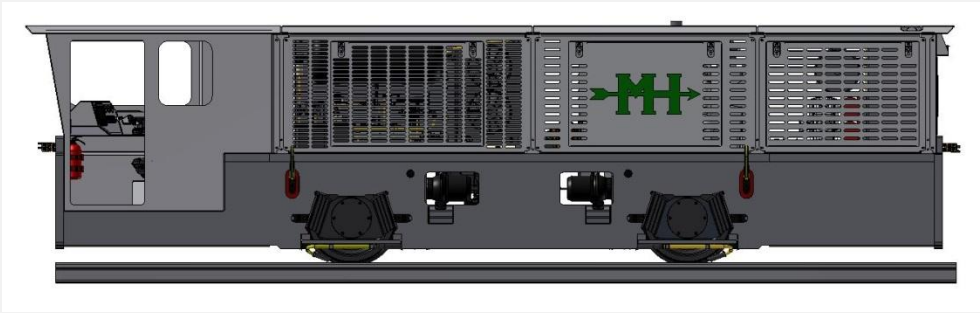
Product Training Locomotive

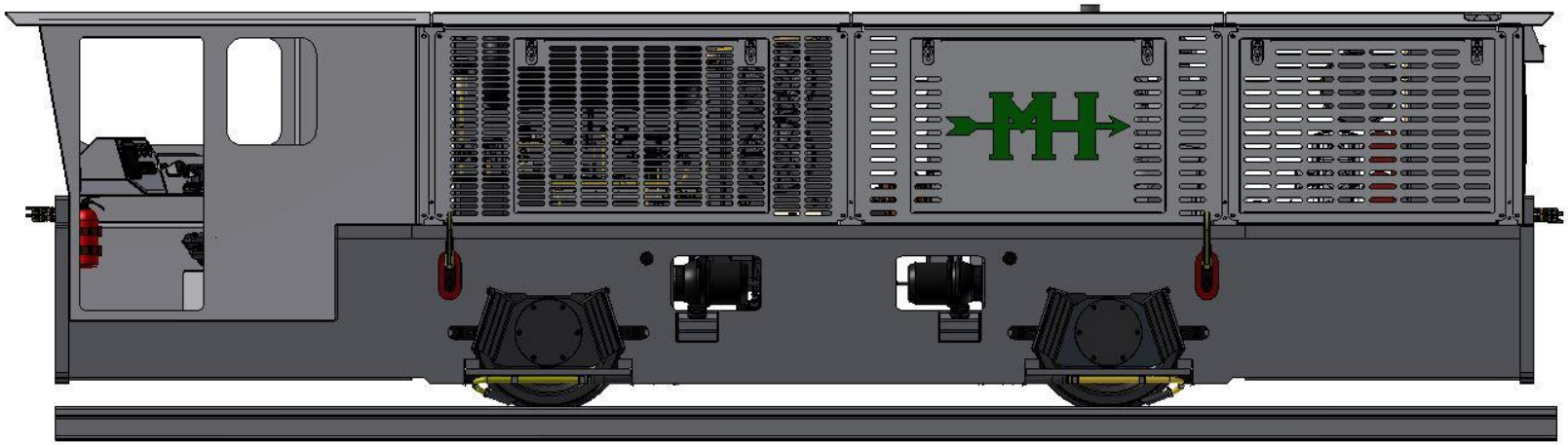
Per Ek
Morgårdshammar AB , Sweden.

LX - Locomotive

What size/weight shall we have on the locomotive ???



