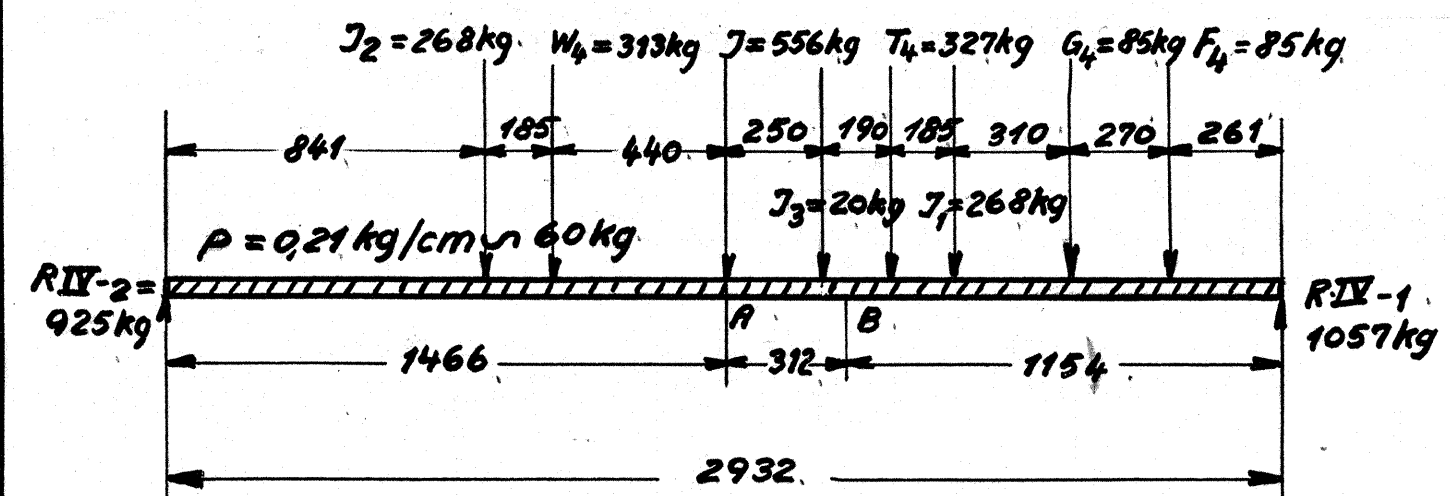
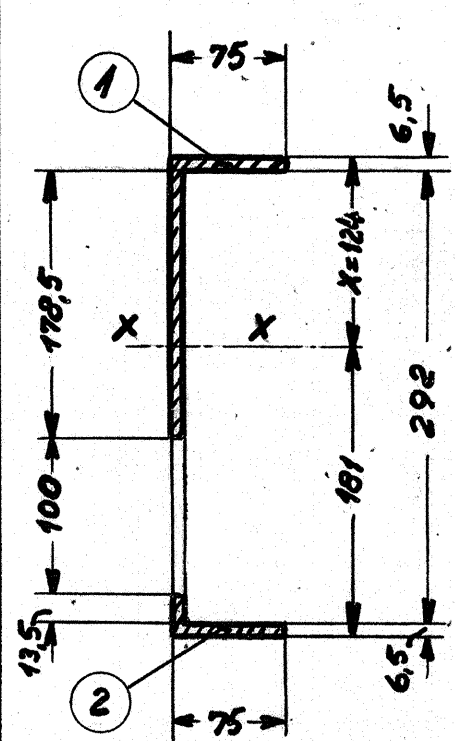


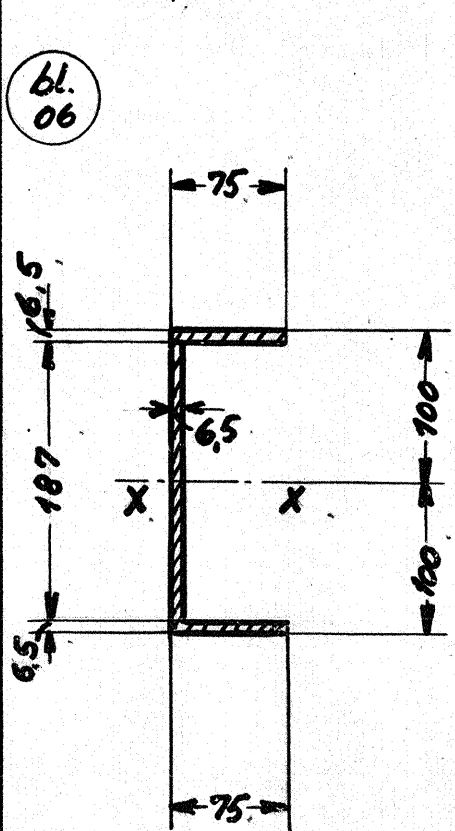
3) Beregning af tværdrager IV (18W-15.103.b).



