TRAILER CONSULTATION

+358 - 6 - 831 9905 +358 - 6 - 831 1008

Kauppatori 2 FIN - 67100 Kokkola FINLAND www.trailerwin.com

E-mail: info@trailerwin.com

Tel

Fax

FrameWIN Subframe Calculation



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FrameWIN : Starting the computer software

Using with TrailerWIN computer software

Subframe calculating computer software **FrameWIN** is designed for to be in use with the **TrailerWIN-**software.





Vehicle measuring, the weight calculation, the crane choosing and the crane mounting in the vehicle are made first by using **TrailerWIN**.

By choosing Menu: **Special - FrameWIN** from the TrailerWIN menu you can go to subframe calculating software FrameWIN.

When you start FrameWIN it will automatically read the crane data from the last made TrailerWIN calculation and it will do the first calculations by using this data as loading moment.

Frame Beam Profile and Subframe Beam Profile you have to choose manually. The software does not know, which is the correct profile for various chassis.

Start the FrameWIN from Windows icon





You can also start the **FrameWIN** from the **Windows Program Manager** by choosing the **FrameWIN**-icon.

Also in this case the software first reads and shows the data from <u>the previous TrailerWIN-calculation</u>. If you want to use some other calculation, you can change the data of that previous calculation.

The FrameWIN Screen

On the screen you will find the Basic Data, Data of Loading (Moment), Data of Material, Calculating results: Stress and Safety Factor, Details of Profiles (Dimensions and Cross Area Values) and Calculated Cross Area Values for Combined Beam (Chassis Frame + Subframe Profiles). Picture when using Basic FrameWIN System calculation method. For more information about calculation systems see Dynamic Loading Factor and Calculation system on page 32.



Loading Data

Loading Data is taken from the last TrailerWIN Calculation (Calculation with Crane) or you have edited the data.

Moment : (Max load at max outreach)	4350kg x 7,5m x g =	320	kNm
Moment : (Crane own weight)	3020kg x 1,565m x g =	46	kNm
M dyn = 366416 Nm * 1.30 = 476341 Nm			

You can edit loading data selecting Menu: Edit - Moment, or selecting Toolbar Button: Moment.

Material Data

Material:	Subframe	Fe52	Re = 355 N/mm2
Material:	Chassis Frame	Fe52	Re = 355 N/mm2

Re = Yield strength in N/mm2

You can edit Material data selecting Menu: Edit - Material.

You can choose different steel qualities for Subframe and for Chassis frame.

Notice that both Subframe Profiles and Chassis Frame Profiles must be same material. For example if Subframe Profile is steel should Chassis Frame Profile be steel as well (or if Subframe Profile is aluminium should Chassis Frame Profile be aluminium also etc). The Program cannot calculate combination with Materials with different E-values (E=modulus of elasticity).

Stress Data

	Flexible mounting	Shear resisting mounting
	[A]	(B) <mark>- 8-8-</mark>
Stress on subframe N/mm2	151	705 Upper flange
Stress on subframe N/mm2	151	-468 Lower flange
Stress on chassis frame N/mm2	679	602
Static Safety factor n Stat	0,52	0,5
Dynamic Safety factor in dyn	0,4	0,38

FrameWIN calculates stress using two different methods: Combined beam data with Flexible mounting [A] and Combined beam data with mounting with shear resisting plates [B]. The Method of calculating is explained in the <u>Appendix SUBFRAME CALCULATION</u>.

Profile Data

The table shows Cross Area Data of all the chosen profiles:

	Profile	Hmm	A mm2	lx cm4	Wx cm3	M kg/m
1	U 60x40x3	60	402	23.45	7.82	3.2
	Chassis Frame					
0	FODEN 2000R 270 x 92 x 8.0	270	3504	3619.36	268.10	27.5
=>	Frame + Subframe	330	3906			30.7
	[A] Flexible mounted			3642.80	269.84	
	[B] Stiff with shear resisting plates			4624.61	259.78	
The	se Cross section dimensions are given f	or one bea	am:			

Height	Н	(mm)
Cross section area	А	(mm ²)
Second moment of area	lx	(cm ⁴)
Section modulus	Wx	(cm ³)
Beam weight / meter	G	(kg/m)

Two last rows show the I_x and W_x for combined beam, [A] Flexible mounting and [B] Shear resisting mounting.

Toolbar	
FrameWIN 2004-01 D:\\B	5\TrW2000\FrWData\ERF model2
File Edit Picture Options H	elp
🖙 🖬 🥌 Open Save As Prir	Moment Subframe Dynamic co Draw Text End
Combined Subfra	me 01
Task name	Coordinate Window
	Safety factor warning limit Subframe/Chassis
	Dynamic factor
Toolbar buttons:	
~ п	
Deen Save As	
open Jave As	Open, Save or Print Calculation
Moment	The Data of Loading Moments: Crane Load and Outreach
Subframe	Choosing the Subframe Profiles
n _/// Dynamic co	Set values for Dynamic Coefficient and Safety Factor warning limit and choose calculation method
Draw	Draw objects: line, rectangle, etc.
Text	Draw Text
X End	Exit FrameWIN

Buttons on FrameWIN program userinterface



Choosing and Editing the Subframe Profiles

Click the Subframe-button or select the menu EDIT - SUBFRAME or CHASSIS FRAME.



Subframe					_	₽ ×
File Edit Picture						
Add Profile	Side plate		-594, 257	Cancel	<	
1: U 60x40x3 L U · beam 1 U · beam Product Wx = 8cm3 G = 3.2kg/m U 60x40x3 Product Wx = 8cm3 G = 3.2kg/m U 60x40x3 Product Y = 0 Coor y = 0 Coor Fe52: ReL = 355 N/mm2 Chassis Frame FODEN FODEN 2000R 270 x 92 x Fe52: ReL = 355 N/mm2	ist of profiles	Refree Subfr Chassis Fal Ma	-× sh Picture rame Material		 ■ 30 ■	

Choosing the Subframe Profile

You can change the profile shape by choosing shape from the Profile Shape List. Choosing the shape changes profile list in Profile Size List.



When the shape is correct, you can choose Profile Size from the Profile Size List.

Add Profile

For adding a profile, click the Add Profile button or use Menu:Edit - Add Profile.

You will get a new profile number (2) on the List of Profiles on the top of the screen.

