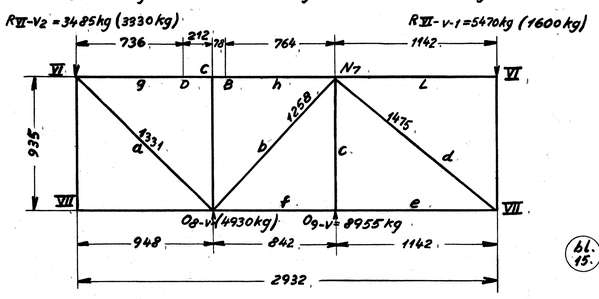
Vandrette tryk overføres af gitter til sidedrager.



a) kraft fra luftbremse $Q_9 V = 8955$ kg

$R_{VII}-V_2 = \frac{8955 \times 1142}{2932} = 3485$ kg $R_{VII}-V-1 = \frac{8955 \times 1790}{2932} = 5470$ kg

$Sg = +\frac{3485 \times 948}{935} = -3530$ kg = Sh. $Sf = Se = -\frac{5470 \times 1142}{935} = -6720$ kg

$Sa = -\frac{3485 \times 1331}{935} = -4950$ kg $Sb = \frac{3485 \times 1258}{935} = +4700$ kg

$Sd = \frac{5470 \times 1475}{935} = 8650$ kg Sk = 0 Sc = −8955 kg.

(bl. 13.)

b) kraft fra haandbremse: $O_8 - V = 4930$ kg

$R_{VII}\ V_2 = \frac{4930 \times 1984}{2932} = 3330$ kg $R_{VII}\ V-1 = \frac{4930 \times 948}{2932} = 1600$ kg

$Sg = +\frac{3330 \times 948}{935} = +3390$ kg = Sh. $Sf = Se = -\frac{1600 \times 1142}{935} = -1950$ kg

$Sa = -\frac{3330 \times 1331}{935} = -4750$ kg $Sb = -\frac{(4930-3330) \times 1258}{935} = -2150$ kg

$Sd = -\frac{1600 \times 1475}{935} = 2280$ kg Sk = 0 Sc = 0

6) spændinger mm. i gitter.

1)stg. a. L = 1,33 m S = −4750 − 4950 = −9700 kg $F_o = \frac{9700}{1120} = 8{,}65$ cm²

$r_o = 0{,}8 \times 1400 = 1120$ kg/cm² $\xi = 5{,}11$ $1/3 \times 5{,}11 \times 1{,}33^2 = 3{,}01$ cm²

$F_o + 1/3\,\xi l^2 = 8{,}65 + 3{,}01 = 11{,}66$ cm² < 12,3 cm² L 80×80×8 F = 12,3 cm²

2) stg b L = 1,26 m S = +4700 kg eller S = −2150 kg

L: 65×65×7 F = 8,70 cm² $\xi = 5{,}48$

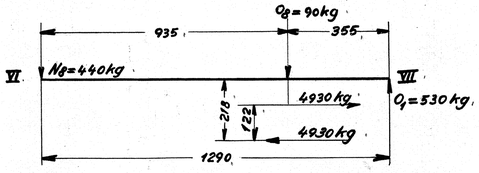
$\sigma = \frac{4700}{8{,}7} = 540$ kg/cm² $F_o = \frac{2150}{1120} = 1{,}92$ cm² $1/3\,\xi l^2 = 1/3 \times 5{,}48 \times 1{,}26^2 = 2{,}93$ cm² > F_o $I_\eta = 13{,}8$ cm⁴ $P_\eta = \frac{2{,}1 \times 13{,}8}{1{,}262} = 13{,}2$ t.

$n = \frac{18{,}2}{2{,}15} = 8{,}5$

3) stang d. S = 8650 + 2280 = 10930 kg

L: 65×65×7 F = 87 cm² $\sigma = \frac{10930}{8{,}7} = 1260$ kg/cm² < 1400 kg/cm²

4) stang k sk = 0



(bl. 14.)

Egenvægt af drager: ca 20 kg. Gitter mm. giver $O_8 = 30$ kg. Bremsearm mm vægt: 80 kg. $O_8 = \frac{80 \times 180}{355} = 40$ kg (14W-22.058) (Bl. 10)

Idet egenvægten tænkes anbragt i O_8 faas: $O_8 = 20 + 30 + 40 = 90$ kg.