Small or Big

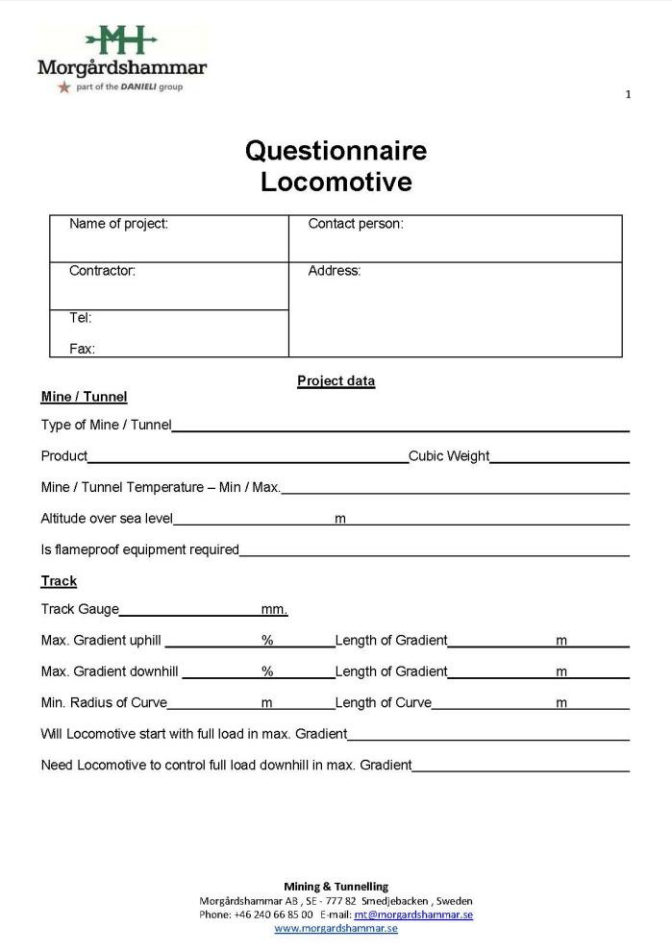


LX - Locomotive

Important to know how the locomotive shall operate.

Fill in Questionnaire

- Load ?
- Speed ?
- Up hill ?
- Down hill ?
- Friction ?
- Gradient ?



Morgårdshammar
part of the DANIELI group

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Questionnaire Locomotive

Name of project:	Contact person:
Contractor:	Address:
Tel: Fax:	

Project data

Mine / Tunnel

Type of Mine / Tunnel_____

Product_____Cubic Weight_____

Mine / Tunnel Temperature – Min / Max._____

Altitude over sea level_____m

Is flameproof equipment required_____

Track

Track Gauge_____mm.

Max. Gradient uphill _____%_____Length of Gradient_____m

Max. Gradient downhill _____%_____Length of Gradient_____m

Min. Radius of Curve_____m_____Length of Curve_____m

Will Locomotive start with full load in max. Gradient_____

Need Locomotive to control full load downhill in max. Gradient_____

Mining & Tunnelling
Morgårdshammar AB , SE - 777 82 Smedjebacken , Sweden
Phone: +46 240 66 85 00 E-mail: mt@morgardshammar.se
www.morgardshammar.se

LX - Locomotive

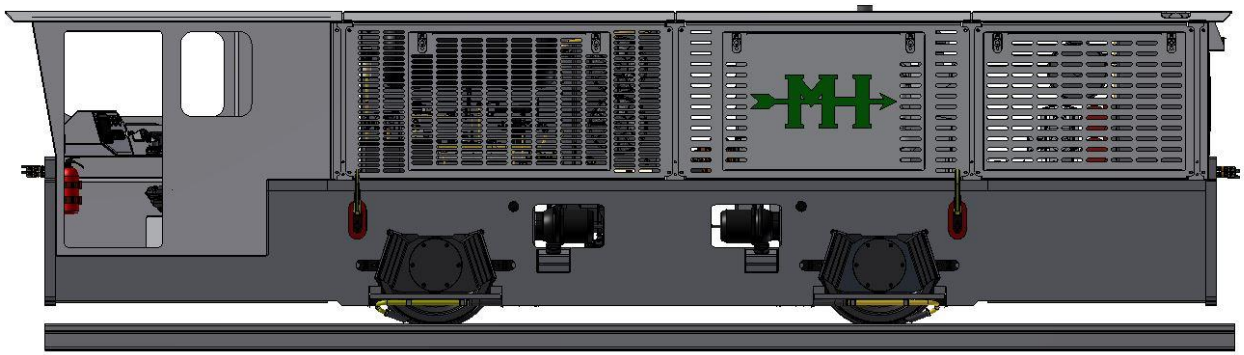
Important to know how the locomotive shall operate.

Easy to remember

In flat = **0%** gradient and friction **0,15**

One **25** ton locomotive can pull **max. 250** ton load

= the weight of locomotive x 10



250 ton

LX - Locomotive

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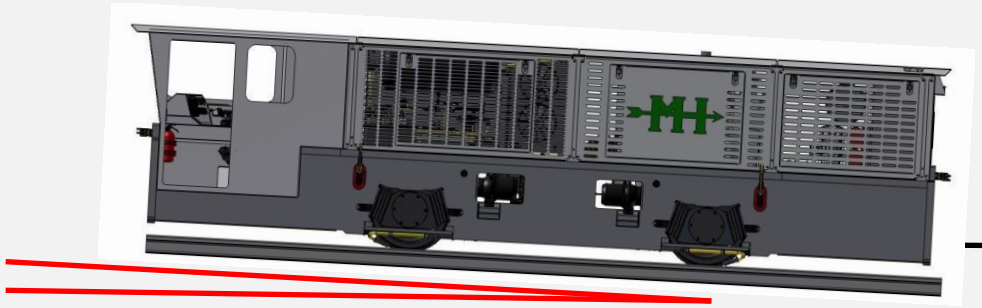
In **1%** gradient in friction **0,15** = slippery

It demands a **43** ton locomotive to pull **250** ton load (= 18 ton heavier)