Choose profile Shape from the Profile Shape List. Take for example a Rectangular Hollow Section (horizontal)

Subframe					_	₽ ×
Add Profile	Side plate		-694,-118	Cancel	ОК	
1: U 100×80×6 2: U - beam U - beam Rectangul Rectangul I - Beam I - Beam F Side plate F Plate horiz F Plate vertii Fe52: ReL = 355 N/	List of profi 2: lar hollow section (vertical) lar hollow section (horisontal) low section iontal cal mm2	-X				

As next step you have to choose the Profile Size from the Profile Size List.

💐 Subframe							8×
File Edit Picture							
Add Profile	Side plate		-699,-28		Cancel	ОК	
1: U 100x80x6 2: 120x60x5 List Rectangular hollow section (horis) 120x60x5 120x60x5 120x60x5 120x60x5 120x60x5 120x80x4 120x80x5 120x80x4 120x80x5 120x80x6.3 120x80x8 150x100x4 150x100x5 × = 0 y = 100 Fe52: ReL = 355 N/mm2 Chassis Frame FODEN FODEN 2000R 270 x 92 x 8.0	of profiles	- X	Consultation	+ Y		67.3 92.7 + X 	5
rep2 : ReL = 300 N/mm2		r rame	001N 2001-08	02/10/01 8:13)		

Add a horizontal plate as the top of the subframe.

For adding a profile, click the **Add Profile** button or use **Menu:Edit - Add Profile**. You will get a new profile number (3) on the List of Profiles on the top of the screen. Choose profile Shape from the Profile Shape List, now **"Plate horizontal"**.



Then choose the size of the plate from the Profile Size List.



Add the Side Plate

For adding a profile, click **Side Plate** Button or use **Menu:Edit - Add Side Plate**. You will get a new profile number (4) on the Profile list on the top of the screen. The Profile Shape List shows **"Side Plate"**.

Choose the size of the Side Plate from the Profile Size List.

If you do not find suitable plate size from the list you can type the dimensions to "Height" and "Width" textboxes (Look at the picture).

You can locate the side plate by typing the x- and y-coordinates in "Coordinates for the plate" textboxes.

The coordinates mean the lower left corner of the cross area of the plate or profile.

After typing the coordinates x and y click small OK button (Refresh picture) to get the picture redrawn.

File Edit Picture Add Profile Side plate -700, 222 Cancel OK 1: U 100x80x6 Profile List 0K 0K 0K 2: 120x60x5 Profile List 0K 0K 0K 3: 8x200 4: 8x150 0K 0K 0K Side plate 0K 0K 0K 0K Side plate 0K 0K 0K 0K Wx = 30cm3 G = 9.4kg/m 0K × 80 0K 0K × 400 Vx = 30cm3 G = 9.4kg/m 0K × 80 0K × 400 0K × 400 Vx = 30cm3 G = 9.4kg/m 0K × 80 0K × 400 0K × 400 0K × 400 Vx = 30cm3 G = 9.4kg/m 0K × 80 0K × 400
Add Profile Side plate -700, 222 Cancel OK 1: U 100x80x66 2: 120x80x55 3: 9x200 4: 8x150 4: 8x150 Side plate 4: 8x150 (x = 30cm3 G = 9.4kg/m) (x = 30cm3 G = 9.4kg
1: U 100x80x6 2: 120x60x5 3: 8x200 4: 8x150 Side plate 9x150 Wx = 30cm3 G = 9.4kg/m 9x150 Height and Width of the Plate x = -8 y = -270 Coordinates for the Plate FDDEN 2000R 270 x 92 x 8.0 Faller Consultation Faller Consultati
FrameWIN 2001-08 02/10/01 8:19

Add the Plate under Chassis Frame

For adding a profile, click the **Add Profile button** or use **Menu:Edit - Add Profile**. You will get a new profile number (5) on the Profile list. Choose profile Shape from the Profile Shape List, now **"Plate horizontal"**.

Choose the size of the Plate from the Profile Size List. If you do not find suitable plate size from the list you can type the dimensions to "Height" and "Width" textboxes (Look at the picture).

You can locate the side plate by typing the x- and y-coordinates in "Coordinates for the plate" textboxes.

The coordinates mean the lower left corner of the cross area of the plate or profile.

After typing the coordinates x and y click small OK button (Refresh picture) to get the picture redrawn.

🥞 Subframe					_	₽ ×
File Edit Picture						
Add Profile	Side plate		-530,-258	Cancel	OK	
2 : 120x60x5 3 : 8x200 4 : 8x150 5 : 8x120 Plate horizontal 8x120 Wx = 1cm3 G = 7.5kg/m 8x120 Wx = 1cm3 G = 7.5kg/m 8x120 Chassis Frame FODEN FODEN 2000R 270 x 92 x Fe52 : ReL = 355 N/mm2	Profile List	e Plate Refresh pin plate) Traile Frame	430 cture	+ Y 200 + 5 120 + 6 100 6 100 6 100 100 100 100 1		

Edit the Dimensions of the Profile

You can edit the dimensions of the profiles manually if you do not find any profile with suitable dimensions from the profile list.

Follow the instructions to edit the dimensions manually:

Step 1. Choose from the Profile List the profile, which you want to edit.

Step 2. Choose from Menu: Edit - Edit Profile

Subframe						_ 8 ×
File Edit Picture						
Edit Profil Edit: Chassis Frame	Side plate		-673,-319	Cancel	ОК	
Add Profile 2: 3: Delete profile 4: 8x150	1.	Choose from the profile, v	the Profile I which you wa	List ant to edit 20	1 ⁸	_
1 : U 10 U · beam	0x80x6 2.	Choose fron Edit - Edit P	1 Menu : rofile			197
Wx = 49cm3 G = 11.7kg/m U 100x80x6 x = 0 y = 0 Fe52 : ReL = 355 N/mm2	 ♪		430	• - • ⁸ 270		249
Chassis Frame FODEN FODEN 2000R 270 x 92 x 8.0 Fe52 : ReL = 355 N/mm2	× × >	Traile Fram	r Consultation 1	92 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 120 1		

You get Profile Editing Window on the screen.



You get a picture of a profile cross-area shape. You can edit dimension of the cross area by typing new dimensions on the textboxes. After the dimensions have been given, click the small OK-button on the picture, and the program redraws the cross area with new dimension values.