Egenvægt af drager udgør ca. 60 kg  $p = \frac{60}{2932} = 0,21 \text{ kg/cm}$   
 Gulv og rist i bagagerum:  $440 \times \frac{1}{2} (1087 + 1259) = 168 \text{ kg}$   
 $W_4 = T_4 = \frac{168(440 + \frac{1}{2} \times 1026)}{2932} \approx 55 \text{ kg}$   
 Bagage med 50% overlast:  $\frac{2400 \times \frac{1}{2} (1087 + 1259)}{4115} = 675 \text{ kg}$   
 $W_4 = T_4 = \frac{675(440 + \frac{1}{2} \times 1026)}{2932} = 220 \text{ kg}$   
 Gulvbærere:  $T_4 = W_4 = 10 \text{ kg}$   
 Kabelkanal:  $600 \times \frac{1}{2} (1087 + 1259) = 40 \text{ kg}$   $I = I_3 = 20 \text{ kg}$   
 Reguleringsmotorer:  $2 \times 75 = 150 \text{ kg}$ . Bæring for do: 80 kg  
 $G_4 = F_4 = \frac{75(575 + 1143)}{2 \times 1087} + \frac{80 \times 653}{2 \times 1087} = 60 + 25 = 85 \text{ kg}$   
 Hovedapparatkasse giver (bl.03)  $H = 82 \text{ kg}$   $W_4 = \frac{82 \times 370}{1037} = 29 \text{ kg}$   
 2 stk. vandbeholder: vægt:  $2 \times 900 = 1800 \text{ kg}$ , der fordeles i I, I<sub>1</sub> og I<sub>2</sub>. Paa drage II falder  $\frac{1800(1600 - 365)}{1259 + 821} = 1072 \text{ kg}$   
 $I_1 = I_2 = 1072 : 2 = 536 \text{ kg}$   $I = \frac{1}{2} \times 1072 = 536 \text{ kg}$   
 Hjelpeapparatkasse: 350 kg  $K_2 = K_3 = \frac{350(\frac{1}{2} \times 2190 - 505)}{2 \times (826 + 821)} = 63 \text{ kg}$   
 $T_4 = \frac{63(276 + 754) \times 826}{1026 \times 1259} \approx 42 \text{ kg}$   
 Jalt:  $I_2 = 268 \text{ kg}$   $W_4 = 55 + 220 + 10 + 28 = 313 \text{ kg}$   $I = 20 + 536 = 556 \text{ kg}$   
 $I_3 = 20 \text{ kg}$   $T_4 = 55 + 220 + 10 + 42 = 327 \text{ kg}$   $I_1 = 268 \text{ kg}$   $G_4 = F_4 = 85 \text{ kg}$   
 $R_{II-1} = \frac{1}{2} \times 60 + 268 + \frac{313 \times 1026 + 556 \times 1466 + 20 \times 1716 + 327 \times 1906}{2932} = 30 + 268 + 109 + 278 + 12 + 213 + 147 = 1057 \text{ kg}$   
 $+ \frac{85(2407 + 2671)}{2932} = 30 + 268 + 109 + 278 + 12 + 213 + 147 = 1057 \text{ kg}$   
 $R_{II-2} = \frac{1}{2} \times 60 + 268 + \frac{313 \times 1906 + 556 \times 1466 + 20 \times 1215 + 327 \times 1026 + 85(261 + 531)}{2932} = 30 + 268 + 204 + 278 + 8 + 114 + 23 = 925 \text{ kg}$   
 $Q = 0$  ved A.  
 $M_{XA} = 925 \times 146,6 - 30 \times 73,3 - 268 \times 62,5 - 313 \times 44 = 135100 - 2200 - 16800 - 13800 - 135100 - 32800 = 102300 \text{ kg cm}$

