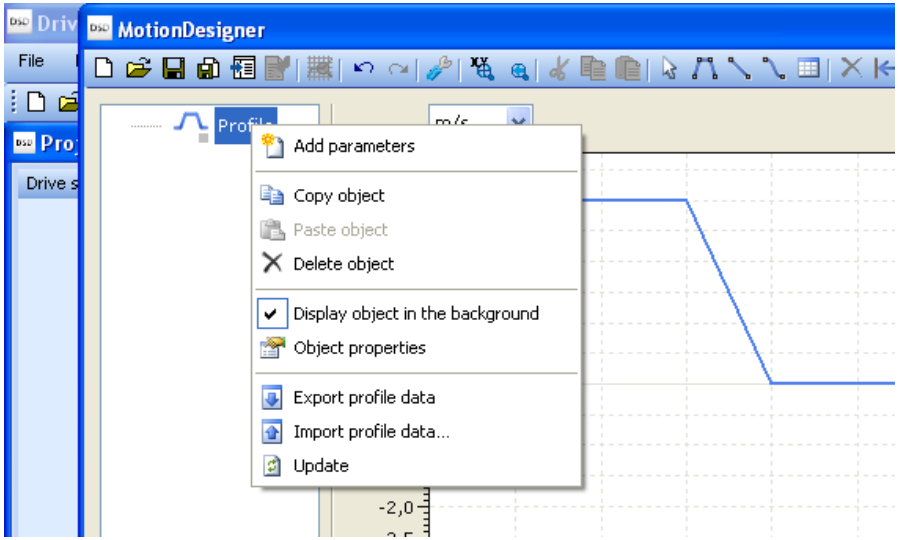
2) Export the profile and save to a file.
   a. Export to txt-file
   b. Save as Lenze Motion Profile (*.lmp)

Übung 03 – Motion Designer

Giving a clue:



Call MotionDesigner directly via DSD's symbol bar.



Import / Export of profile data via context sensitive menu (right hand mouse click on 'Profile')

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Exercise 04 – Spindle drive 1/2

Vertical spindle drive:

Mains supply: 3AC 480 V / 60 Hz

Mechanical data of roller spindle:

- The spindle is made of steel and has a length of 1000mm
- Leadscrew pitch 5mm, leadscrew diameter 25mm
- Mass of the slide 200kg, coefficient of friction of guide rail 0.02

Motion profile:

- Starting at the bottom position the slide is moved upward for a distance of 410mm within a time of 1.63s with a payload of 500kg.
- Acceleration time and deceleration time is 0.5s with a jerk ratio of 33.33%.
- Standstill time at top position is 2s, thereafter reverse motion to bottom position with a payload of 200kg. Standstill for 2s.
- Activate the brake and inhibit the controller at standstill

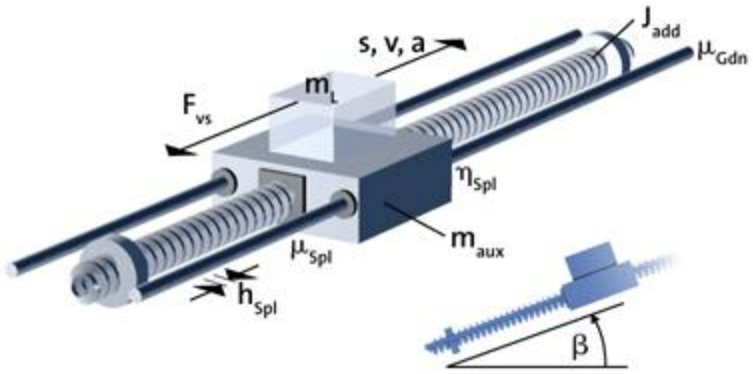
Carry out a DSD sizing with the following components:

- Servo synchronous motor m850 with brake and absolute value encoder
- Servo inverter i950 with brake resistor

Exercise 04 – Spindle drive 2/2

Hints:

- For operation in vertical direction set angle of tilt to 90°
- Use auxiliary calculators für determination of
  - Spindle efficiency
  - Spindle moment of inertia



Exercise 05 – Belt conveyor start/stop

Dimensioning for a queue conveyor in baggage handling (belt conveyor with frequent start/stop operation).

The requirements have been collected in the document „Checklist_Application_Exercise05.pdf“.

Tasks:

1. Carry out a sizing with DSD with IE3-motor m550, right-angle gearbox g500-B and frequency inverter 8400StateLine.
2. Check the data in the check list for plausibility. Is anything missing?

Exercise 05 – Belt conveyor start/stop

Tasks continued:

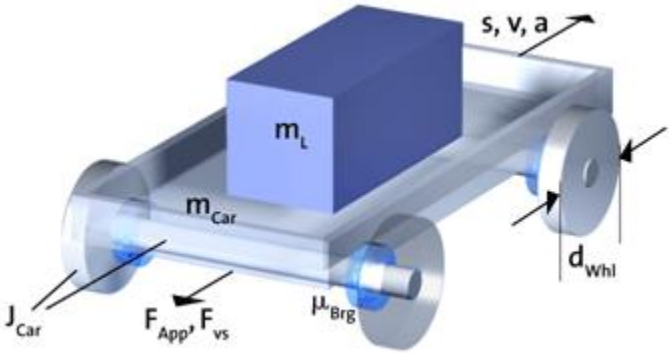
3. On request the customer informs you on the moment of inertia of both drive roller and idler pulley. The moment of inertia 0.06kgm² each.

   Reopen the DSD project from task 1 and enter the moment of inertia in the Application Tuner.

   Analyse the effect on the drive sizing.

Exercise 06 – Travelling drive

A payload is to be moved according to a given speed profile by a wheel-driven travelling drive.



Data in detail:

Horizontal movement, one wheel is driven.

Mass of vehicle: 2.650 kg

Payload: 1.500 kg

Wheel diameter: 400 mm

Specific travelling resistance: 250 N / to

Kinematics: worst case

Operating time: 1 shift (8h/Tag)

Acceleration and deceleration: 2 m/s²

Movement in positive direction : 30 m

max. travelling speed: 220 m/min

Stand still: 10 s

Ambient conditions:

Ambient temperature geared motor: max. 30 °C

Ambient temperature inverter: max. 40 °C

Site altitude: below 1000 m

Electrical supply system: 3 AC 400 V, 50 Hz

Drive solution sought-after:

Drive i500, IE3-motor m500 with g500H helical gearbox in direct mounting.

Make alternative solutions with both m550 and m540. What is the difference?

Exercise 07 – Heavy duty chain conveyor

A chain conveyor is operated at a maximum velocity of 12m/min with a payload mass $m_{var,L}$=5170kg.

The application data is:
d = 96.40mm; m_{Chn} = 70kg; μ_{Gdn} = 0.09; η_{Chn}=0.95

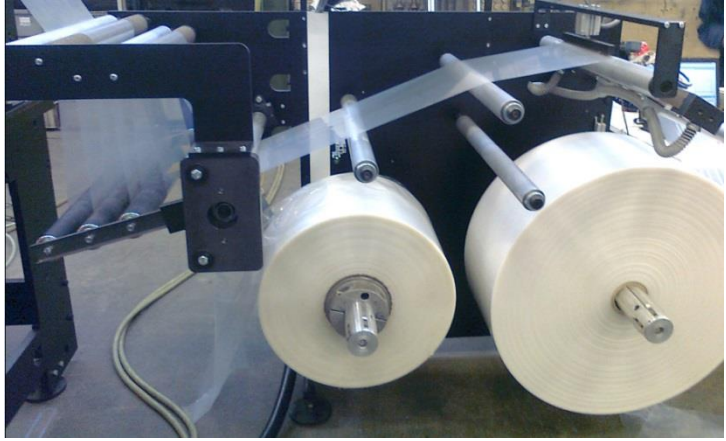
The chain conveyor is used in an intermittent operation mode (S3) with a relative operating time of 80% in two shift operation (16hours/day).

At standstill controller inhibit is set.
There is no motor brake.
Both, the acceleration and deceleration time are 1.5s. The cycle time is 50s (with a positive direction of movement).

The supply and ambient conditions are:
3AC 400V supply system; power system: TT/TN system; max. ambient temperature of motor/gearbox: 30°C; max. ambient temperature of inverter: 40°C; site altitude: 1000m

Task: A suitable Smart Motor m300 without energy saving function and a g500-S gearbox (mounting position E) are to be selected.

Exercise 08 – Unwinder



Dancer-controlled single unwinder

Mains supply: 3AC 400 V / 50 Hz

Application data:

d_{min} / d_{max} = 80 / 800mm F_{min} / F_{max} = 200 / 200N

Width = 500mm Thickness = 0.08mm

Density = 0.95kg/dm³ J_{Cor} = 76kgcm² η =0.97

Motion profile with S-shape :

v_{max} = 400m/min t_{acc} = t_{dec} = 12s t_{ES} = 3s

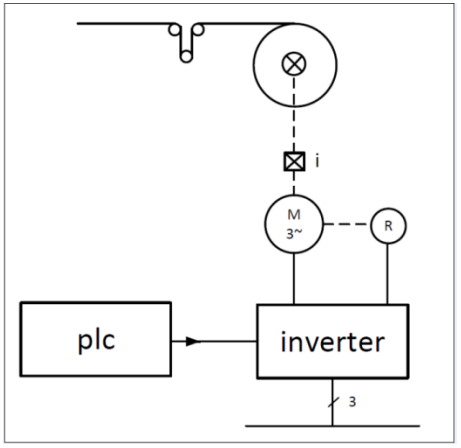
Jerk ratio: 33.3% $t_{0,1}$ = $t_{0,2}$ = 10s $t_{0,3}$ = 600s

Set brake and controller inhibit at standstill

Carry out a drive sizing with the following components:

Tooth belt transmission, Servo controller 9400,
IE2 asynchronous motor with feedback system

Hint: Use motor in field-weakening range to cut motor power



Exercise 09 – Travelling drive 2

A payload is to be moved according to a given speed profile by a wheel-driven travelling drive.

1. Please load the existing DSD-Project Exercise09_travelling_drive_MH_g500.dsd
2. Validate the selected components with respect to the application.
3. The original sizing is to be changed from trapeze profile to s-shape with jerk ratio 33%. Carry out the adaption with Application Tuner. Evaluate the result.
4. Change the profile in the original sizing to s-shape with jerk ratio 20% and keep the max. acceleration at 2m/s².

Exercise 10 – Rack drive

The vertical rack drive of a portal robot has to move a load of 50kg according to a given profile:

Infeed 1200mm

Travelling speed 140m/min

Acceleration-, deceleration- and stand still time 0.3s each.

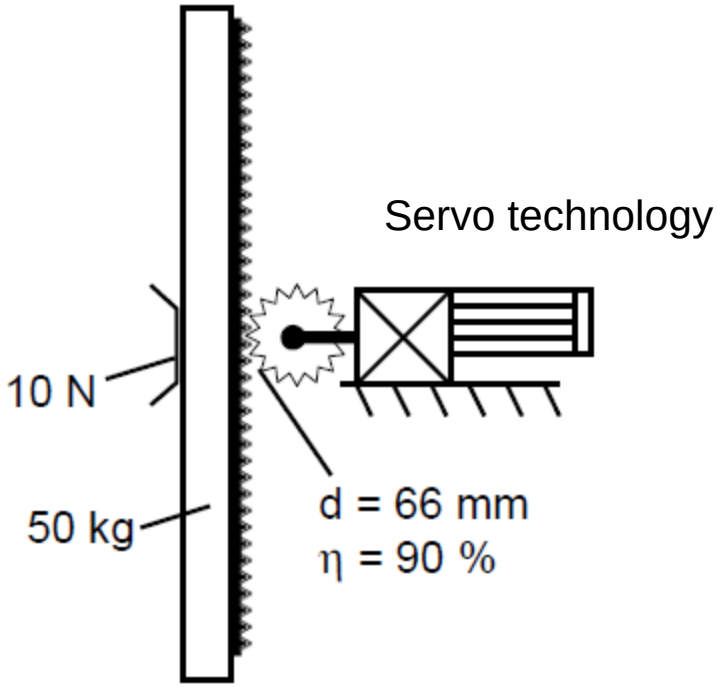
Two shift operation.

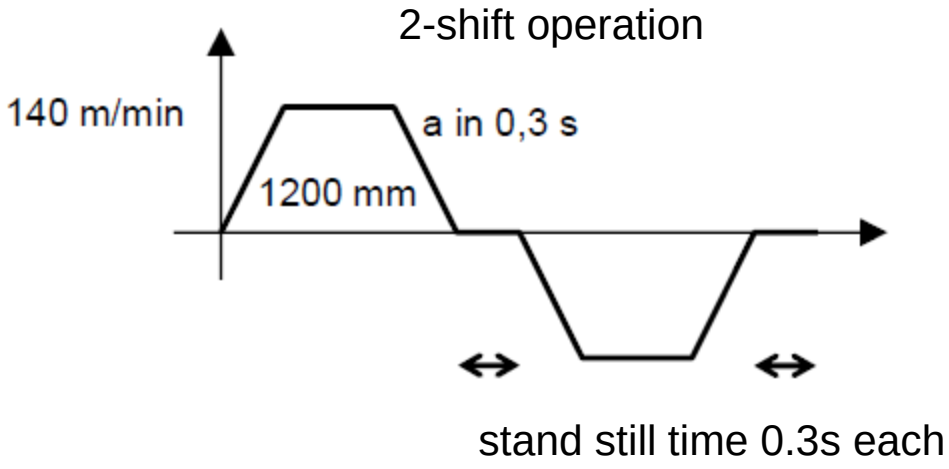
The module length of the rack drive is given with 2.2mm and the pinion has 30 teeth (effective pinion diameter d_{eff} = 66mm).

The efficiency rack/pinion is 90% and the coefficient of friction of the guide rail is10N.