Furthermore on the right side on the picture are the dimension s1 and s2 (mm), that show the Centroid of the cross area.

To give a name for the edited profile, type the new name, or use **Name Automatic**. Click the Check Box **Name Automatic** for turning automatic on or off.

Frame\	II WIN 2004-0	1			
File Edit I	Picture Optio	ns Help			
0 Øpen	Save As	Print	Moment	Subframe	n_M_ Dynamic co
			/		

Add subframe profiles

Changing and adding in subframe profile

From subframe menu You can add more profiles on subframe or add a sideplate on subframe.

You can choose shape of profile, measures for height, width & length and material and give exact coordinates for each added new profile

All added profiles will be taken into consideration in FrameWIN stress and safety factor calculation.

Calculation are made for fixed mounting and for flexible mounting.

Safety factors are calculated for dynamic coefficients and for static coefficients.

Subframe File Edit Picture

Ad	ld Profile	Sid	le plate
1 : U 60x40	Dx3		
		11.00-40-0	
	1:	U 60X40X3	
	,		
U - beam			L
U 60x40x3			•
Wx = 8cm3	G = 3.2kg/m		
Wx = 8cm3	G = 3.2kg/m		
Wx = 8cm3	G = 3.2kg/m Dx3		
Wx = 8cm3 U 60x40 x = Tr	G = 3.2kg/m		
Wx = 8cm3	G = 3.2kg/m 0x3		04.
Wx = 8cm3 U 60x40 x = [0 y = [0	G = 3.2kg/m		<u> </u>
Wx = 8cm3	G = 3.2kg/m		X>
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL	G = 3.2kg/m 0x3) = 355 N/mm2		_OK>
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra	G = 3.2kg/m 0x3) = 355 N/mm2 me		OK >
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT	G = 3.2kg/m Dx3 = 355 N/mm2 me		
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT	G = 3.2kg/m		_OK >
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT RENAULT	G = 3.2kg/m 0x3) = 355 N/mm2 me Mascott 152x56		OK>
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT RENAULT	G = 3.2kg/m Dx3 = 355 N/mm2 me Mascott 152x56		
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT RENAULT	G = 3.2kg/m 0x3 = 355 N/mm2 me Mascott 152x56)x5	OK >
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT RENAULT	G = 3.2kg/m Dx3 = 355 N/mm2 me Mascott 152x56	×5	
Wx = 8cm3 U 60x40 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT RENAULT	G = 3.2kg/m 0x3 = 355 N/mm2 me Mascott 152x56	×5	OK >
Wx = 8cm3 U 60x41 x = [0 y = [0 Fe52 : ReL Chassis Fra RENAULT RENAULT ancel	G = 3.2kg/m 0x3 = 355 N/mm2 me Mascott 152x56	×5	OK >



You can choose shape of profile for each added new profile. List of profile types include:

- 1. U beam
- 2. Rectangular hollow section (vertical)
- 3. Rectangular hollow section (Horizontal)
- 4. Square hollow section
- 5. I beam
- 6. Side plate
- 7. Plate Horizontal
- 8. Plate vertical
- 9. Double I
- 10. Double U (version 1)
- 11. Double U (version2)

List of materials in FrameWIN include: Fe52 (*default material*), Fe510, St52, Gr50, S690, S420, Fe E 420, Fe E490, Fe 44, Fe430, St44, Gr43, Fe37, Fe360, St37, Gr40

You can also give own material and yield strength for the material, but it will not saved into program. Next time You want to use same material, You will need to give yield strength values again.

All materials in chassis frame, subframe and added subframe profiles must be steel. All must have same *elastic modulus* value. FrameWIN can not calculate correctly if *elastic modulus* is different for different parts. (for example steel and aluminium).

				Cano
-	Subframe			
	Fe52		-	
		E E 0		
	Material	Fe52		
	Yield strength minimum Re N/m	nm2	355	
_	Yield strength minimum Re N/n	nm2	355	
_	Yield strength minimum Re N/m	nm2	355	
_	Yield strength minimum Re N/m Chassis Frame	nm2	355	
_	Yield strength minimum Re N/m Chassis Frame Fe52	nm2	355	0
_	Yield strength minimum Re N/m Chassis Frame Fe52	nm2	355	O
_	Yield strength minimum Re N/m Chassis Frame Fe52 Material	nm2 Fe52	¥	0
_	Yield strength minimum Re N/m Chassis Frame Fe52 Material	nm2	¥	0

File	Edit	Picture		
	A	dd Profile	Side plate	
1	: U 60x	40x3		
	Γ	1:	U 60x40x3	
	- beam			-
Γ	L	U - beam		
		Rectangular hollo	w section (vertical)	
		Rectangular hollo	w section (horisontal)	
		Square hollow see	ction	
	Ι	I - Beam		
JF.		Side plate		
		Plate horizontal		
		Plate vertical		
	\square	Double I		
		double U		
		double U		•

Delete Profile

To delete profiles do as follows:

Step 1. Choose from the **Profile List** the profile, which you want to delete.

Step 2. Choose from Menu: Edit - Delete Profile

Subframe								
File Edit Picture								
Edit Profil Edit: Chassis Frame	Side plate			-177, 279	Can		OK	
2: 3: 4: Delete profile		1.	Choose for the profil	rom the Pro e, which y	ofile List ou want to del	lete		_
10.00120					۲۷ 	311	• l°	
5:8	×120	2.	Choose t Edit - De	from Menu lete Profile			<u></u>]	
Plate horizontal	Ū							194.7 19
100120						4 ² 9 ⁴		
Wx = 1cm3 G = 7.5kg/m				400				
8×120 ×= -8	× 120							
y = -278	<u> </u>				5 a²	210		z
JF602 : HeL = 300 N/MM2	>							
- Chassis Frame FODEN	_				• <u> </u>	l+° .		
FODEN 2000R 270 x 92 x 8.0	•				5 <mark>3</mark> -0 120			
Fe52 : ReL = 355 N/mm2	>		Finder Core	falon 6 av. 1 252 8 2	-*			

After that confirm the deleting by clicking Yes. If you want to cancel the deleting click No.



Chassis frame



On the left - lower corner on the Subframe Window you find Lists for Chassis Frame:

You can choose **Chassis Fabricate** and then the **Profile Size**.