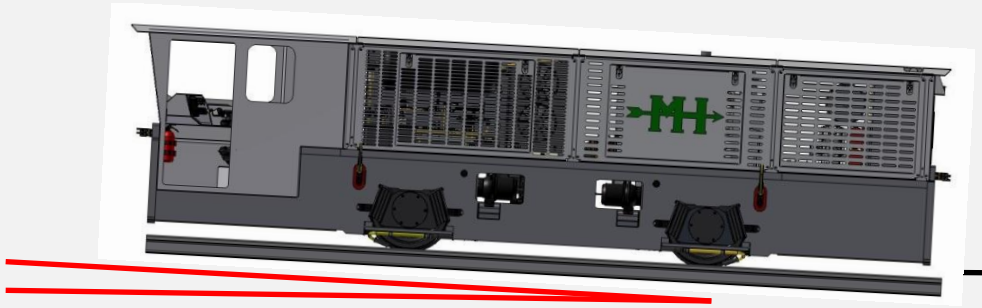
250 ton

LX - Locomotive

Important to know how the locomotive shall operate.

In **1%** gradient in friction **0,2** = slippery + using sanding device

It demands a **31** ton locomotive to pull **250** ton load (= **6** ton heavier)

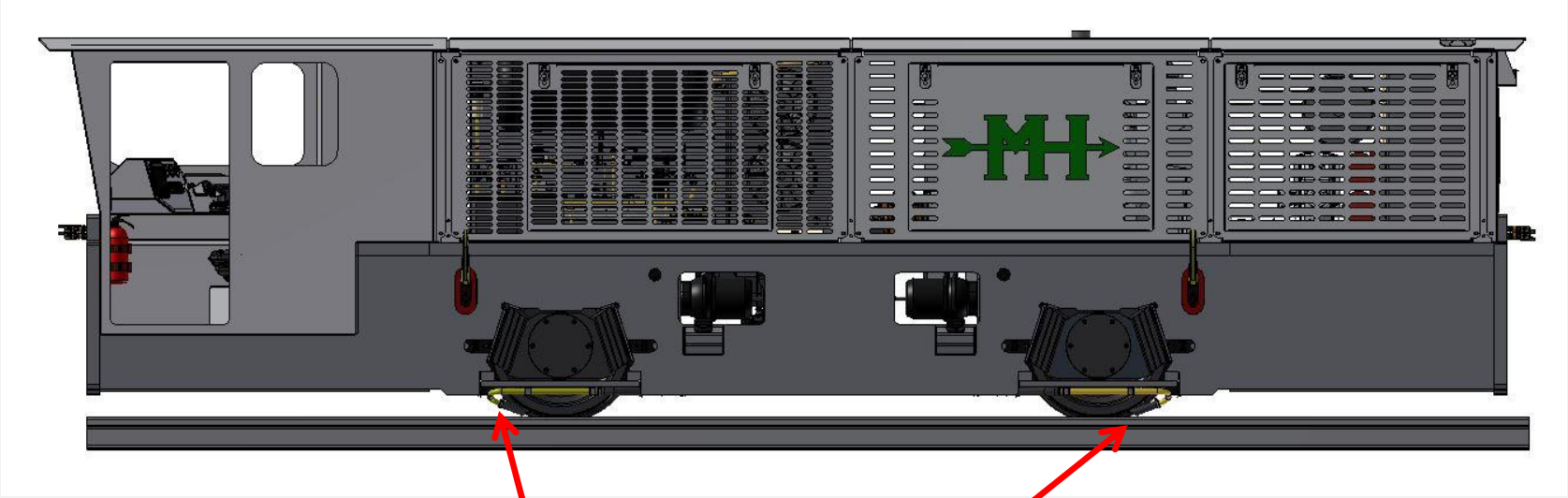


250 ton

LX - Locomotive

Sanding device

Controlled/activated by button integrated in joystick.



LX - Locomotive

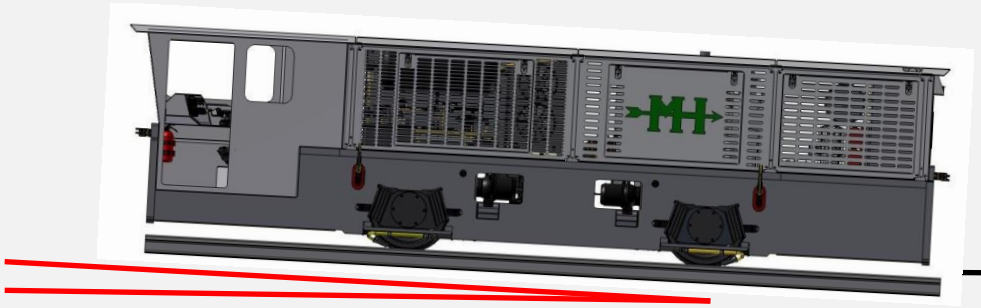
Important to know how the locomotive shall operate.