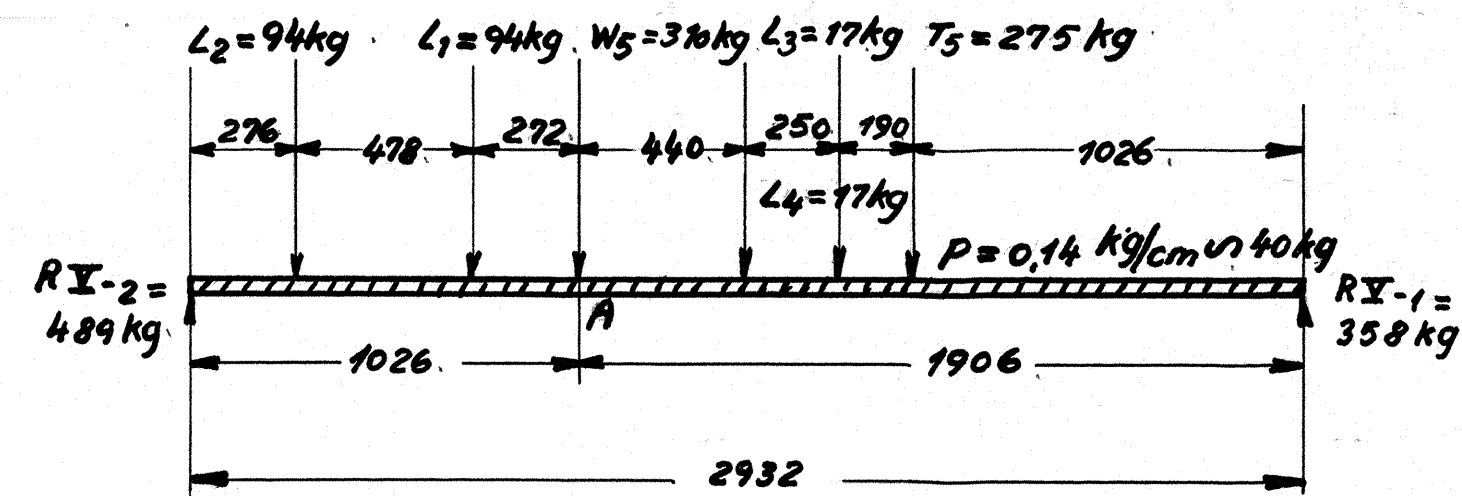


Snit: A-A  
 $F = 2 \times 7,5 \times 0,65 + 17,85 \times 0,65 + 1,35 \times 0,65 = 9,75 + 11,6 + 0,88 = 22,23 \text{ cm}^2$   
 $X = \frac{9,75 \times 16,25 + 11,6 \times 9,57 + 0,88 \times 17,25}{22,23} = 6,72$   
 $+ 5,01 + 0,68 = 12,41 \approx 124 \text{ mm}$   
 $I_x = 2 \times \frac{1}{12} \times 7,5 \times 0,65^3 + 4,87(12,08^2 + 17,78^2) + \frac{1}{12} \times 17,85 \times 0,65 + 11,6 \times 2,65^2 + \frac{1}{12} \times 1,35 \times 0,65^3 + 0,88 \times 16,77^2 = 0,3 + 2250 + 306 + 81,2 + 0,1 + 247 = 2884,6 \text{ cm}^4$   
 $W_{x2} = 2884,6 : 18,1 = 159,5 \text{ cm}^3$   
 $\sigma_2 = \frac{102300}{159,5} = 645 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$

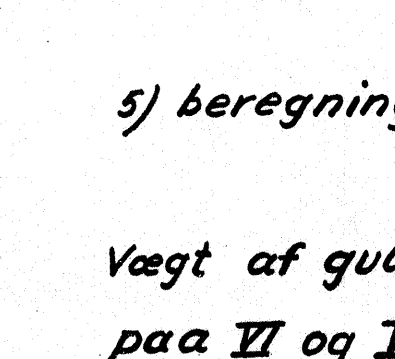


Snit: A-A vandret se tegn. 18W-1.196  
 Snit: B-B  
 $F = 2 \times 7,5 \times 0,65 + 18,7 \times 0,65 = 9,75 + 12,15 = 21,9 \text{ cm}^2$   
 $I_x = 2 \times \frac{1}{12} \times 7,5 \times 0,65^3 + 9,75 \times 9,68^2 + \frac{1}{12} \times 18,7^3 \times 0,65 = 0,3 + 915 + 354 = 1269,3 \text{ cm}^4$   
 $W_x = \frac{1269,3}{10} = 126,9 \text{ cm}^3$   
 $M_{XB} = -1057 \times 115,4 - \frac{60 \times 1154 \times 57,7 - 327 \times 128}{2 \times 2932} - 268 \times 31,3 - 85(62,3 + 89,3) = 122000 - 1300 - 4200 - 9800 - 12900 = 122000 - 28200 = 93800 \text{ kg cm}$   
 $\sigma = \frac{93800}{126,9} = 740 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$