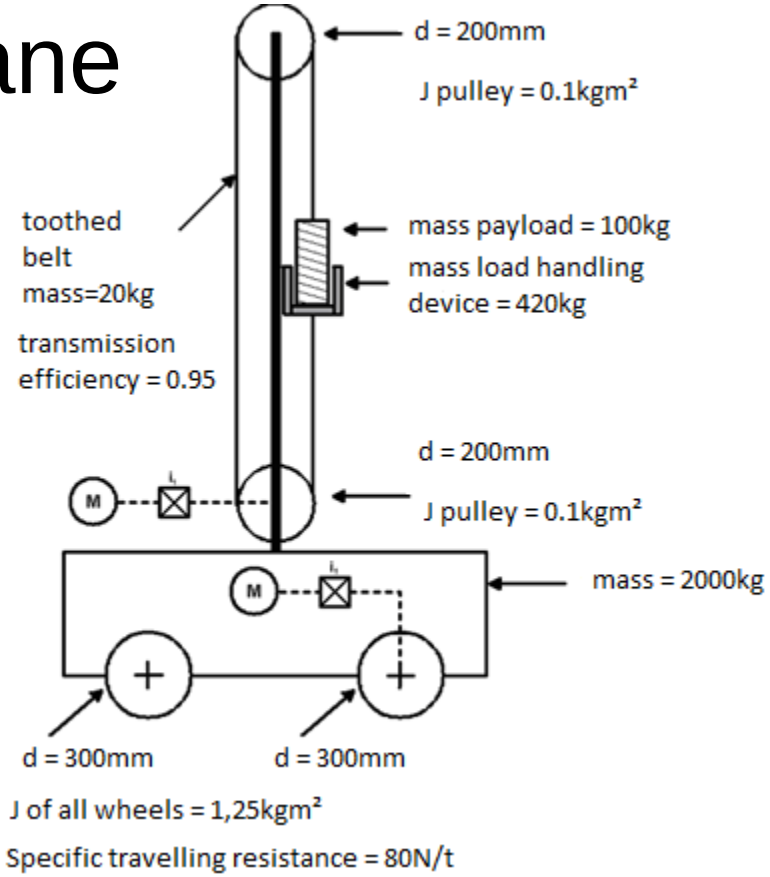
The customer asks for a servo system with i700, synchronous servo motor MCS and planetary gearbox g700 .

Exercise 10 – Rack drive





Exercise 11 – Stacker crane



Data for travelling axis and lifting axis:

Travelling distance: s_{max} = 27m

Lifting height: h_{max} = 13.5m

Load handling time: 6s, Simultaneous start of both axes

Travelling drive: v_{max}= 3.6m/s a_{max}= 1.7 m/s²

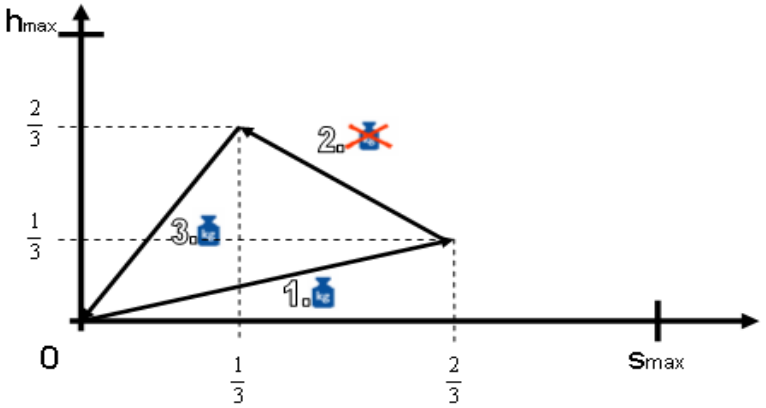
Lifting drive: v_{max}= 1.3m/s a_{max}= 1.0 m/s²

Ambient temperature: T_{max}= 40°C

Profile according to FEM standards (see sketch below right)

Tasks:

1. Determine and sketch the coordinated profiles of both axes.
2. Select a drive solution for both axes with DSD:
   Components: MCA, g500-B, 9400
3. Size a regenerative supply module.



Exercise 12 – Rewinder for paper

Dancer-controlled single rewinder:

- Mains supply: 3AC 400 V / 50 Hz
- d_{min} / d_{max} = 76 / 1350mm; $F_{max}(d_{min})$ / $F_{max}(d_{max})$ = 360 / 250N
- Material: Width = 600mm; Thickness = 0.1mm; Density = 0.9kg/dm³
- Motion profile: v_{max} = 400m/min; t_{acc} = 20s; t_{dec} = t_{ES} = 15s;
- S-shape with jerk ratio 33.3%
- Coil and winding shaft moment of inertia = 76kg/cm²

Tasks:

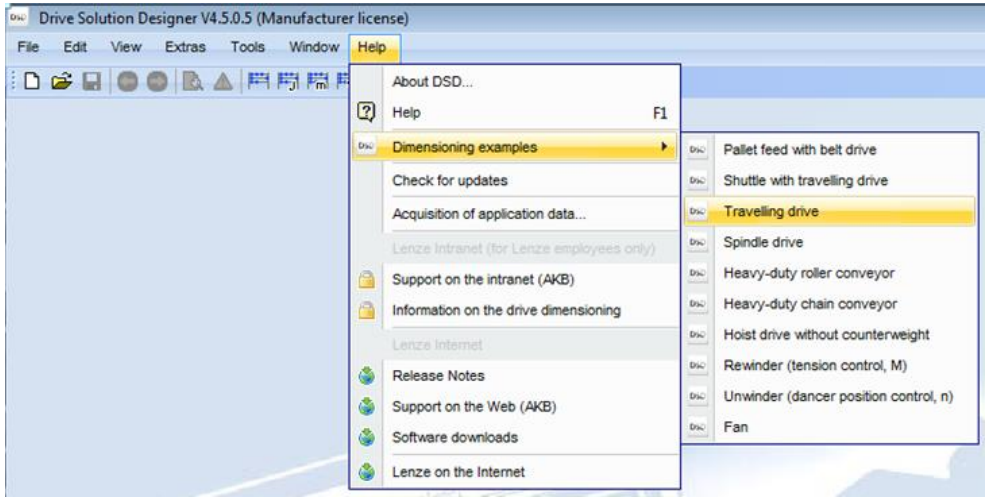
a. Select a suitable drive system with tooth belt transmission and IE2-motor with feedback and servo controller 9400

b. Create an alternative with maximum utilisation of field-weakening

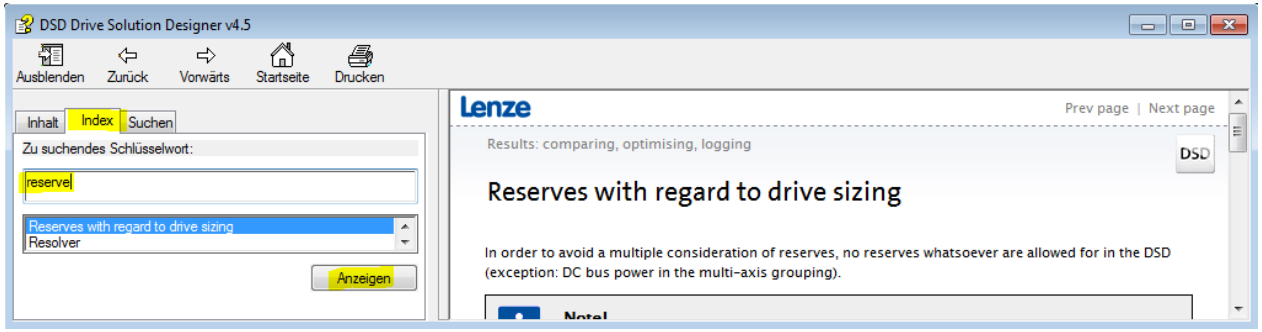
c. Create an alternative with a MH-motor in 29Hz technology (see user motors)

Exercise 13 – Project evaluation1/2

Open example project “Travelling drive”



1. Evaluate the utilisation of the selected components. For this purpose check the recommendations on reserves in the DSD help.

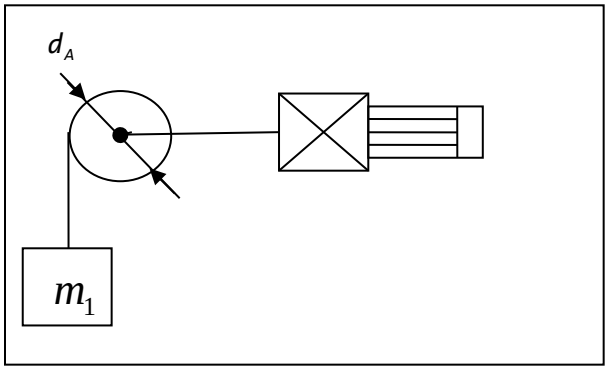


Exercise 13 – Project evaluation 2/2

2. Carry out alternative sizings:
   b. with a MCA motor with reduced power
   c. with a MF motor and use of field-weakening

3. Compare the results of all three projects.

Exercise 14 – Hoist



Rope-guided hoist without counter weight:

- Mains supply: 3AC 400 V / 50 Hz
- Diameter of drum = 300mm
- Mechanical efficiency = 90%
- The lifting speed is adapted in dependency of the load:
- m_L = 1000kg -> v = 0.7m/s; m_L = 400kg -> v = 1.4m/s; m_L = 100kg -> v = 2.0m/s
- Acceleration / deceleration 1m/s² each
- Lifting height up and down 5m each
- Standstill time 1s between each movement

Tasks:

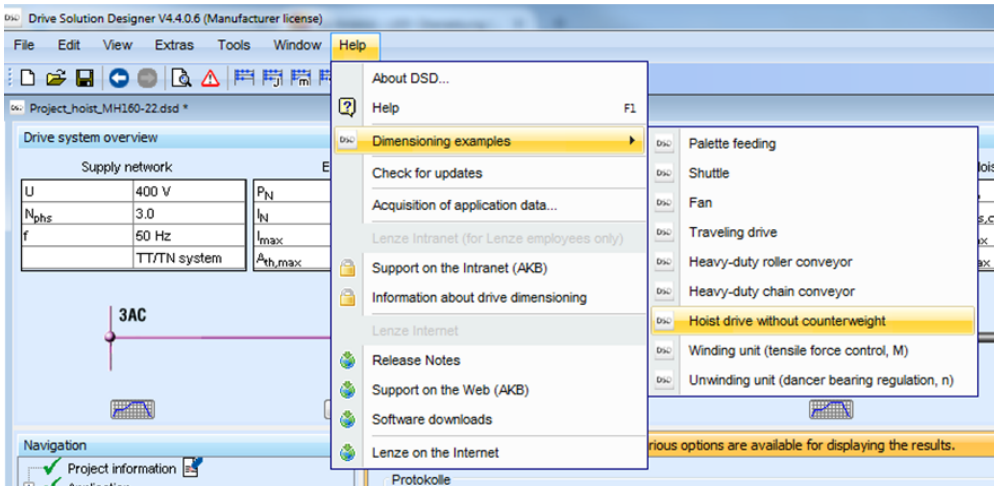
a. Select a suitable drive system with an IE3 asynchronous motor m550 with feedback, right-angle gearbox and inverter i500

b. Carry out an alternative with utilisation of field-weakening

Exercise 15 – Energy efficiency

Comparison of different drive systems in terms of energy efficiency

a. Open DSD‘s example project on „Hoist drive without conterweight“



b. Carry out an alternative with synchronous servo motor MCS19J30 and save to a file. Keep a 9400 single axis with brake resistor.

c. Carry out an alternative with synchronous servo motor MCS19J30 and 9400 multi axis (Supply via DC link).

d. Open BlueGreen solutions and make a comparison of the three projects

Exercise 16 – Creation of user motor

1. Open checklist:

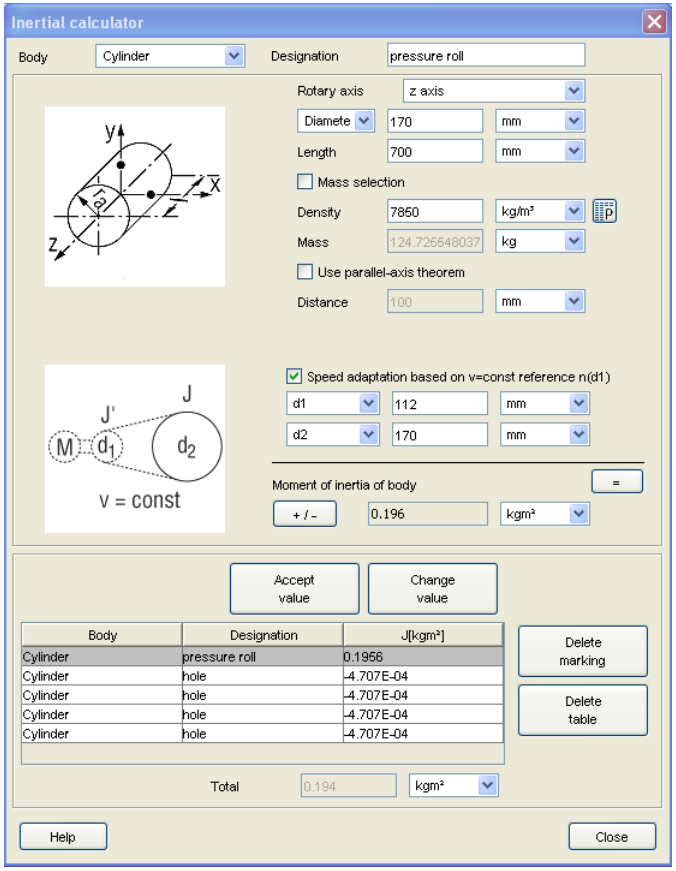
2. Open dialogue „Manage user motors“:

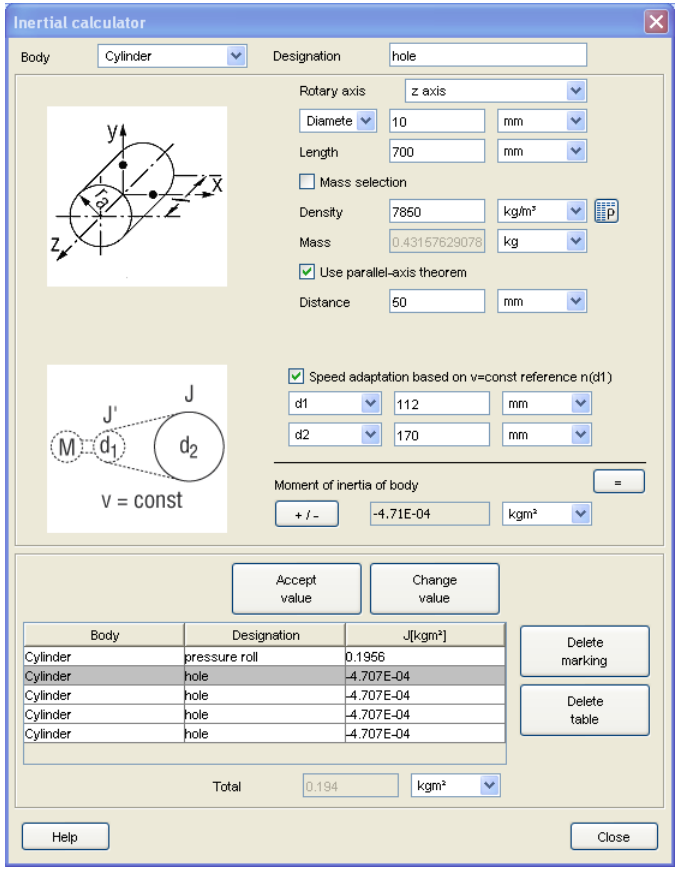
3. Create a new data set for motor m850 120S as user motor.
4. Create a DSD project by including this user motor.