Notice that choosing of the Profile Size comes not automatically from TrailerWIN. Chassis database in TrailerWIN does not include data of frame profiles. You have to choose manually the correct profile size.

From the upper list box you can choose the truck make. The program knows the frame profiles of the trucks on the list.

If you do not find the wanted truck make from the list, or wanted profile size from the lower list, you can edit the beam dimensions manually. For this editing dimensions for Chassis Frame; use Menu: **Edit - Edit:Chassis Frame** (menu in Subframe Window)

Γ	Chassis Frame	
	FODEN	•
	SCANIA	
	VOLVO	
	TERBERG IFBF	
	FODEN	

- Chassis Frame FODEN	•
FODEN 2000R 270 x 92 x 8.0	•
Fe52 : ReL = 355 N/mm2	<u> </u>



Even though you have entered the Subframe calculation in TrailerWIN, where you have already chosen a specific Truck model, the TrailerWIN does not know which beam profile shape belongs to this truck model. You have to choose the Beam Profile model separately. TrailerWIN Truck Data files do not contain frame beam dimension data.

Load / Frame Bending Moment

In the Calculation the Crane or the Tail gate lifter causes the Bending Moment. The Bending Moment is calculated by using the load and the outreach and also by using the cranes own weight and the center of the gravity.



The Moment caused by the Crane

💐 Task name 📝 Moment			×					
Task name	Commercial Vehicle Show 20	01 NEC Birmingham	Cancel					
Customer								
Iruck	ruck FODEN A3-8R.T-C10 8x4 TIPPER							
Crane	HIAB 330-2							
L - Moment : (Max load at m	Crane and B ax outreach) - Crane and th	oom Weight given together- e Boom Weight separately 🔨	∽• `F					
Load	Max load at max o Crane max out	utreach kg 4350 reach mm 7500						
-Moment : (Crane own we Crane Own Weigh	ight) Crane own Crane own t Own weight gravity o	weight kg 3020 centre mm 1565						
			ок					
The M	oment of the Load loment of the own Weight	M1 = 320 kNm M2 = 46 kNm						
Total	Moment	M1 + M2 = 366 kNm						

Interpreting FrameWIN printout



FrameWIN picture on chassis frame and subframe.

Chassis frame of a truck can be seen on this picture above on black color.

Subframe profiles are presented on blue color.

You can draw more details on this picture with the drawing tool, in same way that You use drawing tool also in TrailerWIN and CraneWIN.

You can add more horizontal and vertical measures on this picture with the drawing tool, in same way that You add new measures in drawing tool also in TrailerWIN and CraneWIN. (TrailerWIN drawing tool for adding some new horizontal and vertical measures in page 11)

You can write text and comments on this picture with the Text tool, in same way that You use Text tool also in TrailerWIN and CraneWIN.

S F	rameV	/IN 2004-0	1 C:\TrailerW\FRWD	ATA\TestModel1							
File	Edit F	icture Optic	ns Help								
	Dpen	Save As	Print Moment	Subframe Dynamic co	Draw T	End X					
					•	-286,-364	n=1.4 / 1.4	c dyn=1.3			
		Mate	rial: Subframe		Fe52				F	Re = 355 N/mm2	
		Mate	rial: Chassis Fran	ne	Fe52				ŀ	Re = 355 N/mm2	
						[A]	\$ \$	\$	[B]		
		Stres	s on subframe N/i	mm2			177			182	Upper flange
		Stres	s on subframe_N/i	mm2			339			252	Lower flange
		Stres	s on chassis fram	e N/mm2			156			243	
		Stati	c Safety factor in 1	Stat / Dynamic Sa	afety factor in d	<i>y</i> n					
		Safe	ty factor on subfrar	me: Upper flange			2.00/1	1.54		1.95 / 1.5	0
		Safe	ty factor on subfrar	me: Lower flange			1.05/0).81		1.41/1.0	8
		Safe	ty factor on chassis	s frame			2.28/1	1.75		1.46 / 1.1	3
			List of Profiles				Hmm	A mm2	lx cm4	Wx cm3	M kg/m
		1	U 100x80x6				100	1488	246.43	49.29	11.7
		2	120x60x4				60	1376	84.77	28.26	10.8
		3	8x240				8	1920	1.02	2.56	15.1
		4	448x10				448	4480	7492.95	334.51	35.2
		5	120x60x4				60	1376	84.77	28.26	10.8
		6	10x120				10	1200	1.00	2.00	9.4
		=>	Subframe Profile	es together			448	11840	28344.59	963.99	92.9
			Chassis Frame								
		0	FODEN 2000R	270 x 92 x 8.0			270	3504	3619.36	268.10	27.5
		=>	Frame + Subfran	ne			448	15344			120.5
			[A] Flexible mo	ounted					31963.94	1087.08	
			[B] Stiff with sh	ear resisting plates					37969.41	1518.78	

FrameWIN table on safety factors, stresses, materials and list of profiles

ST FrameWIN 2004-01 C:\TrailerW\FRWDATA\TestM	odel1		
File Edit Picture Options Help			
Image: Constraint of the state of	n M Text	X End	
	-286,	-364 n=1.4 / 1.4 c dyn=1.3	
Material: Subframe Material: Chassis Frame	Fe52 Fe52		Re = 355 N/mm2 Re = 355 N/mm2
		[A] 5 5 5	[B] - 8-8-
Stress on subframe N/mm2 Stress on subframe N/mm2 Stress on chassis frame N/mm2		177 on Upper flange Stress 339 on Lower flange 156 on chassis frame	182 on Upper flange Stress 252 on Lower flange 243 on chassis frame
Static Safety factor n Stat / Dy Safety factor on subframe: Upper Safety factor on subframe: Lower Safety factor on chassis frame	namic Safety factor n dyn flange flange	2.00 / 1.54 Upper flange 1.05 / 0.81 Lower flange 2.28 / 1.75 chassis frame Static Safety factor n Stat Flexible mounting	1.95 / 1.50 Upper flange 1.41 / 1.08 Lower flange 1.46 / 1.13 Chassisframe Static Safety factor n Stat Fixed mounting

FrameWIN table on safety factors, stresses for both flexible mounting and fixed mounting.