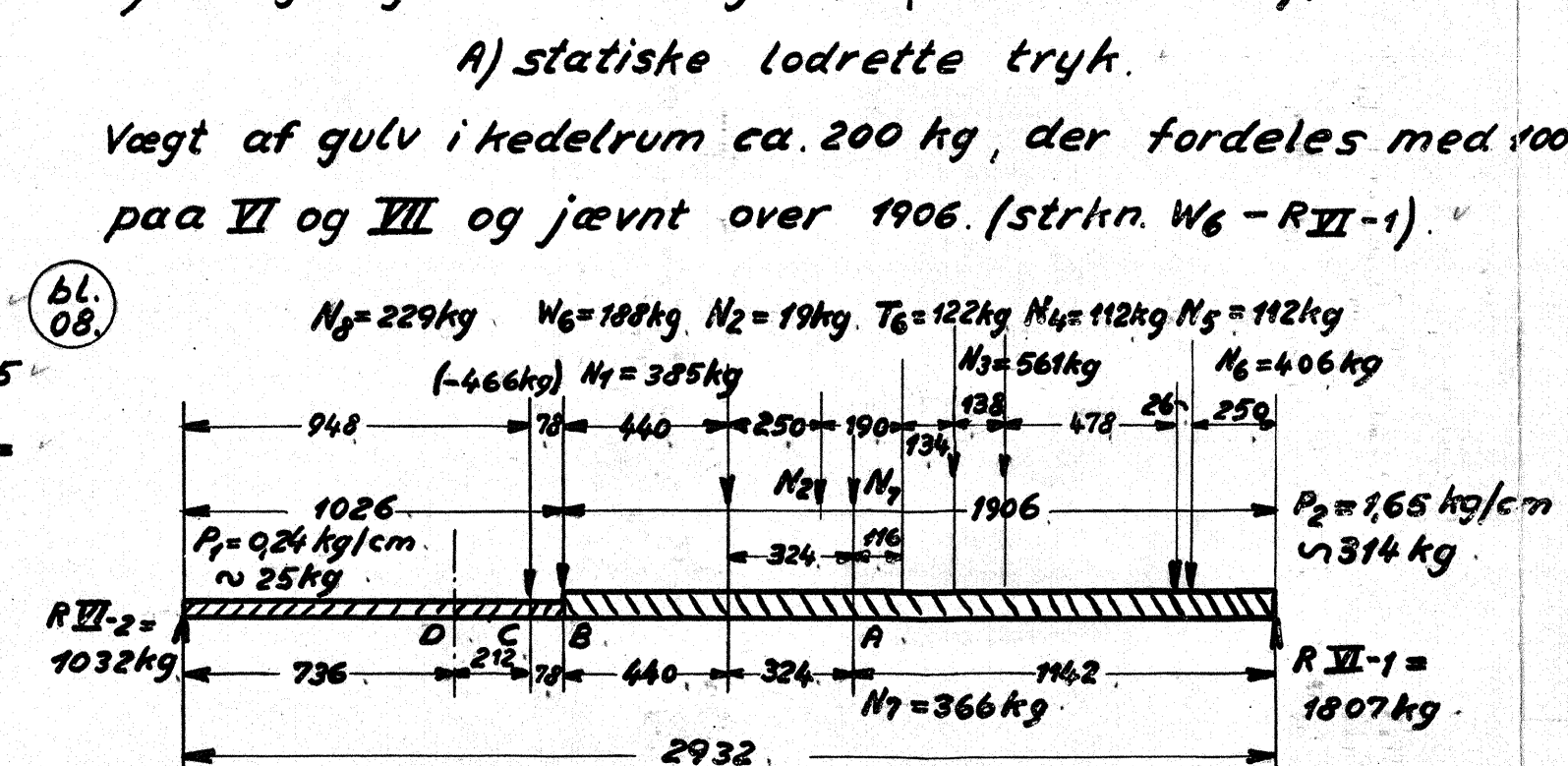
4) Beregning af tværdrager I (18W-15.101 pos.1).



Bagage med 5% overlast:  $2400 \times \frac{1}{2} (\frac{1259 + 821}{4115}) = 605 \text{ kg}$   
 Egenvægt af drager ca. 40 kg  $p = \frac{40}{2932} \approx 0,14 \text{ kg/cm}$   
 Gulv og rist i bagagerum:  $440 \times \frac{1}{2} (1259 + 821) = 149 \text{ kg}$   
 $W_5 = T_5 = \frac{149(440 + \frac{1}{2} \times 1026)}{2932} = 49 \text{ kg}$   
 Kabelkanal:  $600 \times \frac{1}{2} (1259 + 821) = 34 \text{ kg}$   $L_3 = L_4 = 17 \text{ kg}$   
 Hovedapparatkasse vægt: 350 kg  
 $L_1 = L_2 = \frac{350(\frac{1}{2} \times 2189 - 38)}{2(826 + 821)} = 94 \text{ kg}$   $W_5$  og  $T_5 = \frac{605(440 + \frac{1}{2} \times 1026)}{2932} = 196 \text{ kg}$   
 Hjelpeapparatkasse efter bl.05:  $K_2 = K_3 = 63 \text{ kg}$   
 $T_5 = \frac{63(276 + 754) \times 433}{1026 \times 1259} = 22 \text{ kg}$   
 Batterikasse: vægt 750 kg  $M_2 = M_3 = \frac{750 \times (\frac{1}{2} \times 2000 - 5)}{2 \times (521 + 1259 + 155)} = 90 \text{ kg}$   
 $M_1 = \frac{90(292 + 758)}{1026} \approx 90 \text{ kg}$   $W_5 = \frac{90 \times 521}{821} = 57 \text{ kg}$   
 Gulvbærere  $T_5 = W_5 = 8 \text{ kg}$   
 Jalt:  $L_1 = L_2 = 94 \text{ kg}$   $W_5 = 49 + 196 + 57 + 8 = 310 \text{ kg}$   
 $L_3 = L_4 = 17 \text{ kg}$   $T_5 = 49 + 196 + 22 + 8 = 275 \text{ kg}$   
 $R_{II-1} = \frac{1}{2} \times 40 + \frac{94(276 + 754) + 310 \times 1026 + 17(1466 + 1716) + 275 \times 1906}{2932} = 20 + 33 + 108 + 18 + 179 = 358 \text{ kg}$   
 $R_{II-2} = \frac{1}{2} \times 40 + \frac{94(2656 + 2176) + 310 \times 1906 + 17(1466 + 1216) + 275 \times 1026}{2932} = 20 + 155 + 202 + 16 + 96 = 489 \text{ kg}$   
 $Q = 0$  ved  $W_5$  (snit: A-A)  $M_{XA} = 489 \times 102,6 - 94(27,2 + 75,0) - \frac{40 \times 1026}{2932} \times 57,3 = 50200 - 9600 - 700 = 39900 \text{ kg cm}$   
 $F = 7 \times 14 - 6,2 \times 13,2 = 98 - 82 = 16 \text{ cm}^2$   
 $I_x = \frac{1}{12} \times 7 \times 14^3 - \frac{1}{12} \times 6,2 \times 13,2^3 = 412,3 \text{ cm}^4$   
 $W_x = \frac{412,3}{7,0} = 58,9 \text{ cm}^3$   
 $\sigma_A = \frac{39900}{58,9} = 670 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$