Solutions

Exercise 01 – Moment of inertia

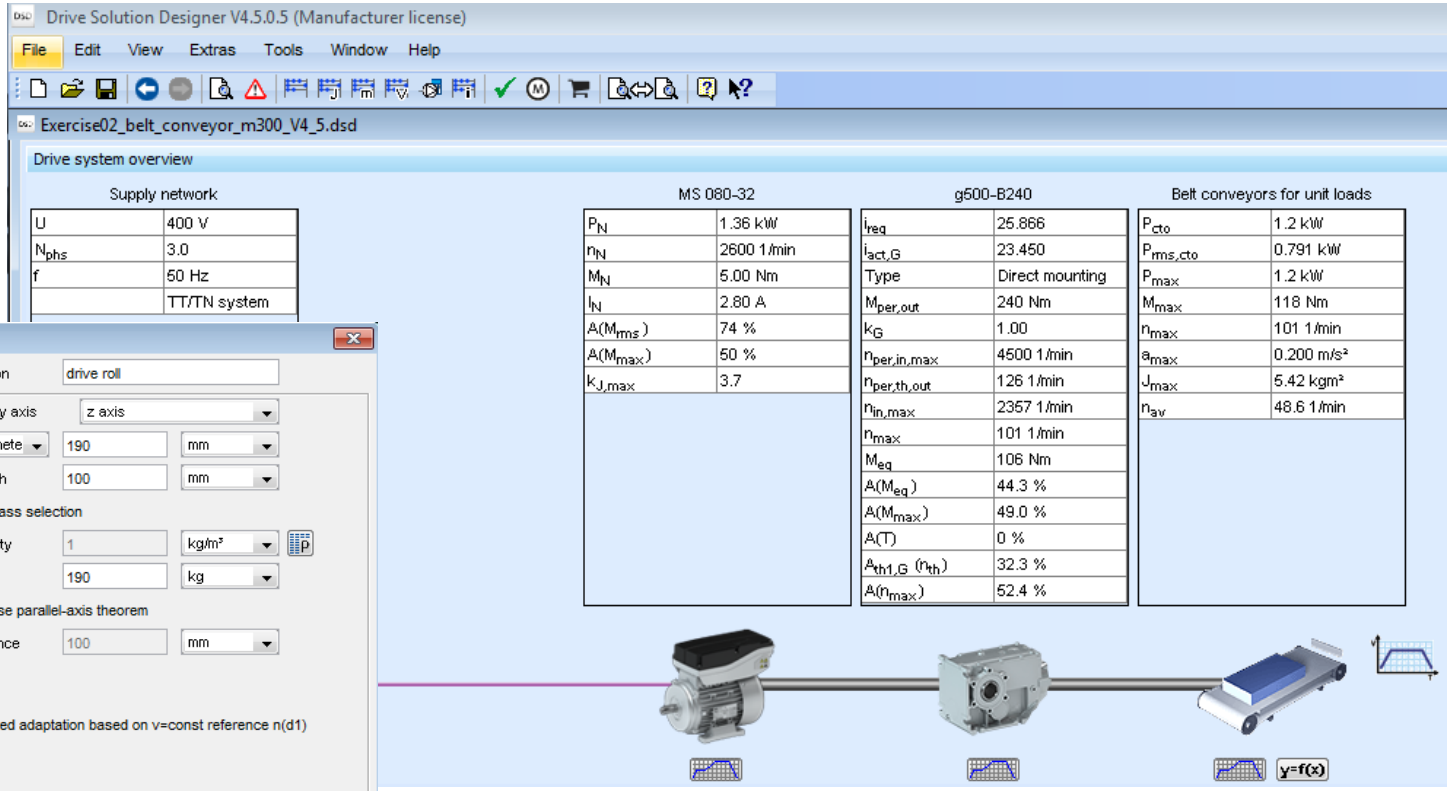
Solution:

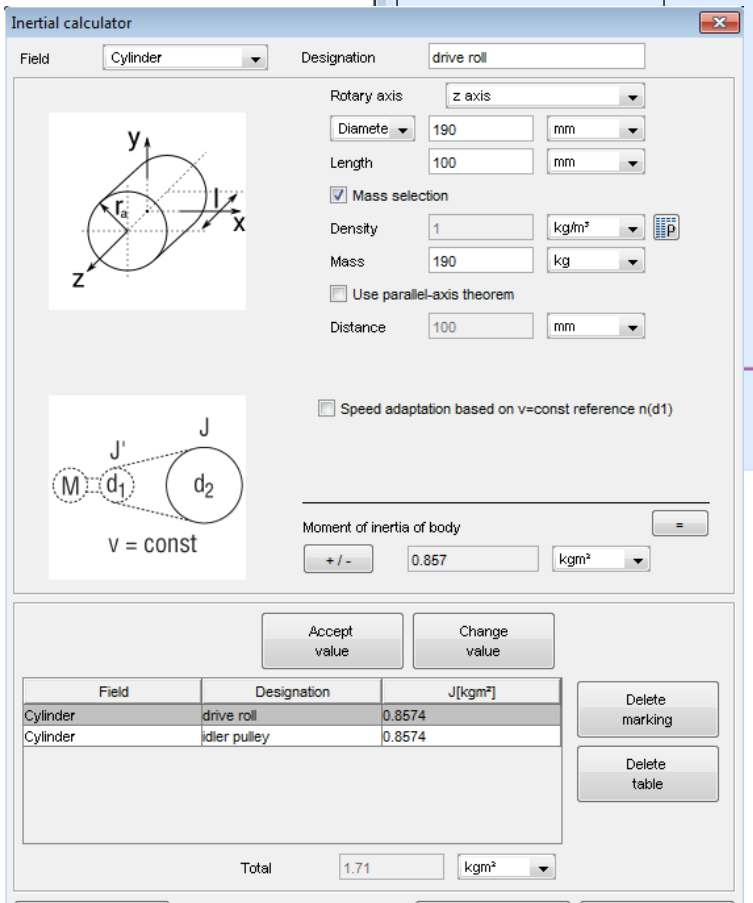




Exercise 02 – Belt conveyor with S3 profile

Solution example:





Determination of moment of inertia of rollers:
This includes drive roll and idler pulley.
There are no supporting rollers.

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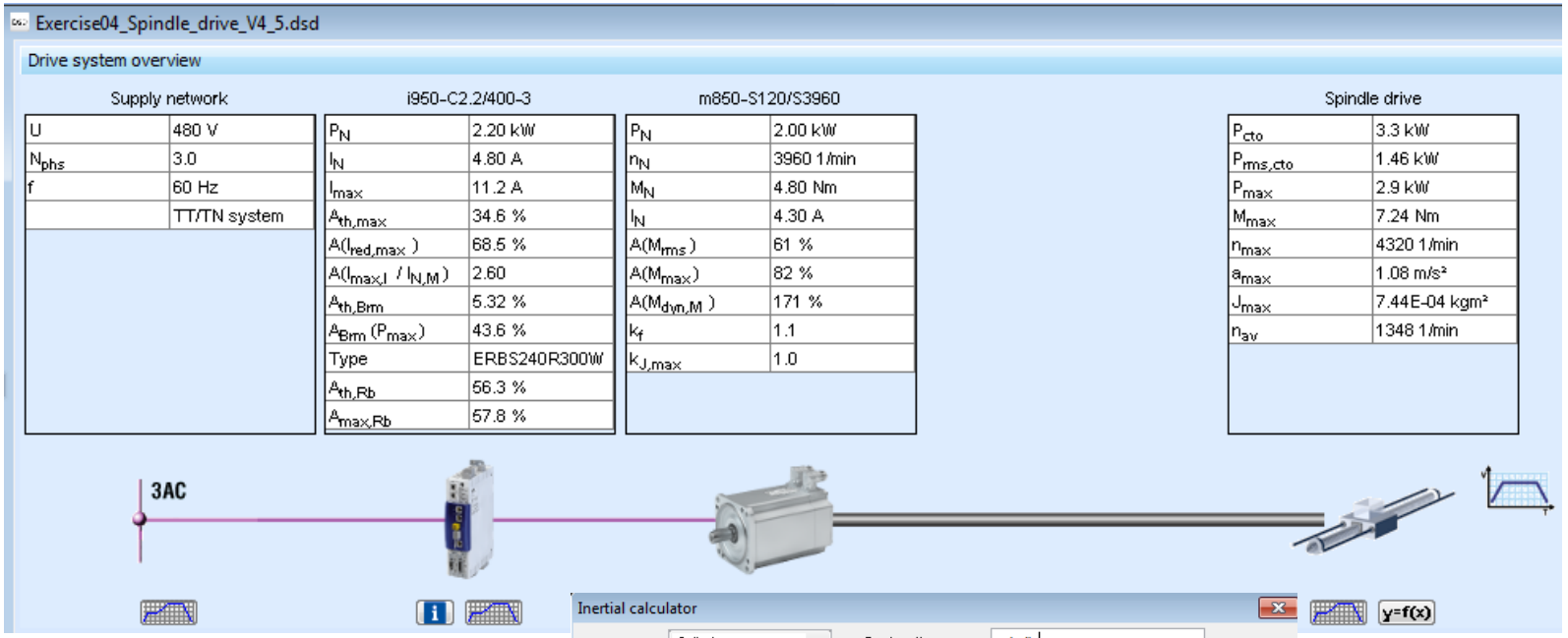
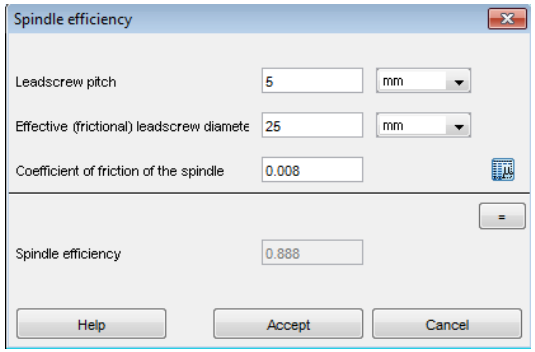
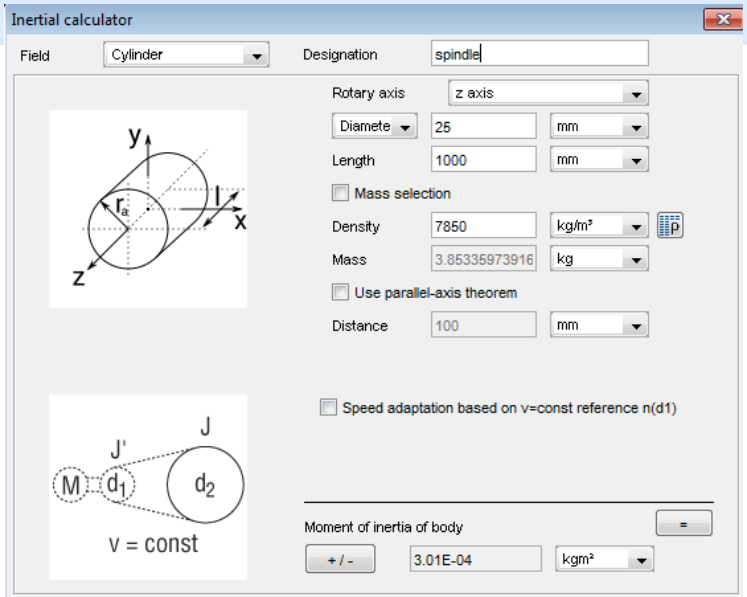
Exercise 04 – Spindle drive

Solution:



Use of auxiliary calculators:





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Exercise 05 – Belt conveyor start/stop

Solution to 1:

Exercise05_queue_conveyor_without_J_V4_5.dsd

Drive system overview

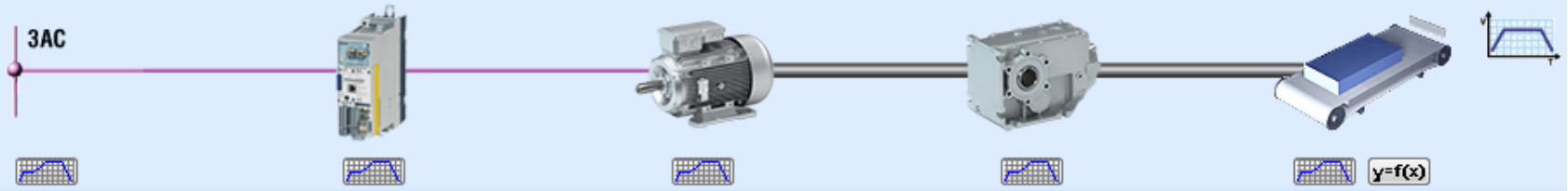
Supply network	
U	400 V
N_{phs}	3.0
f	50 Hz
	TT/TN system