Static & dynamic safety factors should all be more than values 1.25 or 1.4. In this example stress on lower flange is critical, but upper flange chassis frame are ok. The table shows Cross Area Data of all the chosen profiles:

	Profile	Hmm	A mm2	lx cm4	Wx cm3	M kg/m
1	U 60x40x3	60	402	23.45	7.82	3.2
	Chassis Frame					
0	FODEN 2000R 270 x 92 x 8.0	270	3504	3619.36	268.10	27.5
=>	Frame + Subframe	330	3906			30.7
	[A] Flexible mounted			3642.80	269.84	
	[B] Stiff with shear resisting plates			4624.61	259.78	

These Cross section dimensions are given for one beam:

Height H (mm)		
Cross section area	А	(mm²)
Second moment of are	ealx	(cm ⁴)
Section modulus	Wx	(cm ³)
Beam weight / meter	G	(kg/m)

Two last rows on the table show the I_x and W_x value s for the combined beam: All subframe profiles + chassis frame together in two different mounting systems:

[A]	Flexible mounting
[B]	Shear resisting mounting (Fixed mounting).

FrameWIN is a helping tool program to choose the profile for subframe and to calculate cross-section values on one point.

These one cross-section values are calculated for A) Flexible mounting B) Fixed mounting (shear resisting).

FrameWIN does not calculate the whole subframe in longitudinal direction and does not calculate the distribution of the chassis bending moment on different places.

FrameWIN user must self make the choice if subframe mounting is flexible or fixed.

For more detailed subframe and frame calculation is needed to use a FEM strength calculation program (Finite Elements Method).

Chassis frame reinforcement

In the Profile Shape List you find some Reinforcements for chassis beam. Choosing from this "reinforcement" group means, that these profiles will be technically calculated as part of chassis frame and not as part of subframe.





	List of Profiles (data per one rail)	H mm	A mm2	lx cm4	Wx cm3	M kg/m
1	U 100x50x5	100	950	143.29	28.66	7.5
2	5x80	5	400	0.08	0.33	3.1
=>	Subframe Profiles together	111	1350	220.96	30.88	10.6
	Chassis Frame : MB ATEGO 260*65*6					
		260	2268	2020.95	155.46	17.8
3	+ U Reinforcement : 272 x 65 x 6	272	2340	2258.78	166.09	18.4
4	+ L Reinforcement : 60 x 60 x 5	60	575	19.91	4.61	4.5
=>	Chassis Frame total	272	5183	4886.58	330.43	40.7

Warning in FrameWIN:

If you in FrameWIN choose a reinforcement, which is outside of chassis beam, you have to check manually, that subframe parts will be on a correct height above the chassis beam. FrameWIN can not automatically check, if the profiles are "inside each other". You need to lift subframe profiles using the dimension of reinforcement upper flange thickness.



1: U 100x50x5 U - beam U 100x50x5	correct	
Wx = 29cm3 G = 7,5kg/m U 100x50x5 x = 0 y = 6 Fe52 : ReL = 355 N/mm2	-x	▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲
	lift subframe profiles	65

Frame width in FrameWIN





Material of the Beams

Menu: Edit - MATERIAL

San MATERIA	L: Mechanical Properties	_ 🗆 🗵
_	Subframe	Cancel
	Fe52	
	Material Fe52	
	Yield strength minimum Re N/mm2 355	
	Chassis Frame	
	Fe52	ок
	F 50	
	Material Fe52	
	Yield strength minimum Re N/mm2	

By choosing the materials from list boxes, you automatically get the material name and the Yield strength minimum for the chosen material on specific textboxes. You can edit both of these separately, but in this case for example changing the material name from the textbox does not change Yield strength minimum. You have to change that manually too.

Load / Frame Bending Moment

In the Calculation the Crane or the Taillift causes the Bending Moment. The Bending Moment is calculated by using the load and the outreach and also by using the crane own weight and the center of the gravity.



The Moment caused by the Crane

🥞 Task name 📝 Momen	t		×
Task name	Commercial Vehicle Show 20	01 NEC Birmingham	Cancel
Customer		T-U C-4- Lines	- 1
Truck	FODEN A3-8R.T-C10 8x4 TIF	PPER	· ·
Crane	HIAB 330-2		
	Crane and B	oom Weight given together 🔩 🛶	•
– Moment : (Max load at ı	max outreach) <mark>Crane and th</mark>	e Boom Weight separately	Ψ*
	Max load at max o	utreach kg 4350	
	Crane max out	reach mm 7500	″ <mark>≚</mark> †
-Moment : (Crane own w	eight)		
Crana Oum Main	Crane own	weight kg 3020	
	Own weight gravity (centre mm 1565	
			ок
The I	Moment of the Load Moment of the own Weight	M1 = 320 KNm M2 = 46 kNm	
Total	Moment	M1 + M2 = 366 kNm	

The Moment caused by the Tail Gate Lifter

By choosing the option button: **Tail Gate Lifter** you can give the Moment caused by the Tail Gate Lifter.



The data on Tail Gate Lifter and Load on the Lifter are given by typing on textboxes on the screen:



Dynamic Loading Factor and Calculation system

Dynamic coefficient | c dyn .. /.. n

EN 13001

EN 12999 , EN 13001 Basic FrameWIN system

Choosing calculation system

At first program start You will be asked to choose which calculation system the program will use as default. It is possible to modify this setting later using menu Options->Options->Default Values->Default Calculation System. This setting will then be the default setting every time You begin a new calculation..

By choosing Options->Calculation System from menu or by clicking Dynamic coefficient-button You will get the opportunity to set calculation method and also setting options for the calculation.

Options	
General Printer Fonts Colors Default Values	
Default Values	
- Default Calculation System	
Default Calculation System	
Default Values for basic FrameWIN calculation	
Dynamisk faktor c dyn =	.3
Säkerhetsfaktor: Hjälpram	.4
Säkerhetsfaktor: Bilens ram	,4
OK Cancel	Apply

Options Help

Safety factor Dynamic coefficient

Language Options

Calculation system

n_M/		Т	
Dynamic co	Draw coofficient / (Text Colculation of	rtom l
Dynamic	coenciency (Jaiculation s	ystem
	228	6, 103	n=1,1

Calculation by "Basic FrameWIN system"

Dynamic coefficient c dyn

Default value for Dynamic Coefficient in FrameWIN is c dyn = 1.3. You can anyway change the default value from Menu: Options - Default Values

Dynamic Coefficient can be calculated using the formula

 $c dyn = 1.1 \times 0.0022 \times 60$ x v (m/s)c dyn no more than 1.3 v = crane lift velocity If You type a new value in the textbox for

crane lift velocity (m/s), the program calculates the corresponding Dynamic

Coefficient. On the other hand you can also type the wanted Dynamic Coefficient into the textbox. Dynamic Coefficient increases the Moment used in the calculation:

limit, which You choose here, the program shows a warning **!n**.