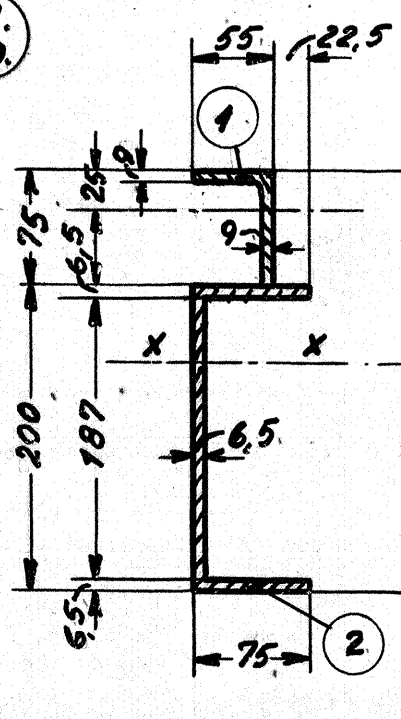
5) beregning af tværdrager VI (18W-15.103.b).



Skallerum 170 kg fordelt over strk.  $W_6 - R_{VI-1}$ .  
 Egenvægt drager ca. 70 kg, fordelt over 2932 mm  
 $P_1 = \frac{70}{2932} = 0,24 \text{ kg/cm}$   $\approx 25 \text{ kg}$   $P_2 = 0,24 + \frac{170 + 100}{190,6} = 0,24 + 1,11 = 1,65 \text{ kg/cm}$   $\approx 314 \text{ kg}$   $Gulv i bagagerum (V-VI): \frac{140 \times 821}{980} = 117 \text{ kg}$   
 $W_6 = T_6 = \frac{117(440 + \frac{1}{2} \times 1026)}{2 \times 2932} \approx 19 \text{ kg}$   $Gulvbærere (V-VI)$   
 $W_6 = T_6$   $\approx 3 \text{ kg}$   $Bagage i V-VI$  med 50% over last:  
 $\frac{2400 \times 821}{4115} = 480 \text{ kg}$   $W_6 = T_6 = \frac{480(440 + \frac{1}{2} \times 1026)}{2 \times 2932} = 78 \text{ kg}$   
 Gulv og rist (VI-VII) over strkn.  $R_{VI-2} - N_8$ :  
 $\frac{140 \times 1290 \times 948}{980 \times 2932} \approx 60 \text{ kg}$   $N_8 = \frac{60}{2 \times 2} \approx 15 \text{ kg}$   $Gulvbærer$  og væg regnes overført ved  $W_6: W_6 = \frac{100 + 10}{2} = 55 \text{ kg}$