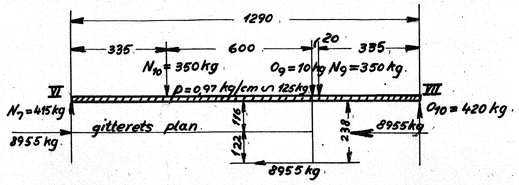
$N_8 = \frac{4930 \times 122}{1290} - \frac{90 \times 935}{1290} = 465 + 25 = 440$ kg. $O_1 = \frac{4930 \times 122}{1290} + \frac{90 \times 935}{1290} = 530$ kg

Ved O_8 faas $M_x = -440 \times 93{,}5 = -41100$ kg cm.

Profil L NP 10 $W_x = 41{,}2$ cm³

$\sigma\ O_8 = \frac{41100}{41{,}2} \backsim 1000$ kg/cm²

5) stang C. S = −8955 kg. L = 1,29 m.



Egenvægt af drager 25 kg. Gulv i kedelrum 200 kg.

Paa $N_7 - O_{10}$ falder: $\frac{200(440 + 324 + 1142) \times 1/2}{1906} = 100$ kg

$p = \frac{100 + 25}{129{,}0} = 0{,}97$ kg/cm ∽ 125 kg.

Egenvægt af gitter: $O_9 = 10$ kg. Fra kedel: $N_{10} = N_g =$ 2800 : 8 = 350 kg. Bremsekraften 8955 kg virker:

93 + 140 + 75 − 140 − 46 = 122 mm under gitterets plan og

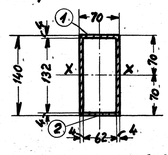
93 + 140 + 75 − 70 = 238

under aksen i $N_7 - O_{10}$. For statiske kræfter faas:

O_{10}: $1/2 \times 125 + 350 + \frac{10 \times 955}{1290} = 63 + 350 + 7 = 420$ kg

(bl. 15.) $N_7 = 1/2 \times 125 + 350 + \frac{10 \times 355}{1290} = 62 + 350 + 3 = 415$ kg

$MN_9 - x = 420 \times 33{,}5 - 33{,}5 \times 0{,}97 \times 16{,}75 = 14100 - 500 = 13600$ kg cm



$F = 7 \times 14 - 6{,}2 \times 13{,}2 = 98 - 82 = 16$ cm²

$I_x = 1/12 \times 14^3 \times 7 - 1/12 \times 13{,}2^3 \times 6{,}2 = 412{,}3$ cm⁴

$W_{x1} = W_{x2} = \frac{412{,}3}{7{,}0} = 58{,}9$ cm³

A) statiske lodrette tryk

$MN_9 = 13600$ kg cm

$-\sigma_1 = \sigma_2 = \frac{13600}{58{,}9} = 232$ kg/cm² < 800 kg/cm²

B) statiske kræfter +30% stød + direkte bremsning

MN_9-x fra lorette tryk: 13600 kg cm (farligst uden stød)

kraften 8955 kg flyttes 122 mm. Lodrette tryk paa

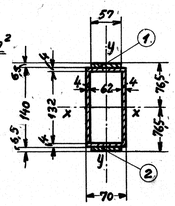
VII og VIII $O_3 = T_7 = -\frac{8955 \times 122}{2 \times 930} = -592$ kg

$T_8 = \frac{8955 \times 122}{2 \times 930} = 592$ kg = Q_9

MN_9 x = 13600 − 8955 × 11,6 = 13600 − 104000 = −90600 kg cm

ved N_7 $MN_7 x = -8955 \times 11{,}6 = -104000$ kg cm S = −8955 kg.

Profilet forstærkes som vist.



F = 16 + 2 × 0,65 × 5,7 = 16 + 7,4 = 23,4 cm²

$I_x = 412{,}3 + 2 \times 1/12 \times 0{,}65^3 \times 5{,}7 + 7{,}4 \times 7{,}32^2 =$

412,3 + 0,2 + 397 = 809,5 cm⁴

$W_{x1} = W_{x2} = \frac{809{,}5}{7{,}65} = 106$ cm³

$\sigma\ N_7 - 2 = -\frac{8955}{23{,}4} - \frac{104000}{106} = -380 - 980 =$

−1360 kg/cm² < 1400 kg/cm²

$I_y = 1/12 \times 14 \times 7^3 - 1/12 \times 13{,}2 \times 6{,}2^3 + 2 \times 1/12 \times 0{,}65 \times 5{,}7^3 =$

400 − 261 + 20 = 159 cm⁴ $\xi_y = 23{,}4^2 : 159 = 3{,}44$

(bl. 16.) $F_o = \frac{8955}{1120} = 8{,}0$ cm² $l_y = 0{,}935$ m $1/3\,\xi_y \times l_y^2 = 1/3 \times 3{,}44 \times 0{,}935^2 =$ 10 cm² $F_o + 1/3\,\xi_y \times l_y^2 = 8{,}0 + 1{,}0 = 9{,}0$ cm² < 23,4 cm²