Safety factor n means here the warning limit for the safety factor. The Program calculates the safety factor for the specific case. If this is lower than the the warning

You can anyway change the default value for Safety Factor from Menu: Options - Default Values

Basi	c FrameWIN system	-	Cancel
Basic system —			
	Crane lift velocity v	1,515	
: dyn = 1.1 + 0.1	J022 * 60 * v (m/s) ; Max 1.3 [[DIN 15018-H1)	
	D 1 1 1 1		
	Dynamic coefficient ic dyn	1,3	
n			
	Safety fa	ctor : Subframe 1.4	
	Safety factor :	Chassis Frame 1,4	
			01/
			UK

Calculation by EN12999 system

When You choose calculation by EN12999, EN13001 You will get the following options to set:

- Vertical hook speed highest possible hook-speed rising or lowering.
- Load combination
 - A1-normal lifting/lowering from one function
 - C1-exceptional load, total speed from all functions activated
 - HC1-HD1..5 Hoist Drive Class. Select correct HD-class depending on the valve-system on the crane.

Dynamic coefficient c dyn / n EN 12999. EN 13001 Basic FrameWIN system EN 12399. EN 13001 EN 12395. EN 13001			Cancel
EN 13001 vertical hook speed Calculated with vertical hook speed	1,5		
Load Combination ① A1, regular load, lifting/lowering speed from one function			
C1, exceptional load, total speed from all functions			
Classes of the type of hoist drive and its operation method C HC1 - HD1, On/Off valve		ø2 = 1.05 + 0.17	7 * v
© HC1 - HD4, Normal spool valve		ø2 = 1.05 + 0.17	7 * v/2
C HC1 - HD5, Automatic speed control		s 2 = 1.05	
n Safety factor : Subframe 1,1 Safety factor : Chassis Frame 1,1			OK

- o HD1- On/Off-valve type.
- o HD4- Normal spool valve, speed can be manipulated directly by user
- o HD5- Automatic speed control of crane movements.
- Safety factor for Chasis Frame and Subframe. Normally 1.1, that is also recommended by the standard. Safety Factor can be set by user.

In this window You can see the formulas for calculating Φ 2-factor. These formulas will change depending on which Load Combination (A1, C1) You have chosen. These settings and formulas will also be printed out.

9	FrameWIN	J 2009-02											[
Fi	le Edit F	icture Optic	ons Help										
	G∰ Open	Save As	int	Moment	Subframe	n _///_ Dynamic co	Draw	Text	oʻ Symbols	En X	d		
						•	-464	4, 358	n=1,1 / 1,1	(EN1299)]		
		Scania I	P340_38		AIA								
		Hiab 10)2-4	o Brance									
		Moment	t : (Max I	oad at max	x outreach	1)					730kg x 11,7m x g =	84	kNm
		Moment	: (Crane	e own weig	ght)						1590kg x 2,58m x g =	40	kNm
		Dyn Mo	ment : (M	/lax load a	t max outi	reach)					1,34 x 1.178 x 730kg x 11,7m x g =	132	kNm
		Dyn Mo	ment : (0	Crane own	weight)						1,22 x 1,1 x 1590kg x 2,58m x g =	54	kNm
		Load Co	ombinati	on = A1. re	adular loa	d. liftina/low	verina sp	eed fron	1 one fund	tion			
		Class of	f hoist dr	ive = HD4	. Normal s	spool valve	· - · · · · · · · · · · · · · · · · · ·						EN12999
		Calculat	led with	vertical ho	ok speed	= 1.5 m/s					ø2 = 1.05 + 0.17 * v/2		-
					•								

File Functions

🥞 Fi	rame\	√IN 200	1-08	
File	Edit	Picture	Options	Help
Op Sa	ien ive As			
Sa Sa	ive As ive As	DXF-File DXF-File	(Entities d	only)
Pri Pri	nt Cal nterse	culation tup		
En	d			Ctrl+X

È	
Open	Save As

Open

Open the saved calculation. FrameWIN uses the same loading moment, which was processed in TrailerWIN for the last time.

Opening the file does not change loading moment data but the profile data.

Open		? ×
Look in: 🔁	FrWData	🗖 🖻 📸 📰
📓 effer_test11c	🛋 inch_test1	🛋 juncar_aisa1400
🛛 🖻 effer_test11c-2	? 🛛 🗃 inch_test2	🔊 SubframeType02233
📄 ERF model	폐 inch_test3	🛋 test 1
🔋 🗟 FrameWIN.INI	🔊 inch_test4	🛋 test1
🔄 🕑 FrW_test.DAT	🔊 inch_test5	🔛 TestFrameDXF1.DXF
🛛 🗐 HMF_55tm ram	nme 1.dat 🛛 🙍 juncar_aisa1250xi 🛛	🛋 TestModel1
•		Þ
File <u>n</u> ame: Su	ibframeType02233	<u>O</u> pen
Files of <u>type</u> :		▼ Cancel
	Open as <u>r</u> ead-only	

Starting from FrameWIN version 2005-07 the program gives you a possibility to use the crane and loading data from the saved FrameWIN calculation.

When you open a file, you will get a window for choosing:

- 1: do you want to use crane and loading data from the current case, which you already have on the screen. in this case you take only beam profiles from the saved calculation.
- 2: do you want to use also crane and loading data from this saved file

Possibility 2 is available only with FrameWIN data files, which are made with FrameWIN version 2005-07 or newer version.

e data from curi	rent calculation		
Task name			U
Customer			
Truck	IVECO EuroTrakker Cursor MP 1	90 E 31 WP 4x4 ETronic	
Crane	Hiab 144B-1 CL		
Max load at max outr	reach ko	2100	
		2100	
Crane max outreach	mm	6100	
Crane max outreach e Data from sav Task name	ved FrameWIN calculation	6100	0
Crane max outreach e Data from sav Task name Customer	mm ved FrameWIN calculation	6100	0
Crane max outreach e Data from sav Task name Customer Truck	mm ved FrameWIN calculation VECO Trakker 340T38 8x4x4	6100	0
Crane max outreach Data from sav Task name Customer Truck Crane	mm ved FrameWIN calculation VEC0 Trakker 340T38 8x4x4 EFFER 750-4S	6100	0
Crane max outreach e Data from sav Task name Customer Truck Crane Max load at max outr	mm ved FrameWIN calculation VECO Trakker 340T38 8x4x4 EFFER 750-4S reach kg	6100 5740	0

Save As

Save the profile combination. The loading data will not to be saved.