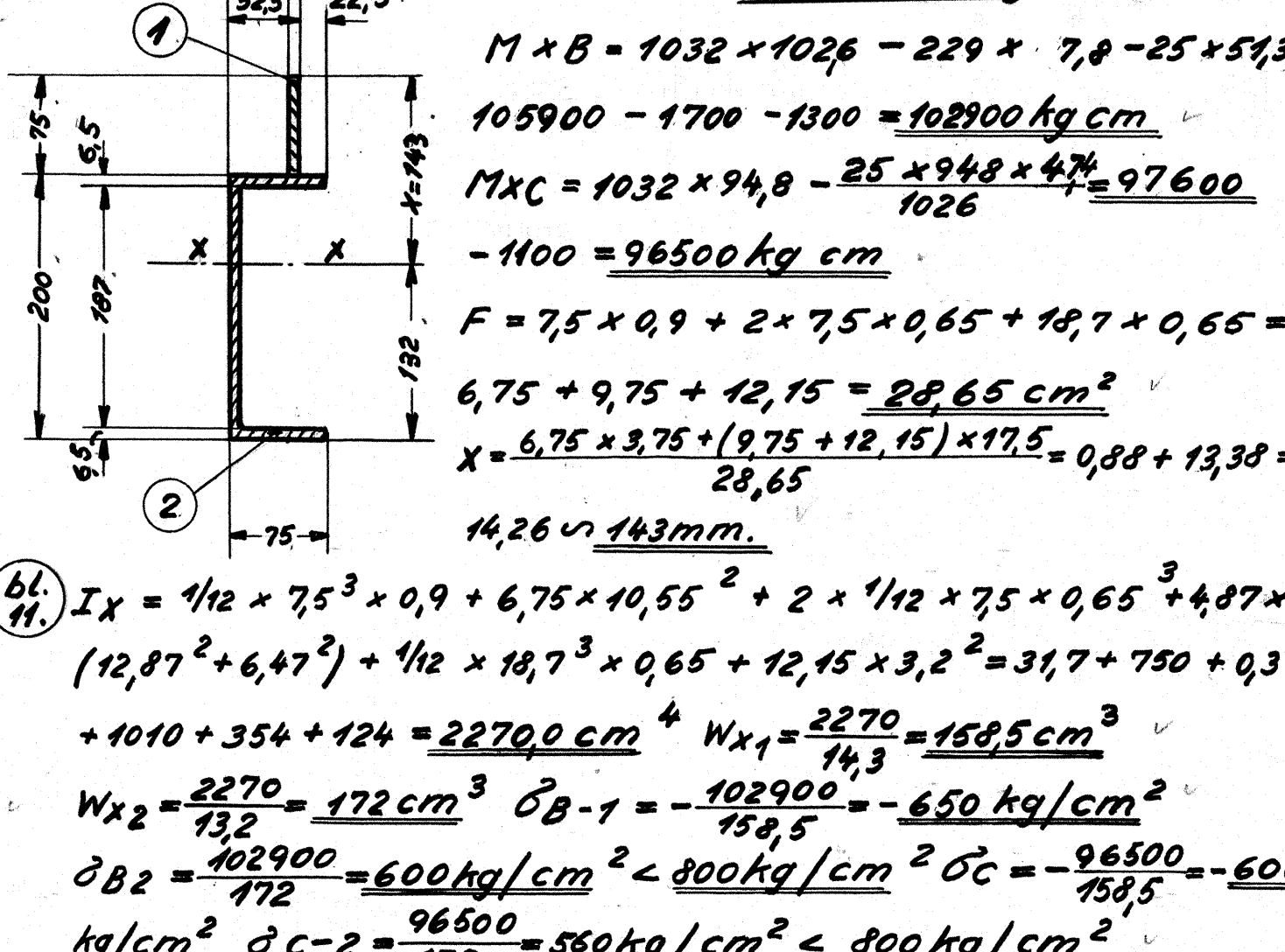
Længdedrager og gitter (VI-VII) ved  $N_7 = \frac{16 + 10}{2} = 13$

$\frac{9 \times 355}{1290} = 13 + 3 = 16 \text{ kg} = N_7$  ved  $N_8 = \frac{16}{2} + \frac{(5 + 3 + 4 + 10) \times 355}{1290} = 8 + 6 = 14 \text{ kg}$   $Bremsearm$   $N_8 = \frac{120 \times 180}{1800 \times 2} = 17 \text{ kg}$   
 Kabelkanal  $N_1 = N_2 = \frac{600 \times \frac{1}{2} (1290 + 930)}{1800} \approx 19 \text{ kg}$   
 Batterikasse vægt 750 kg. Efter bl.07 er  $M_1 = 90 \text{ kg}$   
 $W_6 = \frac{90 \times 300}{821} = 33 \text{ kg}$   $Vandbeholdere: 2 \times 900 = 1800 \text{ kg}$   
 Paa drager VI:  $\frac{1800 \times (1600 - 755)}{1259 + 821} = 732 \text{ kg}$   $N_1 = \frac{1}{2} \times 732 = 366 \text{ kg}$   $N_8 = N_3 = \frac{1}{4} \times 732 = 183 \text{ kg}$  ( $N_8$  regnes at angribe v. haandbremse).  
 Hjelpeapparatkasse vægt 350 kg  
 $N_4 = N_5 = \frac{350 \times (\frac{1}{2} \times 2190 - 38)}{2 \times (826 + 821)} = 112 \text{ kg}$   
 $T_6 = \frac{350(\frac{1}{2} \times 2190 - 505)(276 + 754) \times 433}{2(826 + 821) \times 1026 \times 1259} = 22 \text{ kg}$   
 Kedel vægt 2800 kg  $N_3 = N_6 = 2800 : 8 = 350 \text{ kg}$   $N_7 = 350 \text{ kg}$   
 Dunkrafte:  $2 \times 100 = 200 \text{ kg}$ , der overføres i  $N_3$  og  $N_6$   
 $N_3 = \frac{100(390 + 690)(466 - 250)}{1290 \times 642} = 28 \text{ kg}$   
 $N_6 = \frac{100(390 + 690)(492 - 468)}{1290 \times 642} = 56 \text{ kg}$   
 Jalt:  $N_8 = 15 + 14 + 17 + 183 = 229 \text{ kg}$   
 $W_6 = 19 + 3 + 78 + 55 + 33 = 188 \text{ kg}$   $N_1 = 19 + 366 = 385 \text{ kg}$   
 $N_2 = 19 \text{ kg}$   $N_7 = 16 + 350 = 366 \text{ kg}$   $T_6 = 19 + 3 + 78 + 22 = 122 \text{ kg}$   
 $N_3 = 183 + 350 + 28 = 561 \text{ kg}$   $N_4 = N_5 = 112 \text{ kg}$   
 $N_6 = 350 + 56 = 406 \text{ kg}$   
 $R_{VI-1} = \frac{25 \times 513 + 314 \times 1979 + 229 \times 948 + 188 \times 1026 + 385 \times 1466}{2932} + \frac{19 \times 1716 + 366 \times 1790 + 122 \times 1906 + 561 \times 2040 + 112 \times 2178 + 112 \times 2656}{2932} + \frac{406 \times 2682}{2932} = 4 + 211 + 74 + 66 + 193 + 11 + 224 + 79 + 390 + 83 + 101 + 371 = 1807 \text{ kg}$   
 $R_{VI-2} = \frac{25 \times 2419 + 314 \times 953 + 229 \times 1984 + 188 \times 1906 + 385 \times 1466}{2932} + \frac{19 \times 1216 + 366 \times 1142 + 122 \times 1026 + 561 \times 892 + 112 \times 754 + 112 \times 276}{2932} + \frac{406 \times 250}{2932} = 21 + 103 + 155 + 122 + 192 + 8 + 142 + 43 + 171 + 29 + 11 + 35 = 1032 \text{ kg}$   
 $Q = 0$  i snit A-A (kraft  $N_7$ ). Der undersøges følgende snit A-A ( $M_x$  og  $M_{max}$ ), snit B-B (forstærkning ændres), snit C-C (som B-B, men momentet fra bremsekraftens ekscentricitet er stor) og snit D-D (forstærkning ophører).