In **1%** gradient in friction **0,2** = slippery + using sanding device

In **1%** gradient in friction **0,15** = slippery

It demands a **31** ton locomotive to pull **250** ton load (25 + 6 ton)

It demands a **43** ton locomotive to pull **250** ton load (25 + 18 ton)



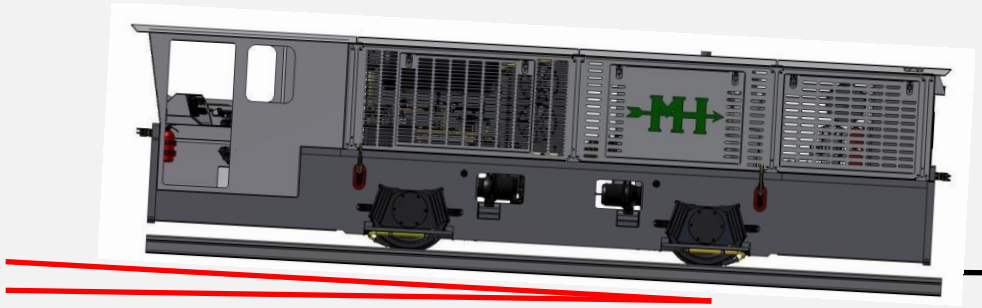
250 ton

LX - Locomotive

Important to know how the locomotive shall operate.

One **25** ton locomotive can pull in different gradient (%)

Friction = **0,15**



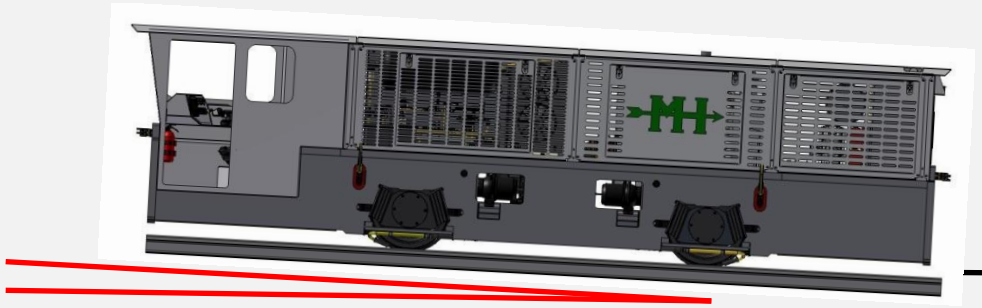
1,5	= 114
1,0	= 145
0,5	= 195
0	= 288

LX - Locomotive

Important to know how the locomotive shall operate.

One **25** ton locomotive can pull in different gradient (%)

Friction = **0,2** (by using sanding device)

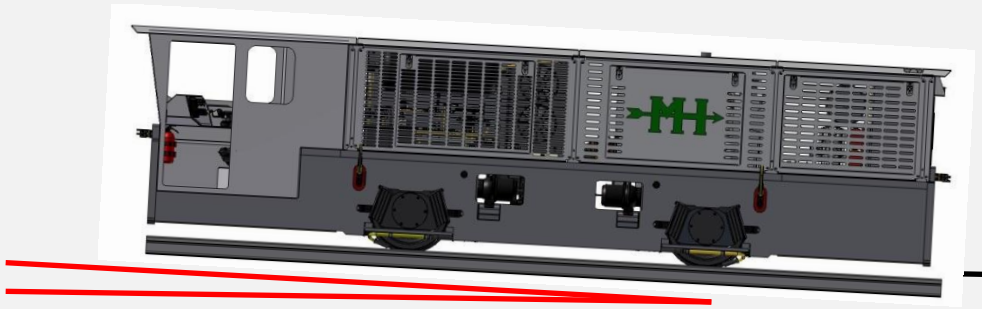


1,5 = 160
1,0 = 202
0,5 = 269
0 = 392

LX - Locomotive

Important to know how the locomotive shall operate.

One **25** ton locomotive can pull in different gradient (%)



0,15 - Friction - 0,2

1,5 = 114	1,5 = 160
1,0 = 145	1,0 = 202
0,5 = 195	0,5 = 269
0 = 288	0 = 392

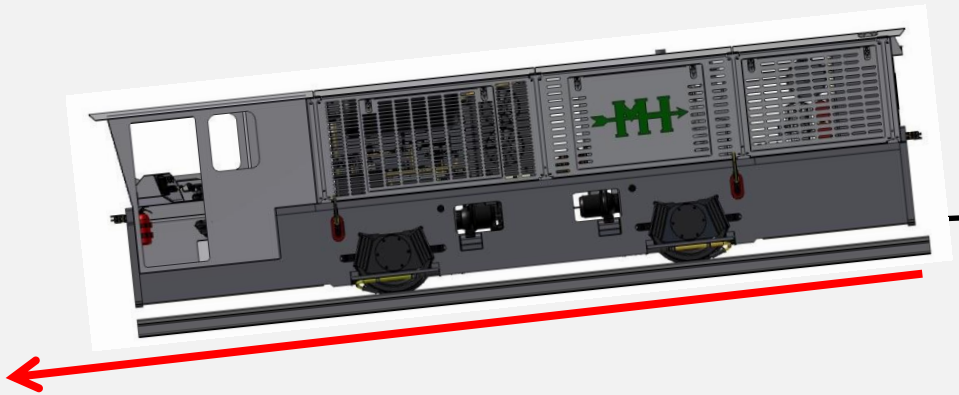
LX - Locomotive

Important to know how the locomotive shall operate.