6) Se = −6720 − 1950 = −8670 kg $l_y = 1.14$ m

stang Foge

Profil: L NP 8 F = 11,0 cm² $I_y = 19{,}4$ cm⁴

$\xi_y = \frac{110^2}{19{,}4} = 6{,}25$

$F_o = \frac{8670}{1120} = 7{,}75$ cm² $1/3\,\xi_y \times l_y^2 = 1/3 \times 6{,}25 \times 1{,}14^2 =$ 2,7 cm² $F_o + 1/3\,\xi_y l_y^2 = 7{,}75 + 2{,}7 = 10{,}45$ cm² < 11,0 cm²

7) stang h

a) snit A-A: Med 30% stød faas fra lodrette tryk

(Bl. 10) $M_{xA} = 129800 \times 1{,}3 = 168600$ kg cm.

Bremsningen giver M_{xA} (Bl. 12) = −17200 kg cm

Sh (Bl. 12 og 13) = 3530 + 3390 = 6920 kg

Jalt $M_{xA} = 168500 - 17200 = 151300$ kg cm.

Efter bl. 10 faas: $\sigma_1 = -\frac{151300}{237} + \frac{6920}{32{,}8} = -640 + 211 = -429$ kg/cm²

$\sigma_2 = \frac{151300}{197{,}5} + \frac{6920}{32{,}8} = 766 + 211 = +977$ kg/cm²

b) snit B-B. Med 30% stød faas fra lodrette tryk (Bl. 10)

$M_{xB} = 102900 \times 1{,}3 = 134000$ kg cm

Fra bremsning (Bl. 12) $M_{xB} = -28700$ kg

Sh (bl. 12 og 13): 3530 + 3390 = 6920 kg

Jalt $M_x B = 134000 - 28700 = 105300$ kg cm. Efter bl. 11.

$\sigma_1 = -\frac{105300}{158{,}5} + \frac{6920}{28{,}65} = -665 + 241 = -424$ kg/cm²

$\sigma_2 = \frac{105300}{172} + \frac{6920}{28{,}65} = +612 + 241 = +853$ kg/cm²

(bl. 17.)

c) snit C-C. Med 30% stød faas fra lodrette tryk (Bl. 10)

$M_{xC} = 1{,}3 \times 96500 = 126000$ kg cm fra bremsning (bl. 12)

$M_{xC} = -29900$ kg cm Sh (Bl. 12 og 13) = 3550 + 3390 = 6920 kg

Jalt $M_{xC} = 126000 - 29900 = 96100$ kg cm.

Efter bl. 11: $\sigma_1 = -\frac{96100}{158{,}3} + \frac{6920}{28{,}65} = -607 + 241 = -366$ kg/cm²

$\sigma_2 = \frac{96100}{172} + \frac{6920}{28{,}65} = 560 + 241 = +801$ kg/cm²

8) stang g

Med 30% stød faas fra lodrette tryk (bl. 11):

$M_{xD} = 75300 \times 1{,}3 = 98000$ kg cm. Fra bremsning (bl. 12)

$M_{xD} = -23300$ kg cm ialt: $M_xD = 98000 - 23300 = 74700$ kg cm

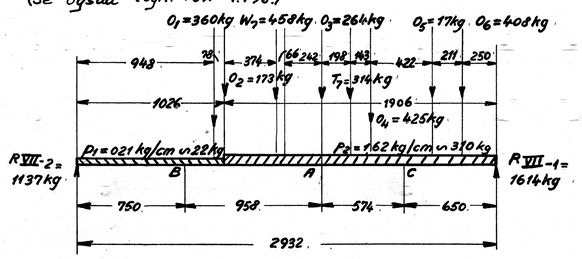
Sg (bl. 12 og 13) = 3530 + 3390 = 6920 kg efter bl. 11

$\sigma_1 = -\frac{74700}{126{,}9} + \frac{6920}{21{,}9} = -592 + 316 = -276$ kg/cm²

$\sigma_2 = \frac{74700}{126{,}9} + \frac{6920}{21{,}9} = +592 + 316 = +908$ kg/cm²

7) Beregning af tværdrager VII (18W-15-101 pos. 3)

(se ogsaa regn. 18W-1.196.)



A) lodrette statiske tryk.