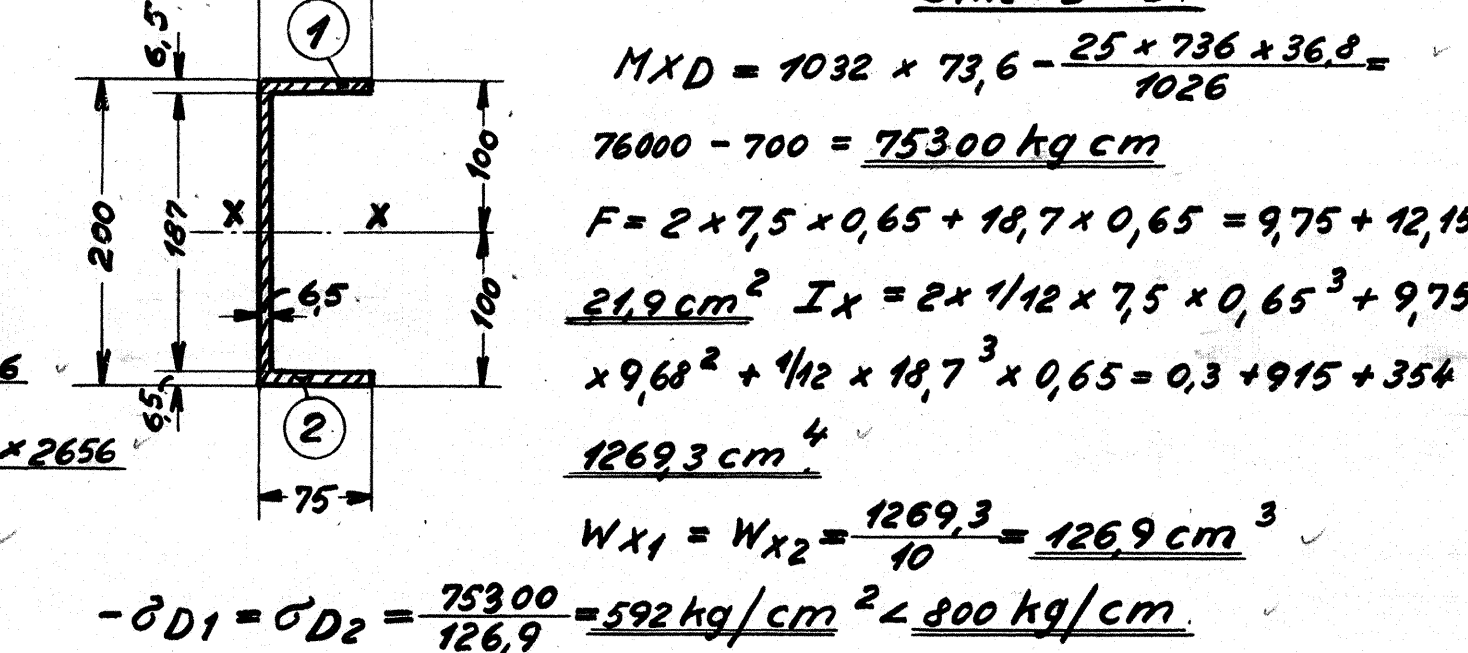
Snit: A-A  
 $M_{XA} = 1807 \times 114,2 - 406 \times 89,2 - 112 \times 86,6 - 112 \times 38,8 - 561 \times 25 - 122 \times 11,6 - \frac{314 \times 1142 \times 571}{1906} = 206400 - 36400 - 9700 - 4300 - 14000 - 1400 - 10800 = 206400 - 76600 = 129800 \text{ kg cm}$   
 $F = 10,9 + 2 \times 7,5 \times 0,65 + 18,7 \times 0,65 = 10,9 + 9,75 + 12,15 = 32,80 \text{ cm}^2$   
 $X = \frac{10,9 \times 2,5 + (9,75 + 12,15) \times 17,5}{32,8} = 0,83 + 11,7 = 12,53 \approx 125 \text{ mm}$   
 $I_x = 59,4 + 10,9 \times 10^2 + 2 \times \frac{1}{12} \times 7,5 \times 0,65^3 + 4,87(14,67^2 + 4,67^2) + \frac{1}{12} \times 18,7^3 \times 0,65 + 12,15 \times 5,0^2 = 59,4 + 1090 + 0,3 + 1152 + 354 + 304 = 2959,7 \text{ cm}^4$   
 $W_{x2} = \frac{2959,7}{15} = 197,5 \text{ cm}^3$   $W_{x1} = \frac{2959,7}{12,5} = 237 \text{ cm}^3$   
 Forstærkede kræfter:  $\sigma_1 = -\frac{129800}{197,5} = -658 \text{ kg/cm}^2$   
 $\sigma_2 = \frac{129800}{237} = 550 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$