E84AVSCx1524	
P_N	1.50 kW
I_N	3.90 A
I_{max}	7.80 A
$A_{th,max}$	82.6 %
$A(I_{red,max})$	71.4 %
$A(I_{max,I} / I_{N,M})$	2.36
$A_{th,Brm}$	3.15 %
A_{Brm} (P_{max})	23.5 %
Type	ERBP180R200W
$A_{th,Rb}$	45.4 %
$A_{max,Rb}$	23.3 %

m550-P90/L4	
P_N	1.50 kW
n_N	1442 1/min
M_N	9.93 Nm
I_N	3.30 A
$A(M_{rms})$	98 %
$A(M_{max})$	90 %
$A(M_{dyn,M})$	149 %
k_f	0.91
$k_{J,max}$	3.3

g500-B240	
i_{req}	3.9047
$i_{act,G}$	3.5650
Type	Direct mounting
$M_{per,out}$	138 Nm
k_G	1.00
$n_{per,in,max}$	4500 1/min
$n_{per,th,out}$	438 1/min
$n_{in,max}$	1317 1/min
n_{max}	369 1/min
M_{eq}	25.6 Nm
$A(M_{eq})$	18.6 %
$A(M_{max})$	33.1 %
A(T)	0 %
$A_{th1,G}$ (n_{th})	32.4 %
$A(n_{max})$	29.3 %

Belt conveyors for unit loads	
P_{cto}	1.5 kW
$P_{rms,cto}$	0.956 kW
P_{max}	1.5 kW
M_{max}	39.2 Nm
n_{max}	369 1/min
a_{max}	6.84 m/s²
J_{max}	0.227 kgm²
n_{av}	234 1/min



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Exercise 05 – Belt conveyor start/stop

Solution to 2. – Validation of check list

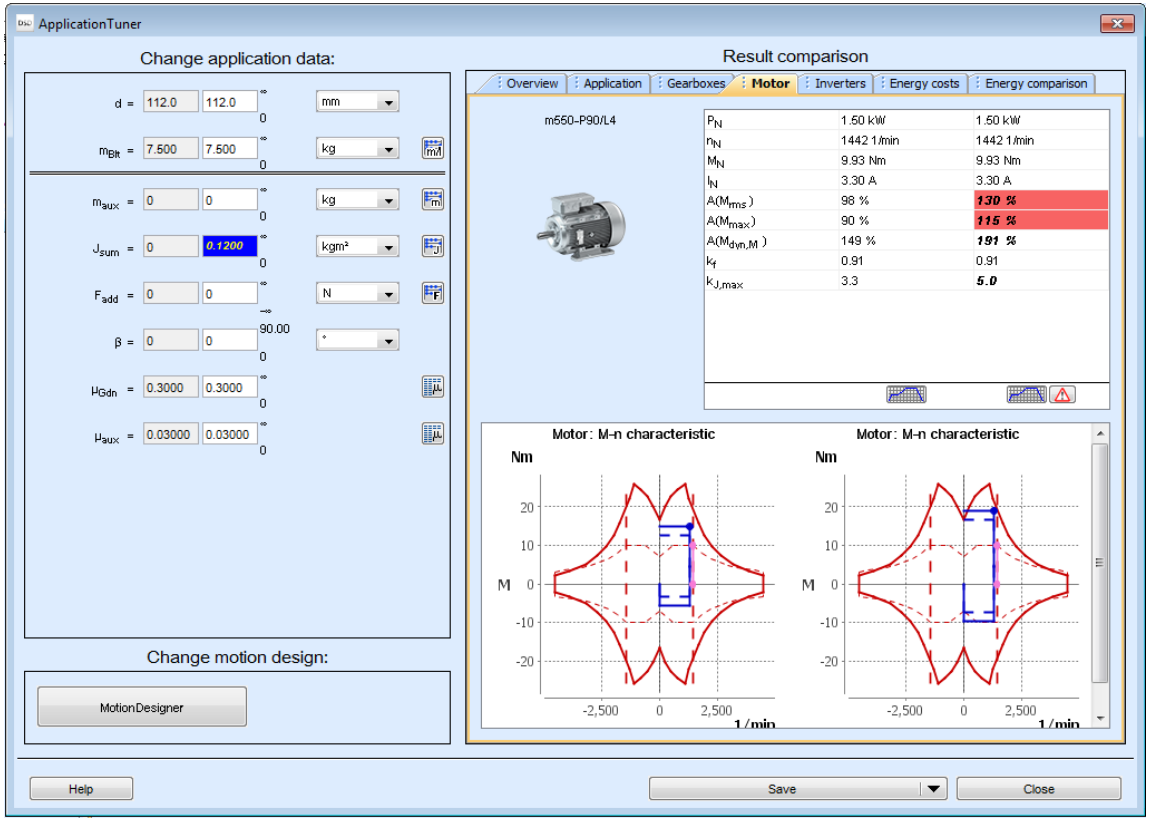
The information on the moment of inertia of both drive roller and idler pulley is missing. As there is no information on the geometry of the rollers, there is no chance to derive the moment of inertia.

As for queue conveyors the moment of inertia of the rollers is a significant fraction of the moment of inertia of the whole application (here 1/3). this information should be collected from the customer.

Exercise 05 – Belt conveyor start/stop

Solution to 3. – Application Tuner

The consideration of the moment of inertia of drive roller and idler pulley leads to motor overload. Selection of a bigger motor becomes necessary.



Adobe Acrobat Document

Project comparison

Lenze

Exercise 06 – Travelling drive

Possible solution with m550:

Helical gearboxes of type g500-H with maximum torque of 3000Nm can be combined with m550.

g500-H in the torque range of 5000 – 14000Nm can be mounted on m540.

Exercise06_travelling_drive_m550_g500H3000_i550_V4_5.dsd

Drive system overview

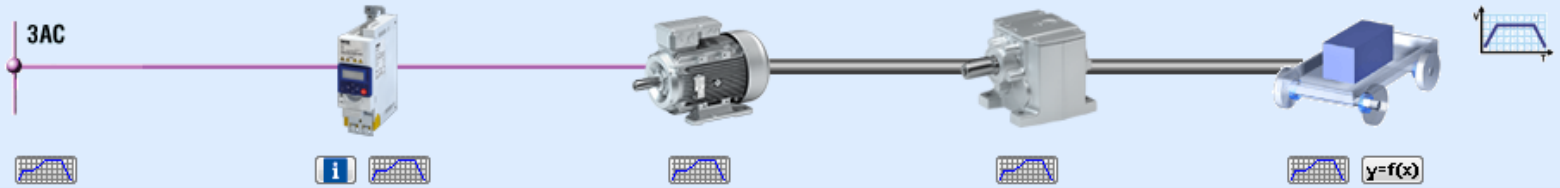
Supply network	
U	400 V
N_{phs}	3.0
f	50 Hz
	TT/TN system

i550-C30/400-3	
P_N	30.0 kW
I_N	61.0 A
I_{max}	122 A
$A_{th,max}$	33.2 %
$A(I_{red,max})$	64.5 %
$A(I_{max,I} / I_{N,M})$	2.38
$A_{th,Brm}$	2.19 %
A_{Brm} (P_{max})	37.8 %
Type	ERBG012R01K9
$A_{th,Rb}$	65.4 %
$A_{max,Rb}$	61.3 %

m550-P160/L4	
P_N	26.3 kW
n_N	2580 1/min
M_N	97.4 Nm
I_N	51.3 A
$A(M_{rms})$	63 %
$A(M_{max})$	80 %
$A(M_{dyn,M})$	152 %
k_f	0.97
$k_{J,max}$	9.7

g500-H3000	
i_{req}	14.737
$i_{act,G}$	14.233
Type	Direct mounting
$M_{per,out}$	2530 Nm
k_G	1.00
$n_{per,in,max}$	3500 1/min
$n_{per,th,out}$	93.8 1/min
$n_{in,max}$	2492 1/min
n_{max}	175 1/min
M_{eq}	1026 Nm
$A(M_{eq})$	40.6 %
$A(M_{max})$	96.8 %
A(T)	0 %
$A_{th1,G}$ (n_{th})	47.8 %
$A(n_{max})$	71.2 %

Travelling drive	
P_{cto}	34 kW
$P_{rms,cto}$	13.3 kW
P_{max}	34 kW
M_{max}	1868 Nm
n_{max}	175 1/min
a_{max}	2.00 m/s²
J_{max}	166 kgm²
n_{av}	71.6 1/min



Exercise 07 – Heavy duty chain conveyor

Possible selection of components:

Exercise07_Heavy_duty_chain_conveyor_V4_5.dsd

Übersicht Antriebssystem

Elektrisches Netz

U	400 V
N_{phs}	3,0
f	50 Hz
	TT/TN-Netz

MS 080-32

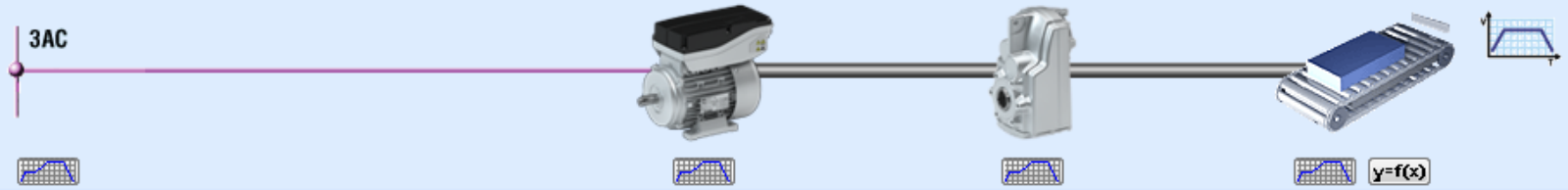
P_N	1,36 kW
n_N	2600 1/min
M_N	5,00 Nm
I_N	2,80 A
$A(M_{rms})$	67 %
$A(M_{max})$	93 %
$k_{J,max}$	1,1

g500-S400

i_{req}	65,617
$i_{act,G}$	65,559
Ausführung	Direktanbau
$M_{per,out}$	400 Nm
k_G	1,00
$n_{per,in,max}$	4500 1/min
$n_{per,th,out}$	47,9 1/min
$n_{in,max}$	2598 1/min
n_{max}	39,6 1/min
M_{eq}	233 Nm
$A(M_{eq})$	58,3 %
$A(M_{max})$	67,1 %
A(T)	0 %
$A_{th1,G}$ (n_{th})	57,9 %
$A(n_{max})$	57,7 %

Kettenförderer

P_{cto}	1,1 kW
$P_{rms,cto}$	0,866 kW
P_{max}	1,1 kW
M_{max}	269 Nm
n_{max}	39,6 1/min
a_{max}	0,133 m/s²
J_{max}	12,2 kgm²
n_{av}	30,5 1/min