Egenvægt af drager 60 kg fordelt over 2932 mm

(bl. 18.) Skillerum 170 kg fordelt over 1906 mm

Gulv i kedelrum ca. 200 kg. Paa drager VII: 100 kg fordelt over 1906 mm $P_1 = \frac{60}{293{,}2} \backsim 0{,}21$ kg/cm ∽ 22 kg

$P_2 = 0{,}21 + \frac{100 + 170}{190{,}6} = 0{,}21 + 1{,}41 = 1{,}62$ kg/cm ∽ 310 kg.

Rist og gulv i bagagerum (VI - VII) over strkn. $R_{VII}2 - Q_1$:

$\frac{140 \times 1290 \times 948}{980 \times 2932} \backsim 60$ kg $O_1 = 60 : 4 = 15$ kg.

Gulvbærer og væg overføres ved W_7: $W_7 = \frac{100 + 10}{2} = 55$ kg

Bremsegitter i kedelrum.

$O_3 = T_7 = 1/4 \times 32 = 8$ kg $O_4 = 1/2(20 + 30) = 25$ kg.

Haandbremsearm m.m. 80 kg $O_1 = \frac{80 \times (1290 - 355)}{1290} = 60$ kg.

Kedel giver: $O_4 = O_6 = 2800 : 8 = 350$ kg

$T_7 = O_3 = \frac{2800}{4 \times 2 \times 2} = 175$ kg.

kabelkanal: $\frac{600 \times 1/2(1290 + 930)}{18000 \times 2} = 19$ kg = $O_2 = O_3$.

Gulv i VII - VIII: 86 kg. Udstyr i toiletrum, vægge mm.

ca 200 kg. Paadrager VII: 100 kg $W_7 = T_7 = \frac{143(440 + 1/2 \times 1026)}{2932} =$

47 kg. Bremsearm mm giver $O_3 = T_7 = \frac{120 \times (930 - 85)}{2 \times 930} + \frac{28}{2 \times 2} =$

55 + 7 = 62 kg. Bremsecylinder med bæring 120 + 36 = 156 kg

$O_4 = O_5 = \frac{156 \times 200}{2 \times 930} = 17$ kg

Dunkrafte i O_4 og $O_6 = \frac{100(600 + 900)}{2 \times 1290} = 58$ kg = $O_4 = O_6$

Hjælpeluftbeholder vægt 75 kg 250 fra vognmidte

$P_1 = \frac{75 \times (550 - 200)(440 + 250)}{(930 - 250)\ 880} = 30$ kg $T_7 = \frac{30 \times 680}{960} = 22$ kg

$P_3 = \frac{75(550 - 220)(440 + 250)}{(930 - 250) \times 880} = 8$ kg $W_7 = \frac{8 \times 650}{930} = 6$ kg

(bl. 19.) oliebeholder vægt 670 kg. 350 fra midtevogn, fordeles i

O_1 og O_2: $O_1 = \frac{670(1300 - 210) \times (350 - 66)}{(930 + 835)\ (78 + 374)} = 260$ kg

$O_2 = \frac{670(1300 - 210)(518 - 350)}{(930 + 835)(78 + 374)} = 154$ kg.

Batterikasser vægte 750 kg og 850 kg

$P_5 = \frac{850(1140 - 40)}{2 \times (775 + 835 + 630)} + \frac{750(1100 - 40)}{2 \times (521 + 1290 + 155)} = 209 + 202 = 411$ kg = P_6

$P_4 = \frac{411(292 + 754)}{1026} = 420$ kg $W_7 = \frac{420 \times 775}{930} = 350$ kg.

Jalt $O_1 = 15 + 25 + 60 + 260 = 360$ kg

$W_7 = 55 + 47 + 6 + 350 = 458$ kg $O_2 = 19 + 154 = 173$ kg

$O_3 = 8 + 175 + 19 + 62 = 264$ kg $T_7 = 8 + 175 + 47 + 62 + 22 =$

314 kg $O_4 = 350 + 17 + 58 = 425$ kg $O_5 = 17$ kg $O_6 = 350 + 58 =$

408 kg. Reaktioner $R_{VIII}-1 = \frac{22 \times 513 + 310 \times 1979 + 360 \times 948}{2932}$

$+ 458 \times \frac{1026}{2932} + \frac{173 \times 1400 + 264 \times 1708 + 314 \times 1906 +}{2932}$

$\frac{425 \times 2049 + 17 \times 2471}{2932} + \frac{408 \times 2682}{2932} = 4 + 209 + 116 + 160 + 83 + 154$

+204 + 297 + 14 + 373 = 1614 kg

$R_{VIII}-2 = \frac{22 \times 2419 + 310 \times 953 + 360 \times 1984 + 458 \times 1906 +}{2932}$