For down hill operation it's even more important to know the conditions

25 ton in speed 10 km/h with Friction = **0,15**

Load / Gradient = brake distance in meter



288 / 2,0 = 600
288 / 1,5 = 90
288 / 1,0 = 42
288 / 0,5 = 27
288 / 0 = 20

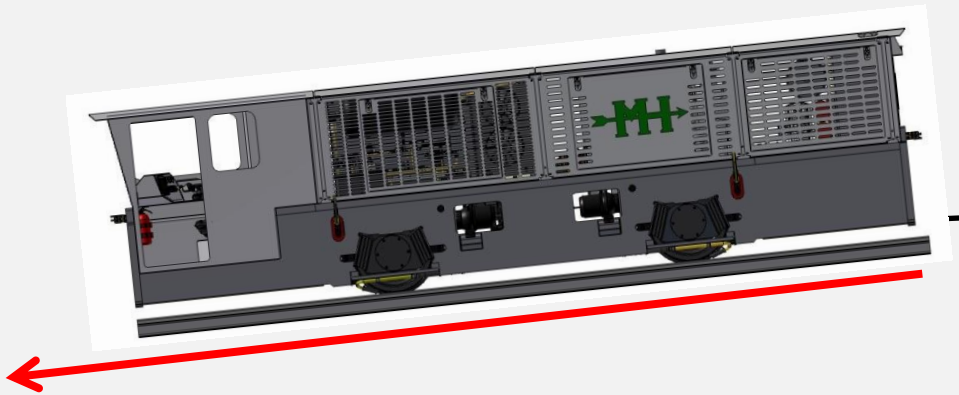
LX - Locomotive

Important to know how the locomotive shall operate.

For down hill operation it even more important to know the conditions

25 ton in speed 10 km/h with Friction = **0,2** (sanding)

Load / Gradient = brake distance in meter



288 / 2,0 = 118
288 / 1,5 = 47
288 / 1,0 = 30
288 / 0,5 = 21
288 / 0 = 17

LX - Locomotive

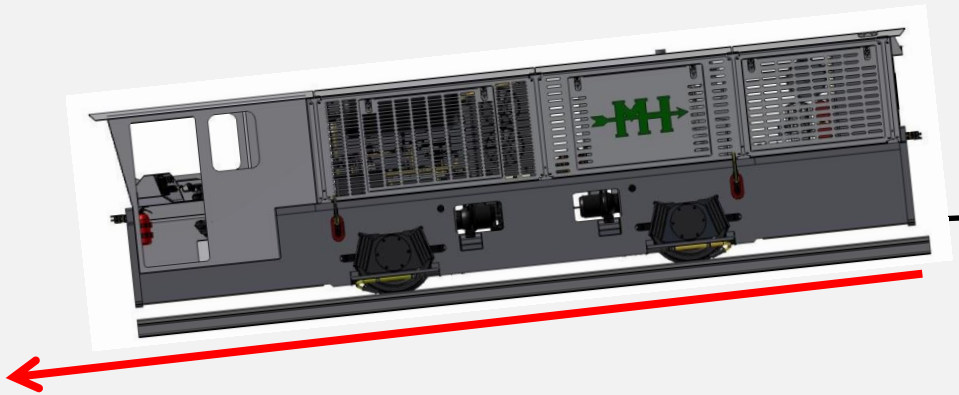
Important to know how the locomotive shall operate.