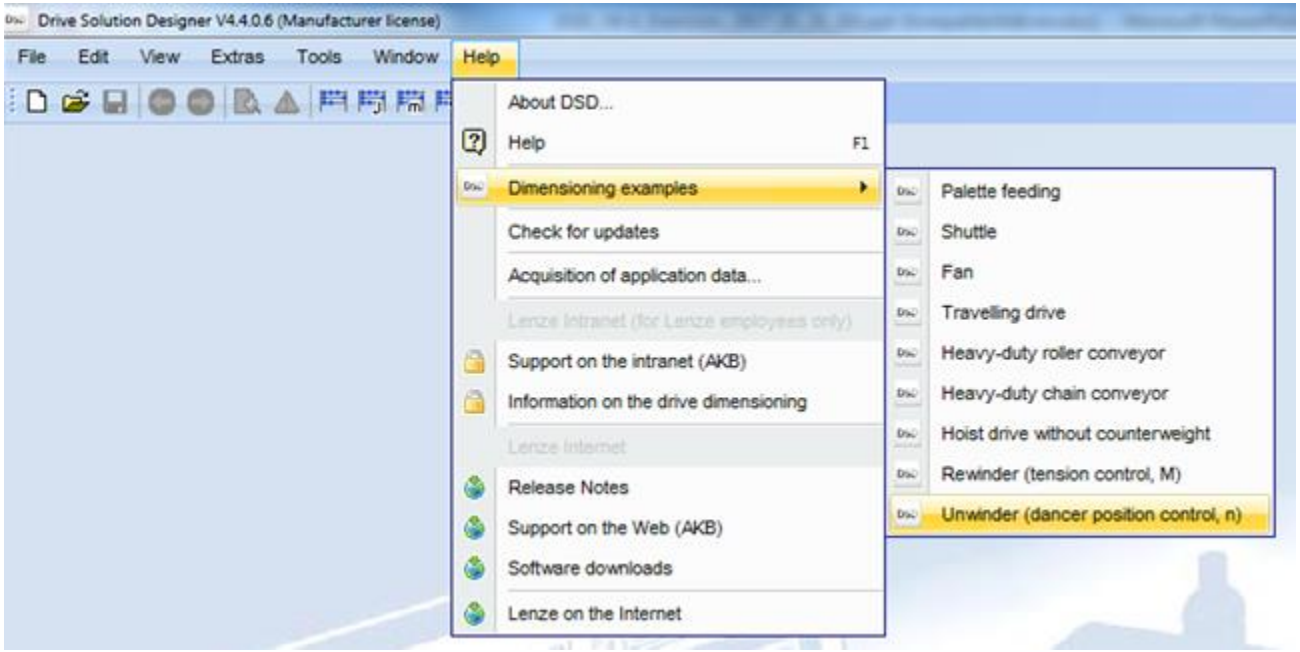


Lenze

Exercise 08 – Unwinder

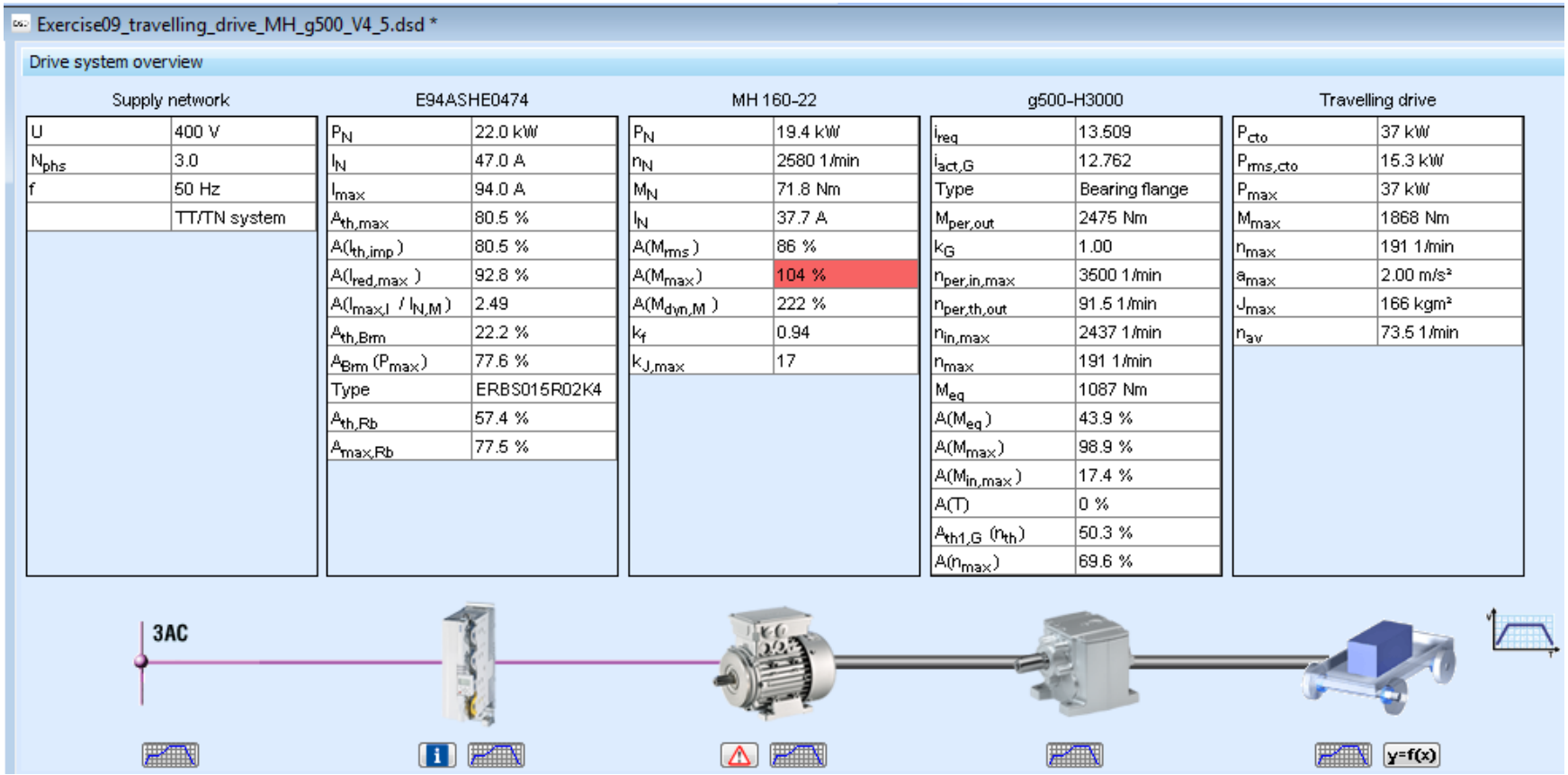
Possible solution:

see commented dimensioning example unwinder



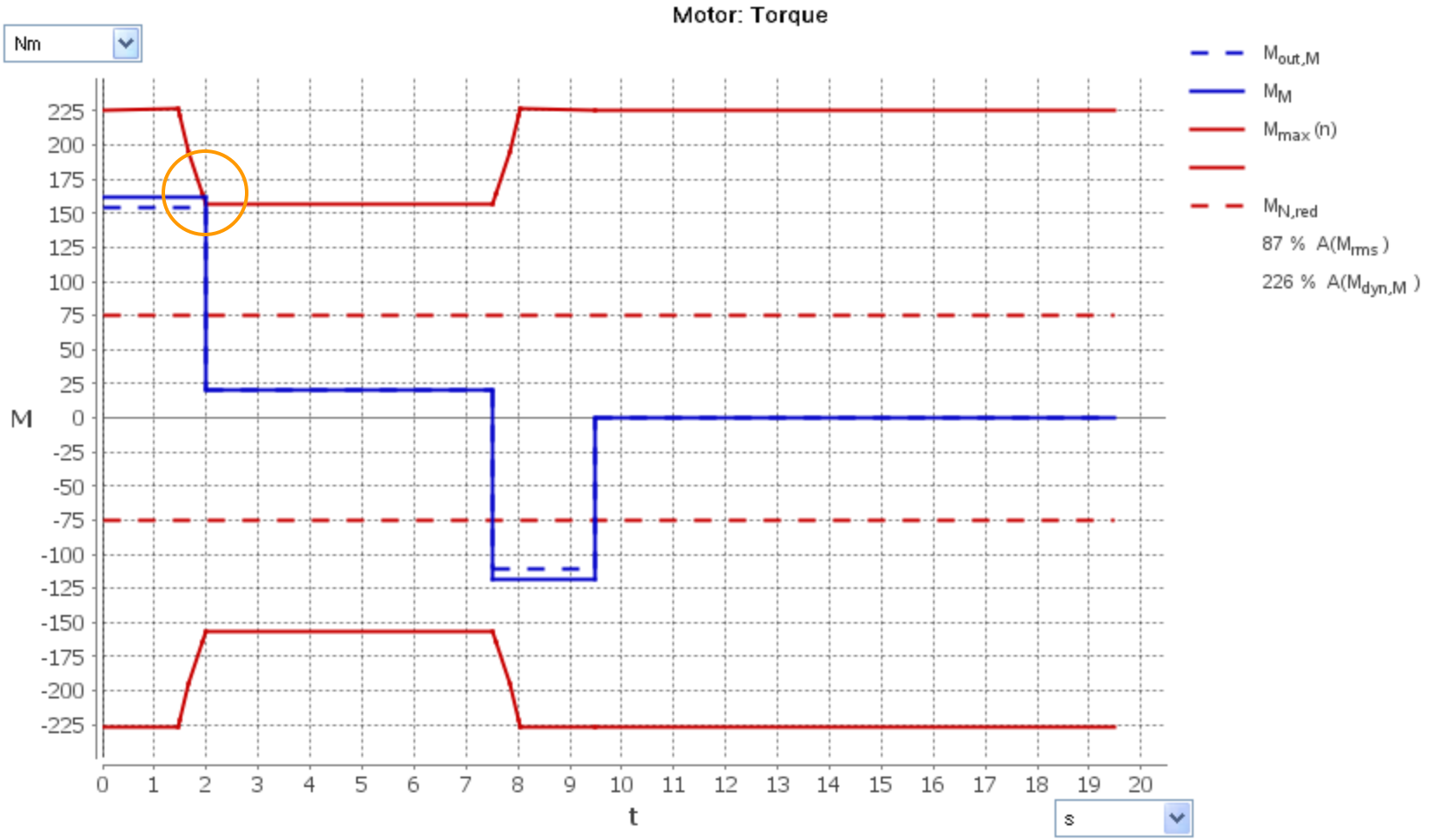
Exercise 09 – Travelling drive 2

Solution: A warning regarding the maximum torque comes up. Click on exclamation mark or characteristics symbol below the motor leads to detailed information on the results (see next slide).



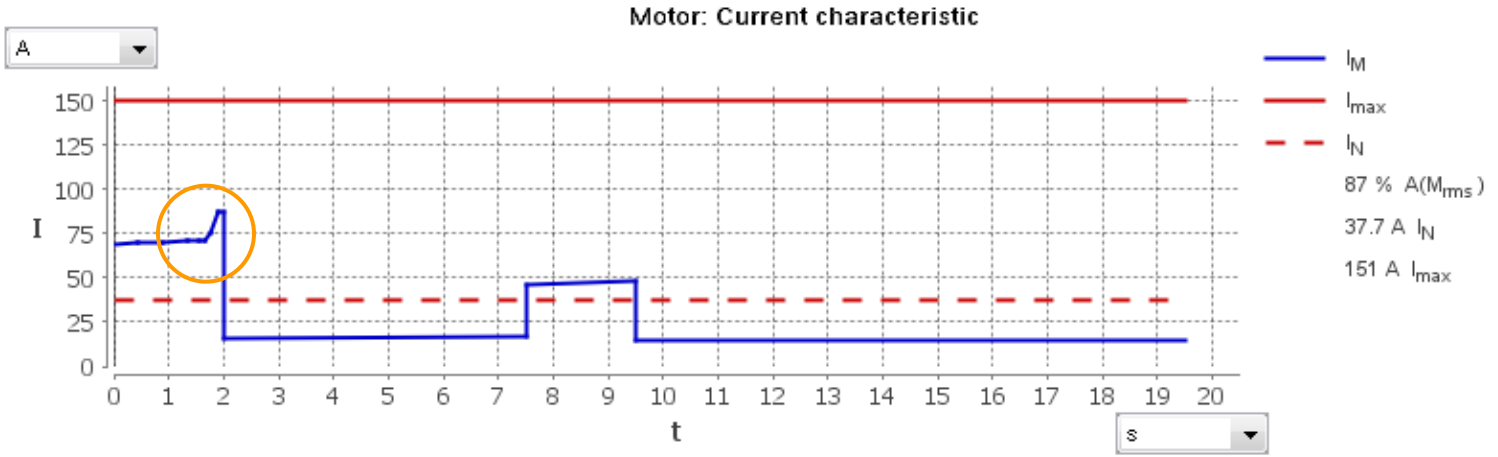
Exercise 09 – Travelling drive 2

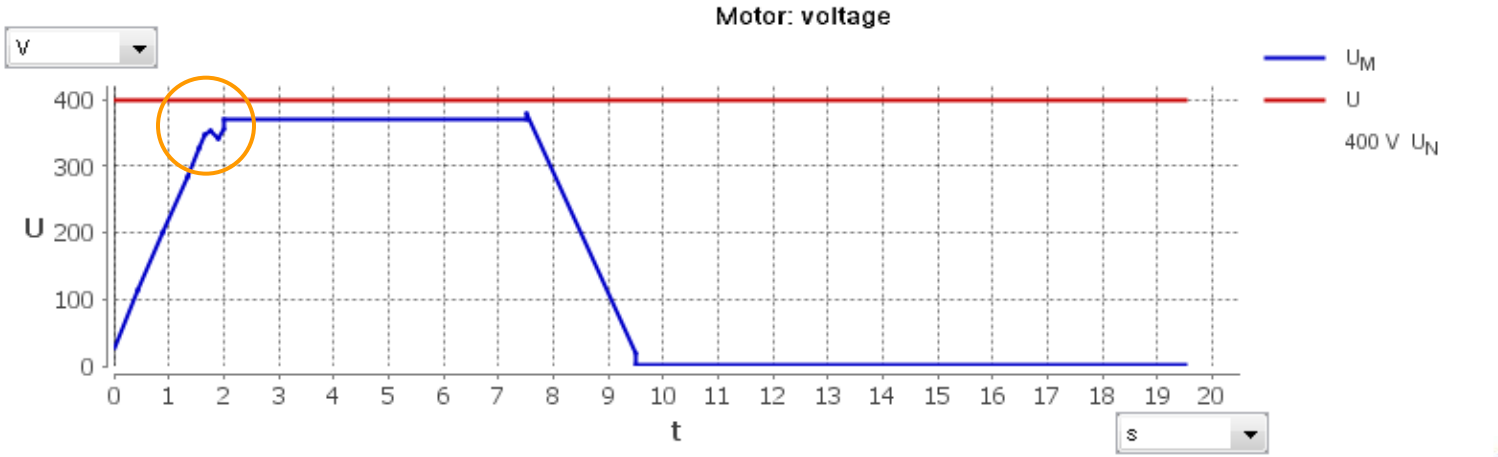
Solution: This restriction in the available torque can be neglected for a travelling drive as the drive has enough time to compensate the following error at the end of the acceleration phase during dwell time.



Exercise 09 – Travelling drive 2

Solution: The drive reaches the voltage limit in this point of operation, which is compensated by an increase of the current.