$\frac{173 \times 1532 + 264 \times 1224 + 314 \times 1026 + 425 \times 883 + 17 \times 461 + 408 \times 250}{2932}$

= 18 + 101 + 244 + 298 + 90 + 110 + 110 + 128 + 3 + 35 =

1137 kg Q = 0 i snit A-A (kraft O_3). Der undersøges

følgende 3 snit a) snit A-A (profilet forstærket

med lamel og vinkel b) snit B-B (forstærket

med L: 75×55×9) og C) snit: C-C (forstærket med

L: 75×55×7)

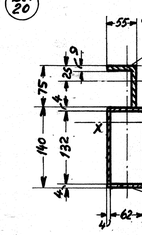
$M_{XA} = 1614 \times 122{,}4 - 314 \times 19{,}8 - 425 \times 34{,}1 - 17 \times 76{,}3 - 408$

$\times 97{,}4 - \frac{310 \times 1224 \times 61{,}2}{1906} = 198000 - 6200 - 14500 - 1300 -$

39800 − 12200 = 124000 kg cm.

(bl. 20)

Snit: B-B og C-C



F = 10,9 + 14 × 7 − 13,2 × 6,2 = 10,9 + 98 − 82

= 26,9 cm²

$x = \frac{10{,}9 \times 2{,}5 + 16 \times 14{,}5}{26{,}9} = 1{,}01 + 8{,}65 = 9{,}76$

∽ 98 mm. $I_X = 59{,}4 + 10{,}9 \times 7{,}3^2 + 1/12 \times$

$(14^3 \times 7 - 13{,}2^3 \times 6{,}2) + (98 - 82) \times 4{,}7^2 =$

59,4 + 580 + 412,3 + 352 = 1405,7 cm⁴

$W_{x1} = \frac{1405{,}7}{9{,}8} = 143{,}5$ cm³ $W_{x2} = \frac{1405{,}7}{11{,}7} = 120$ cm³

$M_{XC} = 1614 \times 65 - 408 \times 40 - 17 \times 18{,}9 - \frac{310 \times 650}{1906} \times 32{,}5 =$

105200 − 16300 − 300 − 3400 = 85200 kg cm $\sigma_{C2} = \frac{85200}{120} =$

710 kg/cm² < 800

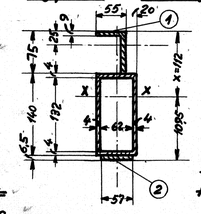
$\sigma_{C1} = -\frac{85200}{143{,}5} = -595$ kg/cm² < 800 kg/cm²

$M_x B = -1137 \times 75 - 0{,}21 \times 75 \times 37{,}5 = 85300 - 600 = 84700$

kg cm. $\sigma_{B1} = -\frac{84300}{143{,}5} = -588$ kg/cm² $\sigma_{B2} = \frac{84300}{120} = 700$

kg/cm² < 800 kg/cm²

Snit: A-A



F = 10,9 + 14 × 7 − 13,2 × 6,2 + 5,7 × 0,65 =

10,9 + 98 − 82 + 3,7 = 30,6 cm²

$x = \frac{10{,}9 \times 2{,}5 + (98 - 82) \times 14{,}5 + 3{,}7 \times 21{,}82}{30{,}6} =$

0,89 + 7,6 + 2,7 = 11,19 ∽ 112 mm

$I_x = 59{,}4 + 10{,}9 \times 8{,}7^2 + 1/12\,(14^3 \times 7 - 13{,}2^3 \times 6{,}2)$

$+ (98 - 82) \times 3{,}3^2 + 1/12 \times 5{,}7 \times 0{,}65^3 + 3{,}7 \times$

$10{,}62^2 = 59{,}4 + 830 + 412{,}3 + 175 + 0{,}1 + 418 = 1894{,}8$ cm⁴

$W_{x1} = \frac{1894{,}8}{11{,}2} = 170$ cm³ $W_{x-2} = \frac{1894{,}8}{10{,}95} = 182$ cm³

Stk.	Betegnelse	Pos.	Materiale kvalitet	Model nr. eller materiale størrelse	rå	færdig Vægt/stk.
		5				
		4				
		3				
		2				
		1				

Tegn. H.A Rev. E.U. 22/2-51 Afd. VII

Kalk. B.F. 10/1-51 Norm. Dato

Dato	Rettelse	Indeks

Målestok:

FRICHS

Anvendelse: Diesel-el. 500/550 HK. motorvogn.

Stykliste nr.: —

Tegningens benævnelse: Beregning af dragere i undervogn.

Tegningens nummer: 18W − 1.192.

Indeks:

FRICHS nr. 147