To shorter the brake distance can wagon brakes be used

Brakes on locomotive and all wagons

25 + 288 = 313 ton braking weight

Load / Gradient = brake distance in meter



288 / 2,0 = 3
288 / 1,5 = 2,9
288 / 1,0 = 2,8
288 / 0,5 = 2,7
288 / 0 = 2,6

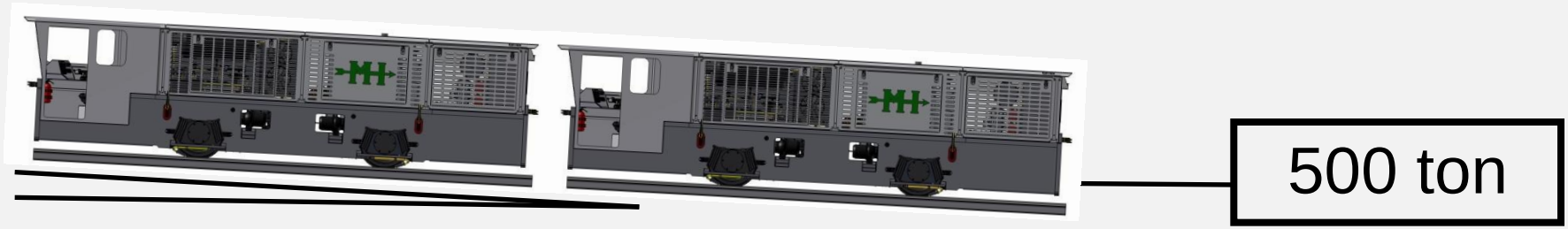
LX - Locomotive

Important to know how the locomotive shall operate.

Tandem operation

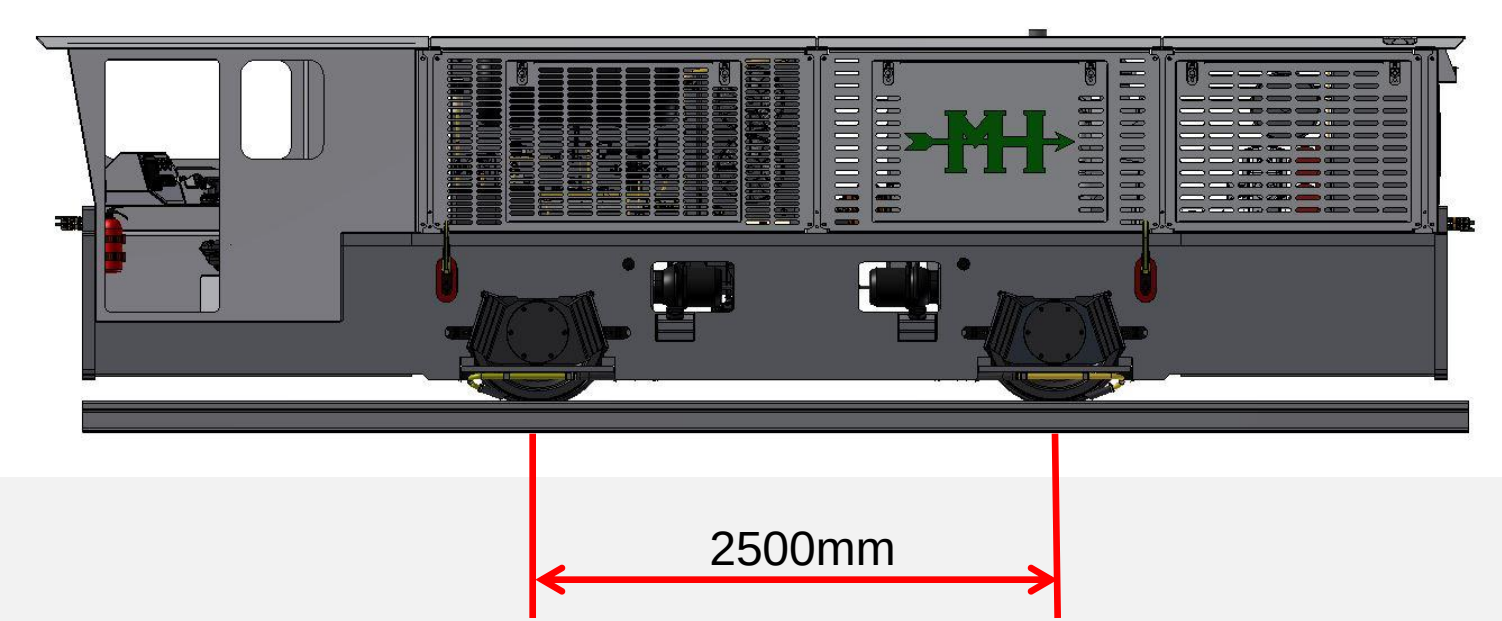
In **1%** gradient in friction **0,15** = slippery

It demands a **86** ton locomotive to pull **500** ton load or **2 x 43** ton



LX - Locomotive

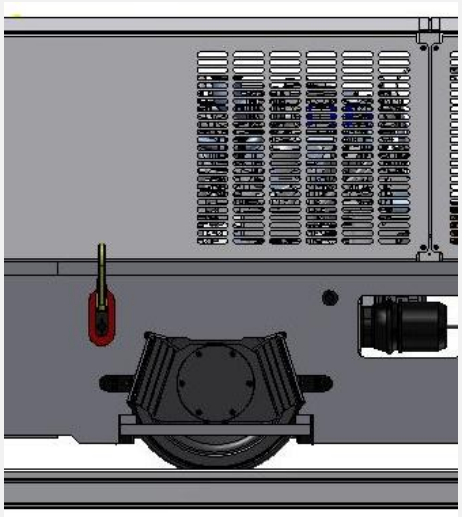
What is the curve radius of the loco ??