Save As					? ×
Savejn:	🔁 FrWData		•		
effer_test11c	5	🖻 inch_test1		juncar_a	aisa1400
effer_test11	o-2	🔊 inch_test2		test 1	
🔊 ERF model		🔊 inch_test3		test1	
🔋 🐻 FrameWIN.II	NI	🔊 inch_test4	4 + DXF	TestFran	meDXF1.DXF
🔹 🗿 FrW_test.DA	λT	🔊 inch_test5		TestMod	del1
BMF_55tm r	amme 1.dat	🔊 juncar_aisa1250xi	3	TestMod	del10
•					▶
File <u>n</u> ame:	SubframeTyp	e02233			<u>S</u> ave
Save as type:			•		Cancel
Г	Open as <u>r</u> e	ead-only			

Save As DXF-File and Save As DXF-File (Entities only)

Save the Picture of the Frame (Combined Profile) in DXF format. Choosing "Entities only" means, that the file includes only the drawing objects.

DXF file can be used in CAD software and also some other computer software can read DXF-files. In DXF format you will get the drawing as vector drawing in CAD software.

Printout		
		4
The printout on paper.		Print
Print	-	
Canon LBP-1760 PCL 5e	 Cancel	
Colors	ОК	
Calculation made by		

Using small blank buttons, you can print only one page, frame with calculation results or only profile combination in bigger scale.

The big OK button prints both pages if both checkboxes are marked, or only one of the pages, depending on which one is marked.

For printing you must give your name in field: "Calculation made by". With checkbox Colors you can choose printing in colours.

Draw Text onto the picture



You can write own texts onto the picture. Following picture shows the possibilities. The size of the text depends on the size of the picture.

Open Save Copy Paste		Font	Text Size	Colour	
🖻 🖬 🛛 🛍	BI	U Arial	▼ 30 ▼		= 73
Add Text	Combi	ned Subframe ll Typ	pe Nummer 02233		Cancel
Delete Text					



On the Text List you see all the text you have in this calculation. With mouse-click on the text line you can choose the text for editing. Press Enter to change the line.

Draw Lines, Rectangles, Dimensions, etc



You can draw simple drawings on the picture.

Draw		×
Delete	Cancel Coordinates Left, Top Draw Cancel	
Edit	es Coordinates Right, Low OK 24.18851 222.9882	
	Left, Top Combined Subframe Type Nummer 02233 Right, Low	

Choose the type of the object by using Shape Buttons "LINE", "RECTANGLE", "CIRCLE". Then draw the line or rectangle or circle with mouse onto the picture. You can drag point with dragging the grips (yellow rectangles). When you click OK, the grips disappear. Click the Edit-Button to get the grips back.

Draw Dimensions: horizontal and vertical.

When you draw a dimension with mouse, you will get the correct dimension text automatically. You can anyway change the dimension text; you only write a new text on the dimension editing box, and click the small ok button on the right side of the editing box.

If you later edit this dimension with the mouse, you get again automatically new dimension text.

You can choose arrow position with direction, when you are drawing a dimension with dragging mouse. The example shows the result and the mouse movement direction, from point 1 to point 2.



List of Symbols

Yield strength minimum	R eL (N/mm ²)	
Cross section area	A (mm ²)	
Second moment of area	I x (cm ⁴)	
Section modulus	W _x (cm ³)	
Beam weight / meter	G (kg/m)	
Stress	S (N/mm ²)	
Safety Factor Static Safety Factor Dynamic	n stat n dvn	
Dynamic Coefficient	c dyn (11.3)	
Crane lift velocity	V (m/s)	

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You may use the **TRAILER CONSULTATION Computer Software** on one or more computers in one office or in one factory area.

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The possible faults are repaired as soon as possible and that is guaranteed (the faults are guaranteed to be repaired in at least one years time minimum) and possibly later on updating contracts.

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The maker, dealer, or agent of the software will not compensate possible costs caused by diskettes or any other data media (mechanical faults, virus, etc.)

SUBFRAME CALCULATION THEORY IN FRAMEWIN

STRESS CALCULATION : BENDING MOMENT ON U-BEAM :

Bending moment **M** at a certain cross-section makes the normal stress σ on a longitudinal fiber at a distance y from the neutral axis of the beam:

$$\sigma = \frac{M y}{I} = \frac{M}{W}$$



The second moment I_X (moment of inertia) and section modulus W_X of a symmetrical U-cross-section area can be calculated as follows:

$$I_{x} = \frac{B H^{3}}{12} - \frac{b h^{3}}{12}$$

$$W_{x} = \frac{I_{x}}{H/2} = \frac{I_{x}}{H}$$

COMBINED BEAM : CHASSIS FRAME + SUBFRAME

Subframe can be mounted on different systems:

- Flexible mounting : subframe mounted with brackets or clamps
- Rigid mounting : subframe mounted with shear resisting plates

Flexible mounting : subframe mounted with brackets or clamps





With a flexible mounting I_x and W_x can be calculated for a combined beam as follows:

$$I_{c} = I_{F} + I_{S}$$

$$W_{c} = \frac{I_{F} + I_{S}}{e_{c}}$$

$$e_{c} = \max e_{F_{1}}, e_{F_{2}}, e_{S_{1}}, e_{S_{2}}$$

Maximum normal stresses $\,\sigma\,\,$ with bending moment $\textbf{\textit{M}}$ at a combined beam cross-section with flexible mounting are $\,$:

$$\sigma_{FI} = \frac{M e_{FI}}{I_c} \quad on \ chassis \ frame \ lower \ fibers$$

$$\sigma_{F2} = \frac{M e_{F2}}{I_c} \quad on \ chassis \ frame \ upper \ fibers$$

$$\sigma_{SI} = \frac{M e_{SI}}{I_c} \quad on \ subframe \ lower \ fibers$$

$$\sigma_{S2} = \frac{M e_{S2}}{I_c} \quad on \ subframe \ upper \ fibers$$



With a rigid mounting the calculation of I_x and W_x for a combined beam turns out to be more complicated :

At first we have to calculate the centroid (Center of gravity) *yC* for the combined cross-section.