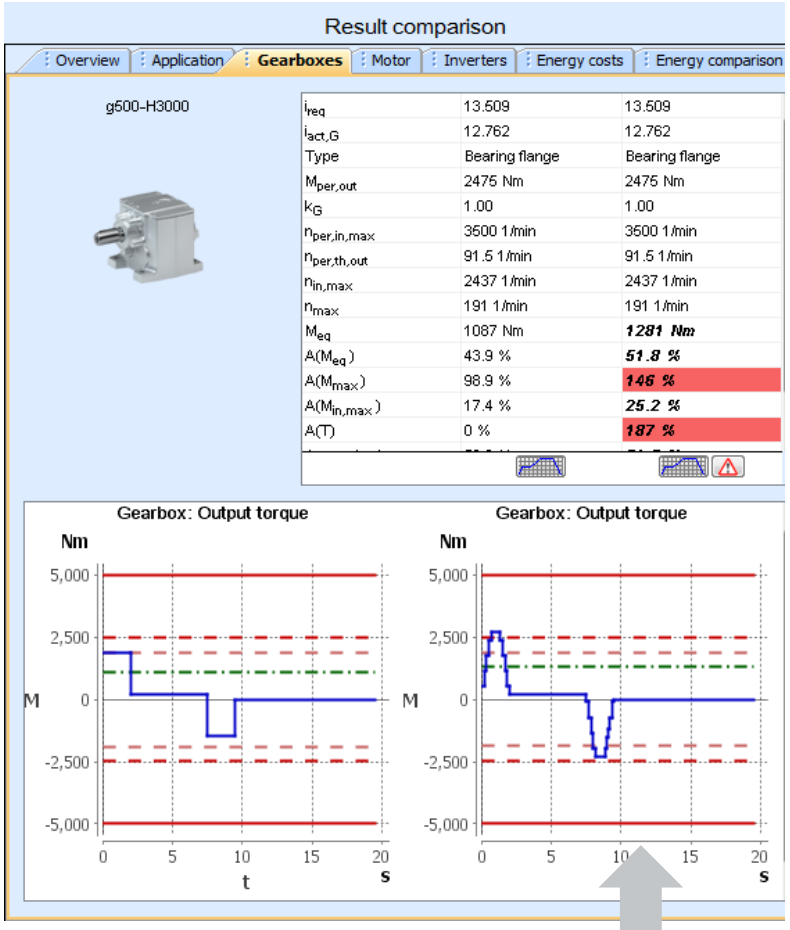


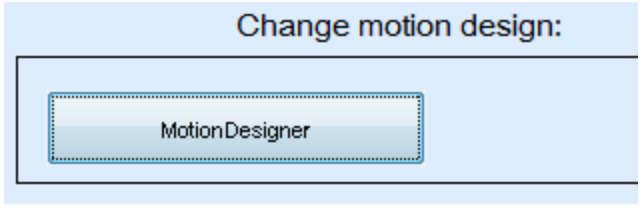


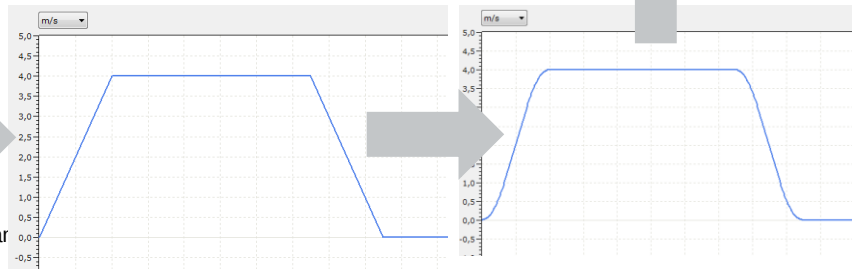
Exercise 09 – Travelling drive

Solution to 3:

Adapting the trapeze profile to s-shape in Application Tuner leads to significant increase of max. acceleration (2m/s² to 3m/s²) resulting in overutilisation of the drive components.



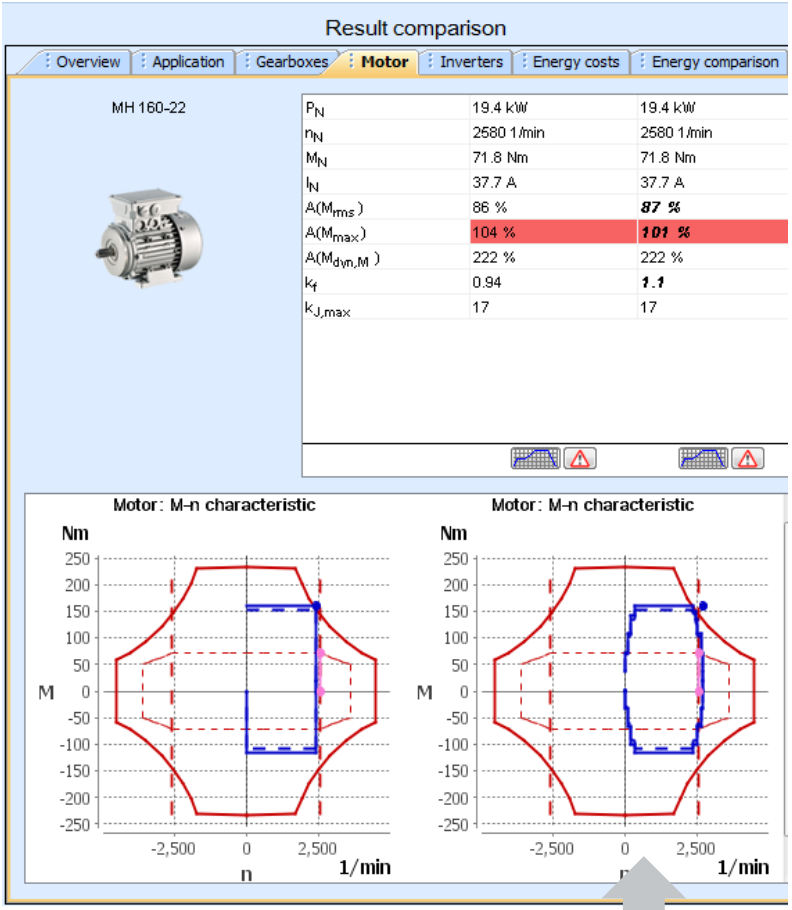


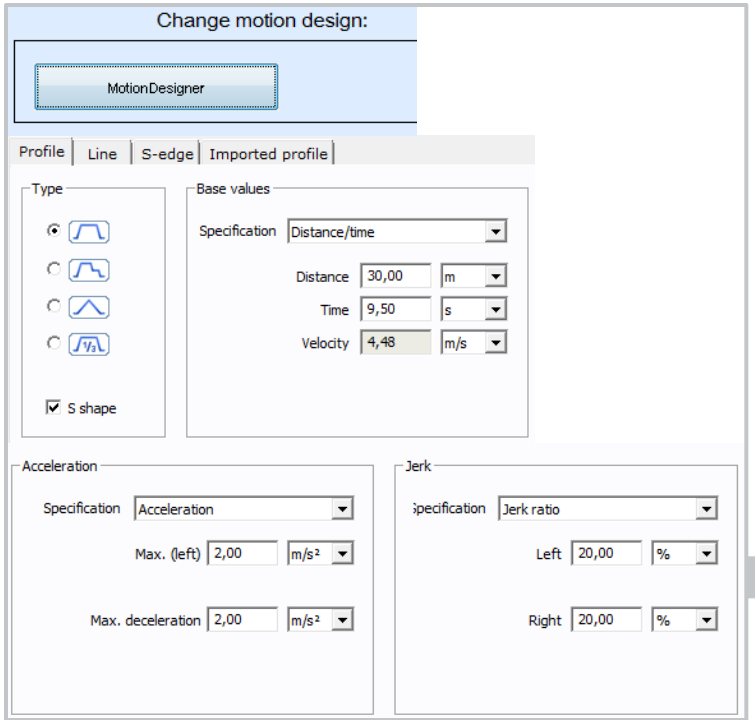


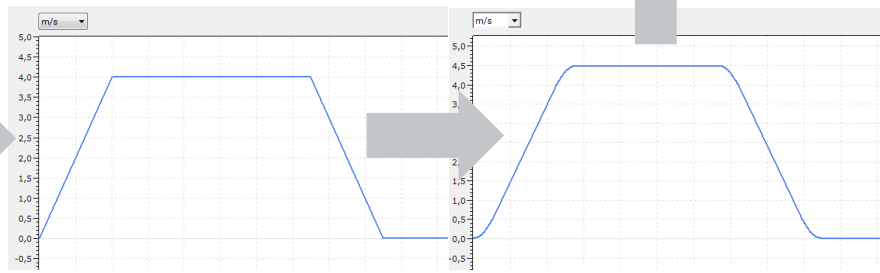
Exercise 09 – Travelling drive

Solution to 4:

Adapting the trapeze profile to s-shape and keeping the max. acceleration to 2m/s² results in a higher max. speed. The increased field-weakening factor k_f leads to a better utilisation of the M-n characteristic. S-shape leads to a de-coupling of max. speed and max. torque.

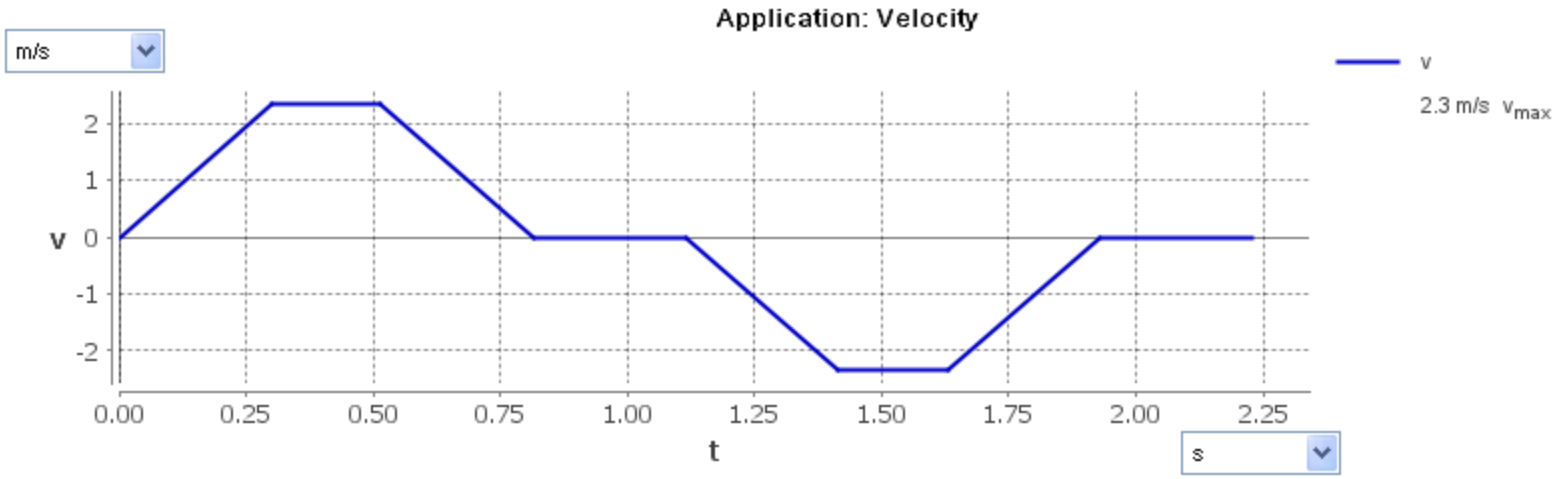


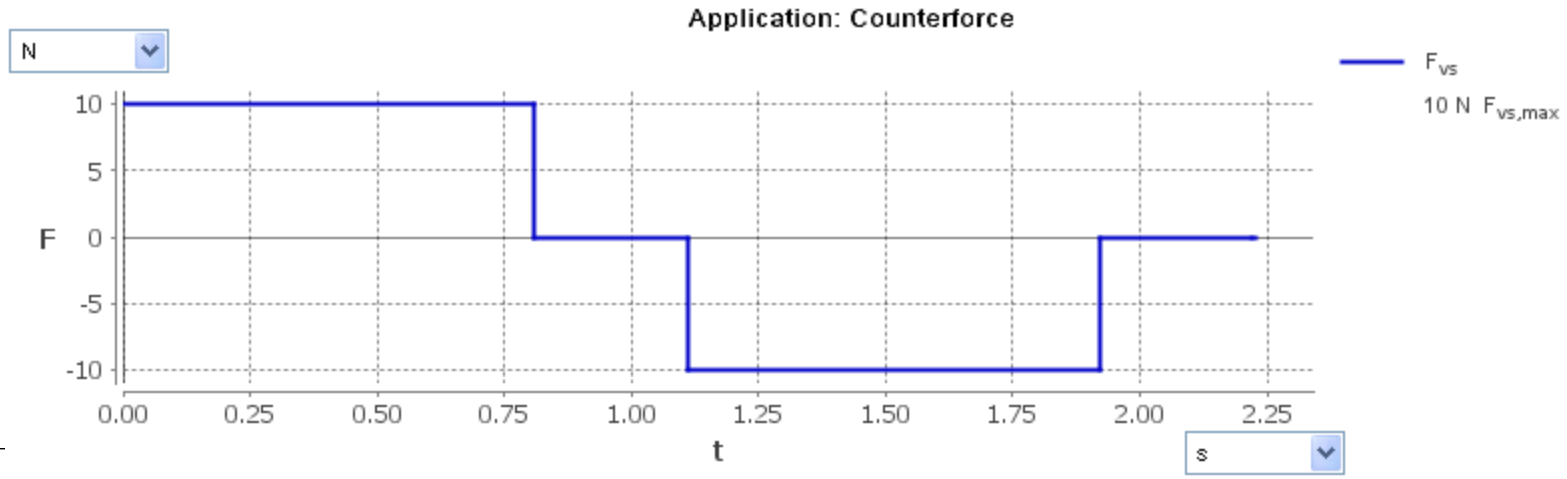




Exercise 10 – Rack drive

Solution: In the Motion Designer the coefficient of friction of the guide rail has to be considered as counterforce. Make sure to enter it like sign with the velocity.