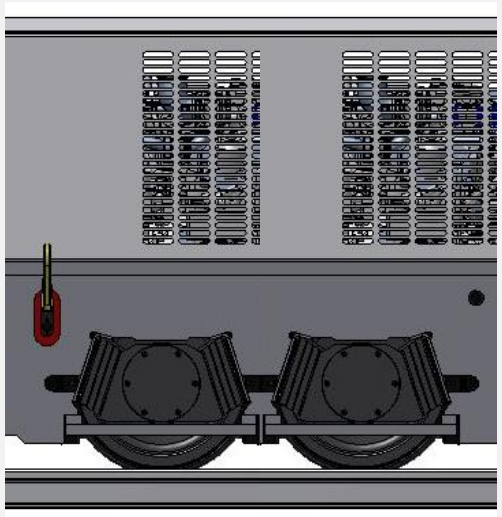
The distance between the axles x 10, eg. LX 25 = 2500mm between the axles = min. 25 m curve radius.

LX - Locomotive

Maximum axle pressure wheel to rail



25 ton for a single axle



50 ton for a boogie axle

LX - Locomotive

To make the right choice of locomotive calculation is needed

Input from Questionnaire

- Total load incl. wagons
- (rolling resistance)
- Gradient up/down
- Friction *
- Wish of speed

* Two ways of friction

Traditionella indata			
Acceleration of gravity			
General curves resistance coefficient			
Locomotive/adhesion wheigt	Tl	40	[ton]
Wheigt of undriven cars (empty)	Tc	0	[ton]
Loading weight	Tp	100	[ton]
Braking weight		0	
Coeff. roll resistance (train+track)	Rr	8	[kp/ton]
Inclination gradient (neg=downhill)	gt	3,2	[%]
Gauge	Gr	0	[mm]
Axel distance	Wb	0	[mm]
Curve radius	Cr	25	[m]
Friction coefficient (wheel-rail)	k	0,15	[-]
Desired operation speed	V	8	[km/h]
Engine efficiency	eta	0,7	[-]

Rail condition	Not sanded	Sanded
Most favourable	0,33	0,37
Clean dry	0,25	0,3
Dry	0,2	0,24
Slippery	0,15	0,2
Dry snow covered	0,11	0,15

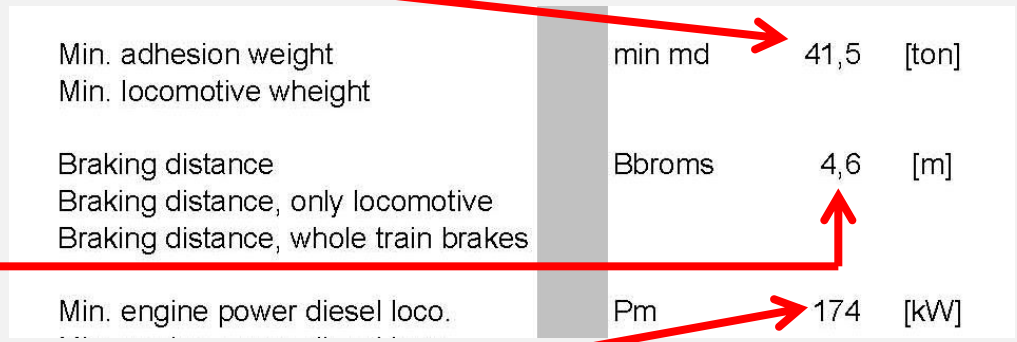
LX - Locomotive

The program tells us

Minimum weight of locomotive

Brake distance from operation speed

Minimum engine power



Min. adhesion weight Min. locomotive wheight	min md	41,5	[ton]
Braking distance Braking distance, only locomotive Braking distance, whole train brakes	Bbroms	4,6	[m]
Min. engine power diesel loco.	Pm	174	[kW]

LX - Locomotive

Calculation is ready and sent to customer and discussions starts.