With dimension y_C we calculate z_F and z_S and then the second moment of combined cross-section I_C and the section modulus for the combined cross-section W_C .



$$y_{C} = \frac{A_{F} y_{F} + A_{S} (H_{F} + y_{S})}{A_{F} + A_{S}}$$

$$z_{F} = y_{C} - y_{F}$$

$$z_{S} = H_{F} + y_{S} - y_{C}$$

$$I_{C} = (I_{F} + A_{F} z_{F}^{2}) + (I_{S} + A_{S} z_{S}^{2})$$

$$W_{C} = \frac{I_{C}}{e_{C}} \qquad e_{C} = \max(y_{C1}, y_{c2})$$

Maximum normal stresses σ with bending moment $\textbf{\textit{M}}$ at a combined beam cross-section with rigid mounting are $\ :$

$$\sigma_F = \frac{M \ y_{C1}}{I_C} \quad on \ frame \ lower \ fibers$$

$$\sigma_S = \frac{M \ y_{C2}}{I_C} \quad on \ subframe \ upper \ fibers$$

In both cases :

The normal stress distribution in figures:

Young's modulus *E* for chassis frame material = Young's modulus *E* for subframe material. With all steel qualities $E \approx 210\ 000\ \text{N/mm}^2$

Safety factor can be calculated:

$$n = \frac{R_e}{\sigma} \qquad R_e = Yield \ point \qquad ; \ for \ material \ Fe52, \ R_e = 350 \ N \ / \ mm^2} \\ \sigma = calculated \ stress$$

Bending Moment *M*

In **FrameWIN** software by Trailer Consultation the bending moment M is the lifting moment of the crane multiplied by dynamic coefficient v (default v = 1.3).

CALCULATION WITH NEW STANDARD EN12999

Subframe safety factor can now be made by two different systems, Basic FrameWIN System or EN12999/EN13001. The main difference from the Basic FrameWIN System is that it uses different safety-factors for crane-weight and the load. The new standard also takes notice of differencies in operation methods. On a crane with automatic speed control the forces on sudden rising/stopping will be much lower than on cranes with On/Off-type valve. FrameWIN now gives you the possibility to choose calculation method.

New calculation system EN12999 in FrameWIN

In FrameWIN You can choose calculation system for dynamic forces. By choosing Options->Calculation system or by clicking on Dynamic coefficient-button on menu.

When choosin EN12999, EN13001 You will have to choose following settings:

- Vertikal hook Speed
- Load Combination A1/C1
- HD class of Hoist Drive. HD1/HD4/HD5.
- Safety factors for Frame and Subframe.
 Recommendation by standard is: Ym = 1.1

The calculation is made for mobile cranes, Hoist Class 1 (HC1).

You will also get the settings and formulas on the outprint.

[Option	s		
Dynamic coefficient ic dyn / n				
EN 12999, EN 13001	•			Cancel
- EN 13001				
vertical hook speed Calculated with vertical hook speed		1,5		
Load Combination				
C1, exceptional load, total speed from all functions				
Classes of the type of hoist drive and its operation method —				
○ HC1 - HD1, On/Off valve			ø2 = 1.05 + 0.17	* v
• HC1 - HD4, Normal spool valve			ø2 = 1.05 + 0.17	* v/2
O HC1 - HD5, Automatic speed control			ø2 = 1.05	
n Safety factor : Sı Safety factor : Chassis	ubframe 1,1 Frame 1,1			OK

Options Help

Safety factor

Language

Dynamic coefficient

Calculation system

С

Subf

Þ

About calculation system EN12999/EN13001

Here is a short description of the new standard EN12999. For more information, please refer to the standards EN12999, EN13001.

FrameWIN makes calculation by Hoist Class 1 (HC1) which is the Hoist Class for mobile- and flexibile mounted cranes. (HC2 is for rigidly mounted cranes)

From options window You can make following selections for Hoist Drive Class:

- HD1 for cranes with On/Off -type valves regulating lifting and lowering
- HD4 for cranes with normal spool valve operated by user.

n_M		Т	
Dynamic co	Draw coefficient	Tevt / Calculation s	ustem
⊂ Uyhanna ▼	2	28, 103	n=1,1

HD5 for cranes with automatic speed control

Formulas and symbols



Formula for calculating stresses and safety factor



Symbols and coefficients

Gf	= Crane own weight without boom system
Gb	= Boom system weight (or total crane weight)
Yb	= Center of gravity for boom system (or crane)
Р	= Payload
R	= Center of gravity for payload
Vh	= Rising/lowering hook speed used for calculating Φ_1 , Φ_2
Vhmax	= Maximum hook speed
γp₁	 Partial safety factor for payload
	For Load combination A1 safety factor $\gamma_{p_1} = 1.22$
	For Load combination C1 safety factor $\gamma_{p_1} = 1.1$
γ p2	= Partial safety factor for crane weight
	For Load combination A1 safety factor γ_{p2} = 1.34
	For Load combination C1 safety factor $\gamma_{p_2} = 1.1$
Φ1	= Crane weight factor for dynamic effects when rising/lowering suddenly stops
	$\Phi_1 = 1.1 \text{ or max } \Phi_2$
Φ2	= Payload factor for dynamic effects when rising/lowering suddenly stops. $\Phi_2 = 1.05 + 0.17$ Vh
	For Load Combination A1 :
	Vh = Vhmax for Hoist Drive Class 1 (HD1)
	Vh =0.5 Vhmax for Hoist Drive Class 4 (HD4)
	Vh =0 for Hoist Drive Class 5 (HD5)
	For Load Combination C1:
	Vh = Vhmax for Hoist Drive Classes 1 and 4 (HD1 / HD4)
	Vh =0.5 Vhmax for Hoist Drive Class 5 (HD5)
W	= Bending moment
g	= 9.81 Nm (=1 kg)
σа	= Calculated stress
γm	= Safety factor
	γm >= 1.1