Exercise 10 – Rack drive

Possible selection of components:

Exercise10_rack_drive_V4_5.dsd

Drive system overview

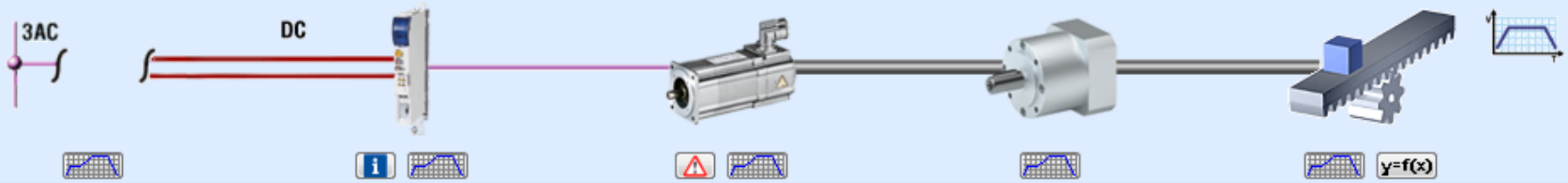
Supply network	
U	400 V
N_{phs}	3.0
f	50 Hz
	TT/TN system

E70ACMxx0104Sx1	
P_N	2.20 kW
I_N	5.00 A
I_{max}	10.0 A
$A_{th,max}$	69.5 %
$A(I_{red,max})$	82.4 %
$A(I_{max,I} / I_{N,M})$	2.22

MCS 09F60-	
P_N	1.50 kW
n_N	6000 1/min
M_N	2.40 Nm
I_N	4.50 A
$A(M_{rms})$	76 %
$A(M_{max})$	73 %
$A(M_{dyn,M})$	186 %
k_f	1.0
$k_{J,max}$	2.6

g700-P44	
i_{req}	8.8862
$i_{act,G}$	9.0000
Type	Bearing flange
$M_{per,out}$	44.0 Nm
k_G	0.792
$n_{per,in,max}$	7000 1/min
$n_{per,th,out}$	428 1/min
$n_{in,max}$	6077 1/min
n_{max}	675 1/min
M_{eq}	21.1 Nm
$A(M_{eq})$	60.4 %
$A(M_{max})$	74.1 %
A(T)	0 %
$A_{th1,G}$ (n_{th})	72.9 %
$A(n_{max})$	86.8 %

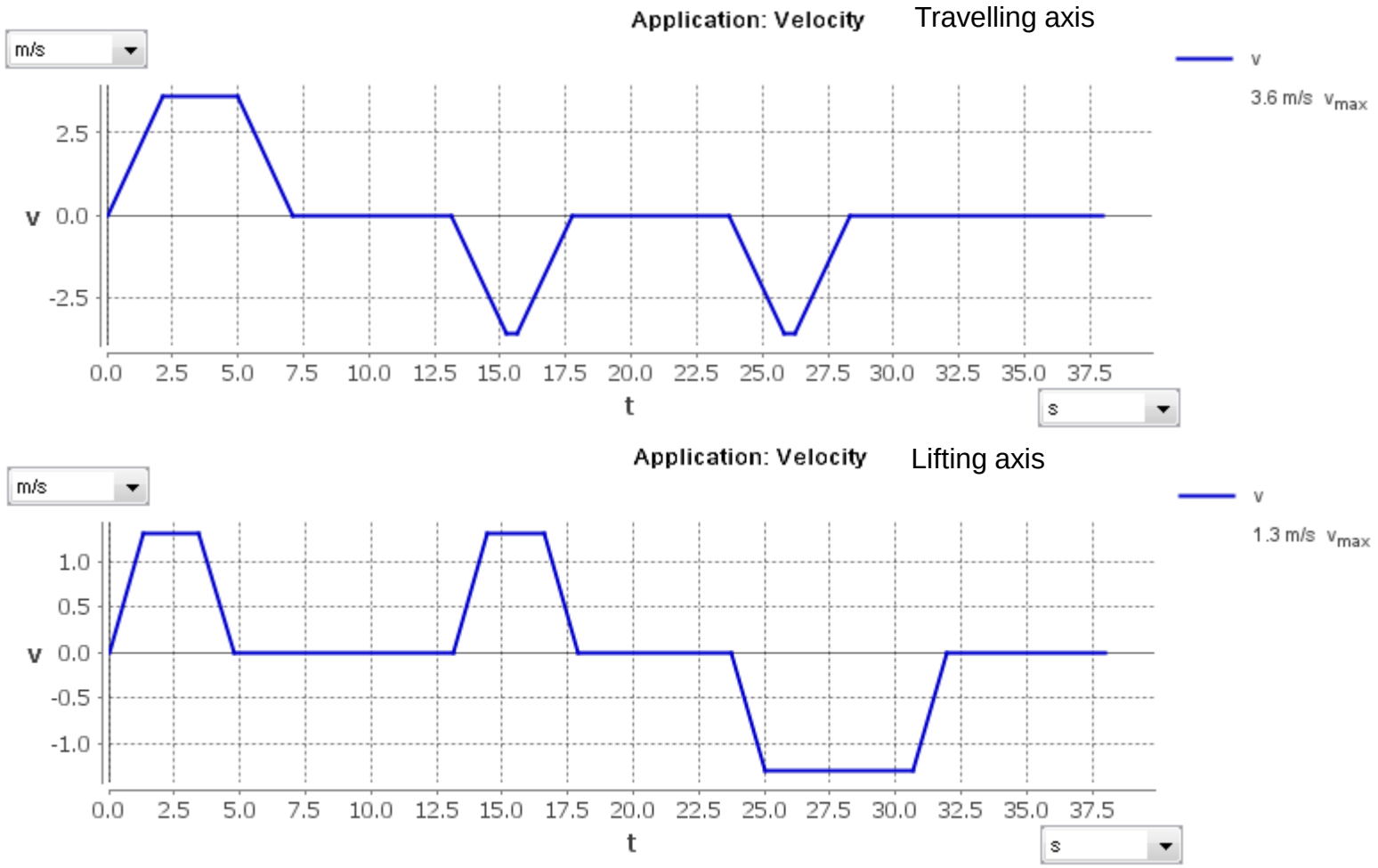
Rack drive	
P_{cto}	2.3 kW
$P_{rms,cto}$	1.33 kW
P_{max}	2.3 kW
M_{max}	32.6 Nm
n_{max}	675 1/min
a_{max}	7.78 m/s²
J_{max}	0.0544 kgm²
n_{av}	312 1/min



Lenze

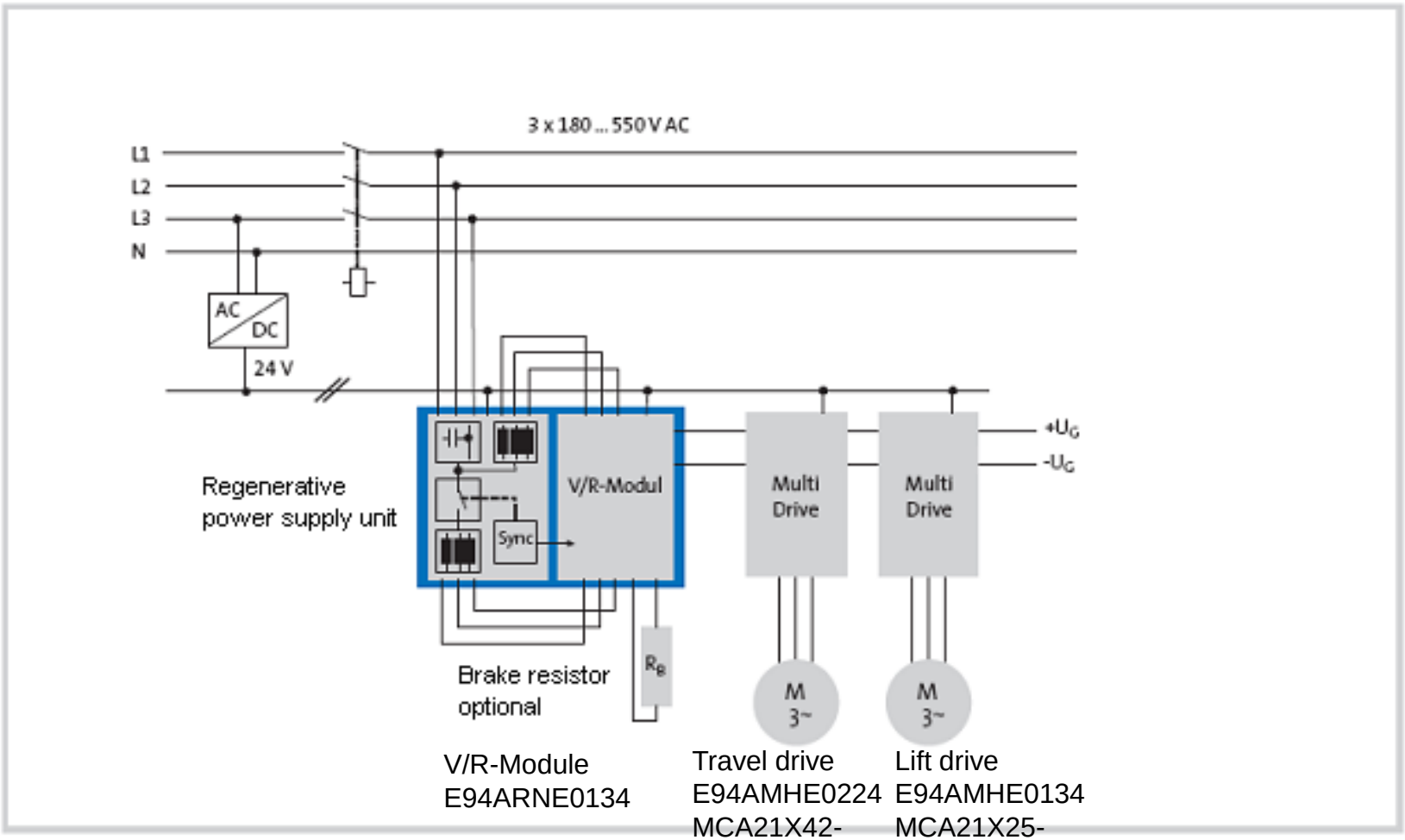
Exercise 11 – Stacker crane

Motion profiles of both axes:



Exercise 11 – Stacker crane

Topology Stacker crane:



V/R-Module
E94ARNE0134

Travel drive
E94AMHE0224
MCA21X42-
g500-B1500

Lift drive
E94AMHE0134
MCA21X25-
g500-B1500

Exercise 12 – Rewinder for paper

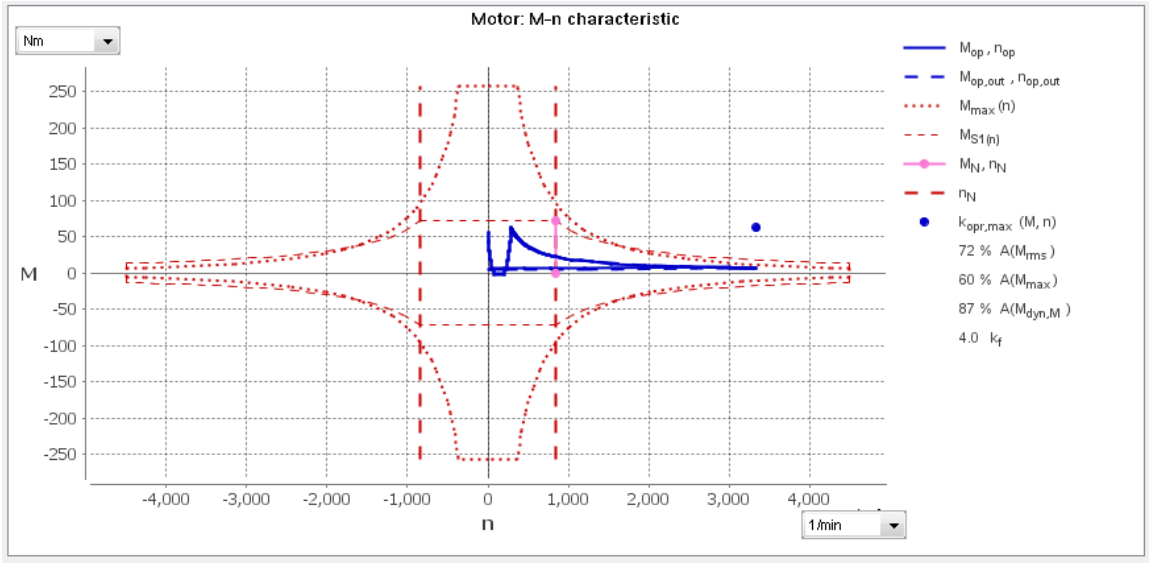
Best solution

Parameter	12a_Rewinder	12b_Rewinder	12c_Rewinder
Motor			
Motor group	MHXMA	MHXMA	***MH 29 Hz***
Type designation	160-22	***132-22***	160-22
Rated power	11.0 kW	***7.50 kW***	***6.28 kW***
Rated torque	71.5 Nm	***49.1 Nm***	71.5 Nm
Rated speed	1470 1/min	***1460 1/min***	***840 1/min***
Rated current	21.8 A	***15.6 A***	***12.6 A***
Rated voltage	400 V	400 V	400 V
Moment of inertia	570 kgcm²	***336 kgcm²***	570 kgcm²
Field weakening factor	2.0	***3.0***	***4.0***
Utilisation with reference to the effective torque	83 %	***93 %***	***72 %***
Utilisation, maximum torque (motor, inverter)	28 %	***34 %***	***60 %***
Short-time overload	100 %	***97 %***	***87 %***
Stationary torque efficiency	101 %	***97.6 %***	***87.2 %***
Max. load-matching factor	445	***338***	***334***
Inverters			
Inverter type	E94ASHE0244	***E94ASHE0174***	***E94ASHE0134***
Rated inverter power	11.0 kW	***7.50 kW***	***5.50 kW***
Output current	23.5 A	***16.5 A***	***13.0 A***
Max. output current	58.8 A	***49.5 A***	***39.0 A***
Max. thermal utilisation	79.1 %	***90.2 %***	***82.2 %***
Max. utilisation, power pulse current	55.9 %	***62.6 %***	***57.1 %***
Utilisation referenced to max. current	32 %	***31 %***	***28 %***