Acceleration of gravity	g	9,81	[m/(s^2)]
General curves resistance coefficient	kk0	0,1429	[-]
Locomotive/adhesion wheigt	md	40000	[kg]
Wheigt of undriven cars (empty)	mv	0	[kg]
Loading weight	ml	100000	[kg]
Braking weight	mbroms	15000	[kg]
Coeff. roll resistance (train+track)	kr	0,008	[-]
Inclination gradient (neg=downhill)	lambda	0,032	[-]
Gauge	ls	0	[m]
Axel distance	lh	0	[m]
Curve radius	R	25	[m]
Friction coefficient (wheel-rail)	my	0,15	[-]
Desired operation speed	vgång	2,22	m/s
Engine efficiency	eta	0,7	[-]
Traction due to roll resistance	Fr	1120	[kp]
Traction due to inclination	Fg	4480	[kp]
Traction due to curve resistance	Fc	0	[kp]
Traction at start	Fstart	6160	[kp]
Traction during operation	Fgång	5600	[kp]
Brake power			
Brake power, only locomotive			
Brake power, the whole train brakes			
Min. adhesion weight	min md	41,5	[ton]
Min. locomotive wheight			
Braking distance	Bbroms	4,6	[m]
Braking distance, only locomotive			
Braking distance, whole train brakes			
Min. engine power diesel loco.	Pm	174	[kW]
Min. engine power diesel loco.			
Min. engine power diesel loco.			
Min. engine power electric loco.			
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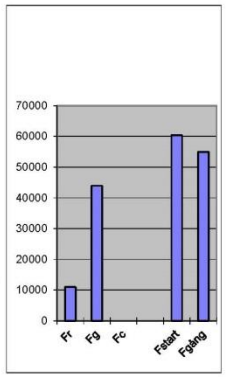

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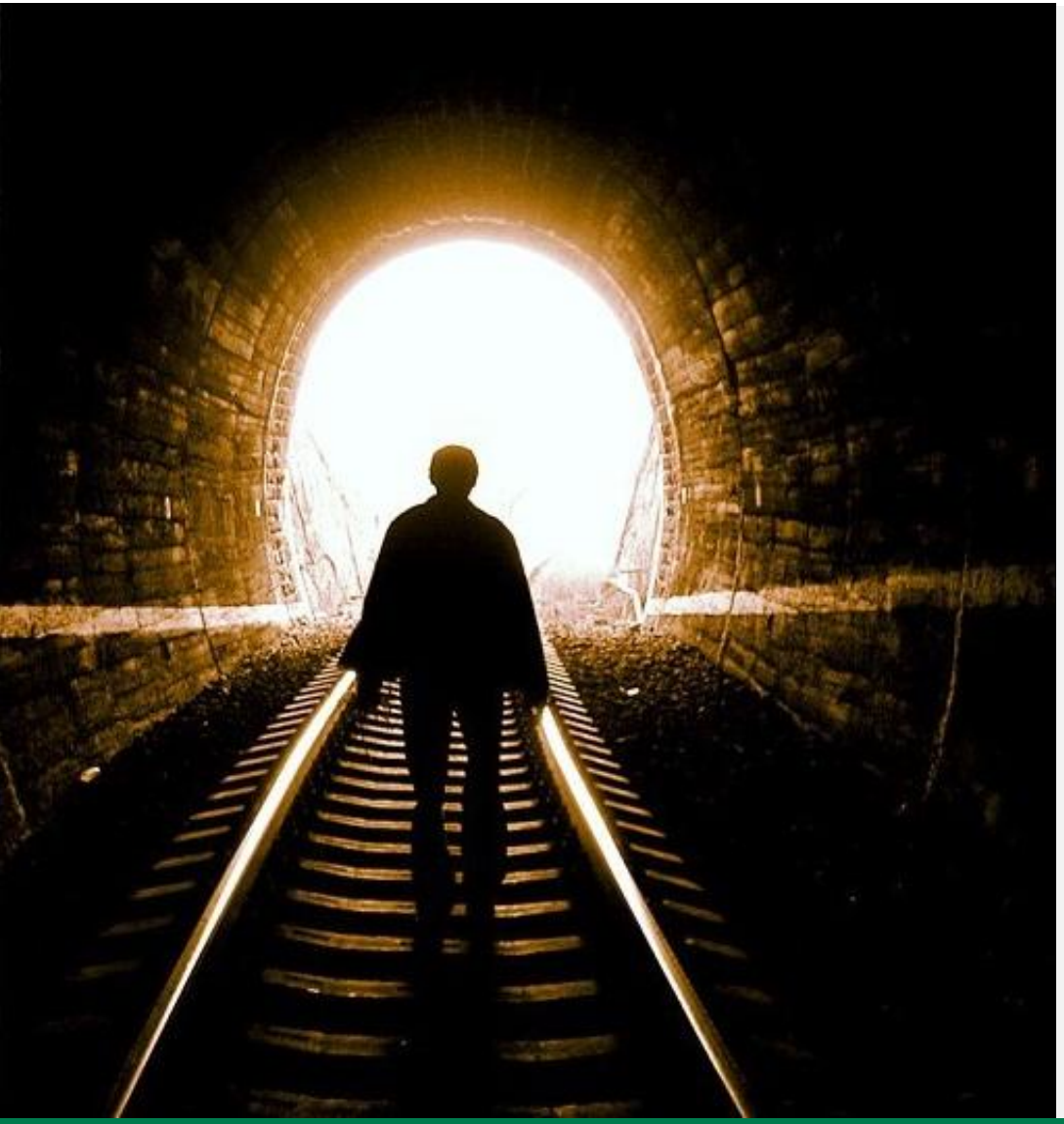

Thank You