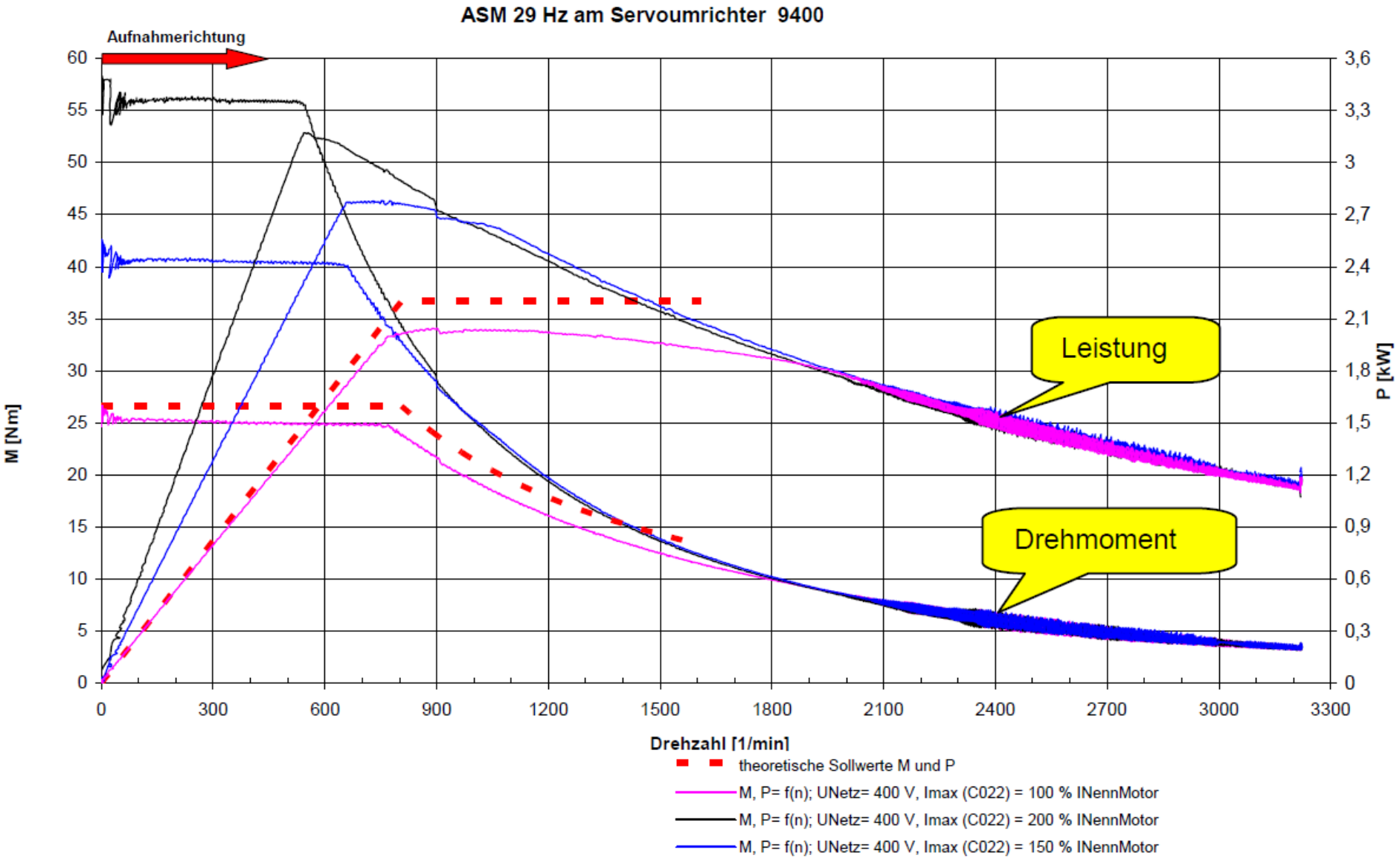
Exercise 12 – Rewinder for paper

Result:
The favorite (best performance for money ratio) is solution C featuring the smallest drive in combination with a motor (29Hz technology) with big frame size but small power.
For a winding application the load-matching factor k_J is moderate.
By maximum utilisation of the field-weakening range the drive power can be reduced from 11 to 5.5kW.

M-n characteristic of MHXMA 160-22, 29Hz technology:

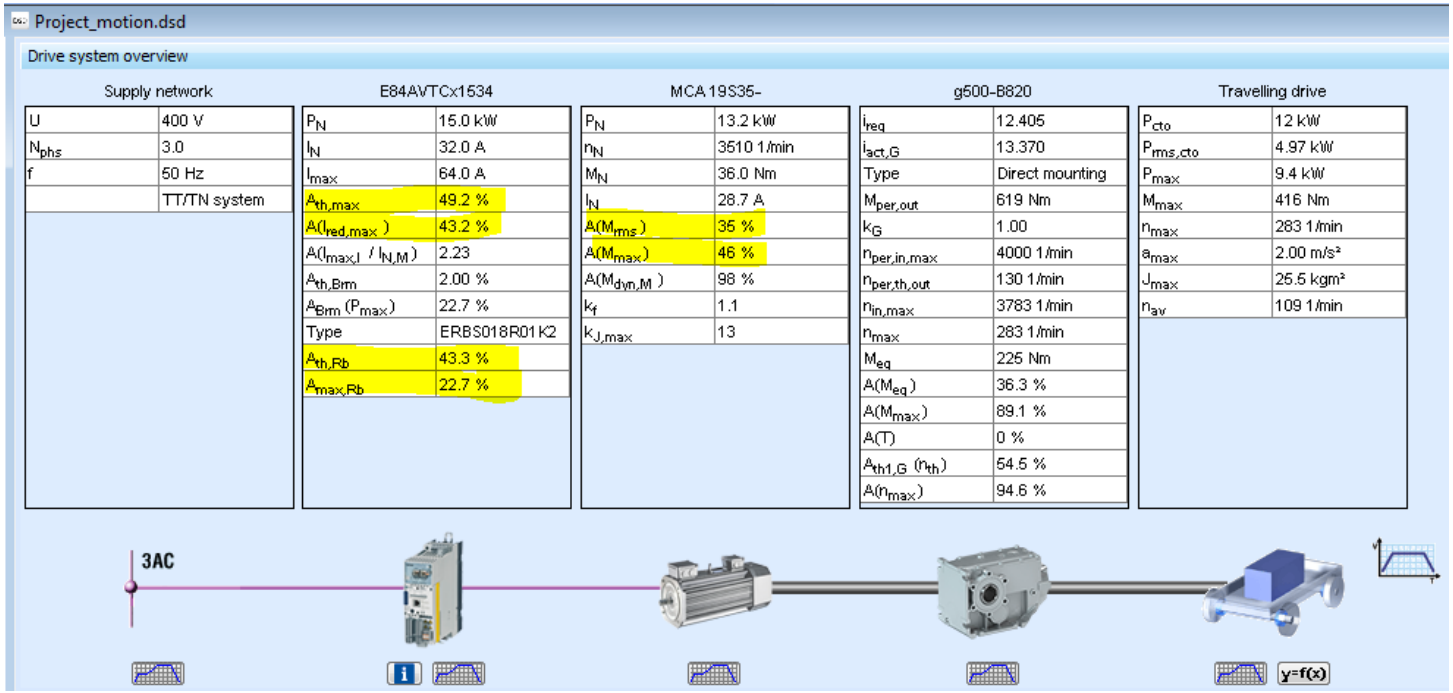


Exercise 12 – Rewinder for paper



Exercise 13 – Project evaluation 1/2

1. Result of project evaluation: Motor, inverter and brake resistor have been selected with a high reserve.



Exercise 13 – Project evaluation 2/2

Parameter	Project_motion.dsd	13b_MCA_5.2kW	13c_MF_7.5kW
Lenze gearbox			
Gearboxes	g500-B820	g500-B820	g500-B820
Actual gearbox ratio	13.37	13.37	***14.63***
Thermal utilisation of the gearbox with mineral oil.	55 %	55 %	***49 %***
Utilisation with reference to the max. Input speed.	95 %	95 %	***92 %***
Utilisation, with reference to the equivalent torque	36 %	36 %	***35 %***
Utilisation with reference to the max. Output torque.	89 %	89 %	***85 %***
Motor			
Motor group	MCA	MCA	***MFXMA***
Type designation	19S35-	***19S42-***	***100-32***
Rated power	13.2 kW	***5.20 kW***	***7.50 kW***
Rated torque	36.0 Nm	***12.0 Nm***	***20.3 Nm***
Rated speed	3510 1/min	***4150 1/min***	***3515 1/min***
Rated current	28.7 A	***14.0 A***	***15.9 A***
Field weakening factor	1.1	***0.91***	***1.2***
Utilisation with reference to the effective torque	35 %	***76 %***	***61 %***
Utilisation, maximum torque (motor, inverter)	46 %	***64 %***	***83 %***
Short-time overload	98 %	***295 %***	***157 %***
Max. load-matching factor	13	13	***18***
Inverters			
Inverter type	E84AVTCx1534	***E84AVTCx1134***	***E84AVTCx7524***
Rated inverter power	15.0 kW	***11.0 kW***	***7.50 kW***
Output current	32.0 A	***23.5 A***	***16.5 A***
Max. output current	64.0 A	***47.0 A***	***33.0 A***
Max. thermal utilisation	49.2 %	***53.2 %***	***61.6 %***
Utilisation referenced to max. current	43 %	***76 %***	***72 %***
Brake resistor			
Brake resistor type	ERBS018R01K2	***ERBS027R600W***	***ERBS027R600W***
Thermal utilisation of brake resistor	43 %	***90 %***	***92 %***
Max. utilisation of brake resistor	23 %	***34 %***	***35 %***

Exercise 14 – Hoist

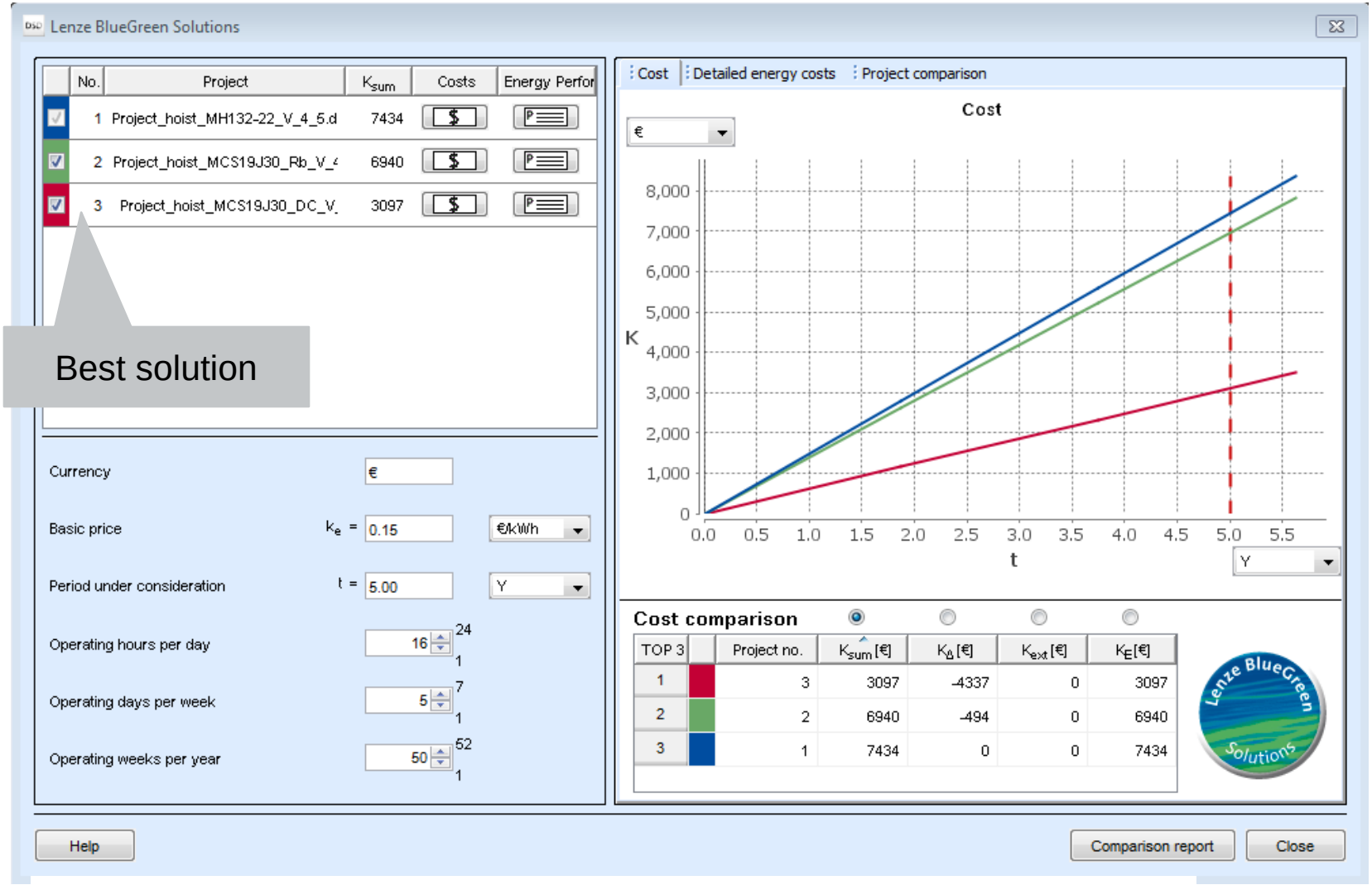
Best solution

Parameter	14a_Hoist	14b_Hoist
Application		
Application base process power	23.8 kW	23.8 kW
Max. application power	8.33 kW	8.33 kW
Lenze gearbox		
Gearboxes	g500-B2700	g500-B2700
Actual gearbox ratio	11.71	***19.54***
Motor		
Motor group	m550-P	m550-P
Type designation	P180/M4	***P160/M4***
Rated power	18.5 kW	***11.0 kW***
Rated torque	119 Nm	***71.1 Nm***
Rated speed	1483 1/min	***1478 1/min***
Rated current	33.7 A	***22.8 A***
Moment of inertia	1730 kgcm²	***770 kgcm²***
Field weakening factor	1.0	***1.7***
Utilisation with reference to the effective torque	72 %	***74 %***
Utilisation, maximum torque (motor, inverter)	76 %	***60 %***
Short-time overload	148 %	***152 %***
Max. load-matching factor	0.89	***0.72***
Inverters		
Inverter type	i550-C18/400-3	***i550-C15/400-3***
Rated inverter power	18.5 kW	***15.0 kW***
Max. thermal utilisation	67.7 %	***60.3 %***
Utilisation referenced to max. current	61 %	***49 %***

Result: Favorite is solution B with smallest drive and geared motor thanks to utilisation of field-weakening.

Lenze

Exercise 15 – Energy efficiency



Result: Favorite is solution no. 3 with synchronous motor and recovery of regenerative energy.

Lenze