Snit B-B og C-C.



$M \times B = 1032 \times 1026 - 229 \times 7,8 - 25 \times 57,3 = 105900 - 1700 - 1300 = 102900 \text{ kg cm}$   
 $M \times C = 1032 \times 94,8 - 25 \times 94,8 \times \frac{47}{1026} = 97600 - 1100 = 96500 \text{ kg cm}$   
 $F = 7,5 \times 0,9 + 2 \times 7,5 \times 0,65 + 18,7 \times 0,65 = 6,75 + 9,75 + 12,15 = 28,65 \text{ cm}^2$   
 $X = \frac{6,75 \times 3,75 + (9,75 + 12,15) \times 17,5}{28,65} = 0,88 + 13,38 = 14,26 \approx 143 \text{ mm}$   
 $I_x = \frac{1}{12} \times 7,5^3 \times 0,9 + 6,75 \times 10,55^2 + 2 \times \frac{1}{12} \times 7,5 \times 0,65^3 + 4,87 \times (12,87^2 + 6,47^2) + \frac{1}{12} \times 18,7^3 \times 0,65 + 12,15 \times 3,2^2 = 31,7 + 750 + 0,3 + 1010 + 354 + 124 = 2270,0 \text{ cm}^4$   $W_{x1} = \frac{2270}{14,3} = 158,5 \text{ cm}^3$   
 $W_{x2} = \frac{2270}{13,2} = 172 \text{ cm}^3$   $\sigma_B - 1 = -\frac{102900}{158,5} = -650 \text{ kg/cm}^2$   
 $\sigma_B 2 = \frac{102900}{172} = 600 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$   $\sigma_C = -\frac{96500}{158,5} = -608 \text{ kg/cm}^2$   $\sigma_C - 2 = \frac{96500}{172} = 560 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$

Snit: D-D.



$M \times D = 1032 \times 73,6 - \frac{25 \times 736 \times 36,8}{1026} = 76000 - 700 = 75300 \text{ kg cm}$   
 $F = 2 \times 7,5 \times 0,65 + 18,7 \times 0,65 = 9,75 + 12,15 = 21,9 \text{ cm}^2$   
 $I_x = 2 \times \frac{1}{12} \times 7,5 \times 0,65^3 + 9,75 \times 9,68^2 + \frac{1}{12} \times 18,7^3 \times 0,65 = 0,3 + 915 + 354 = 1269,3 \text{ cm}^4$   
 $W_{x1} = W_{x2} = \frac{1269,3}{10} = 126,9 \text{ cm}^3$   
 $\sigma_D 1 = \sigma_D 2 = \frac{75300}{126,9} = 592 \text{ kg/cm}^2 < 800 \text{ kg/cm}^2$

B) statiske kræfter + 30% stød + direkte bremsning. Ved anvendelse af haandbremsen faas et vandret tryk i  $O_3$  (18W-1.480):  $2110 + 2820 = 4930 \text{ kg}$ . Fra bremsecylinder med direkte bremsning faas et vandret tryk i  $O_9$  (18W-1.480) paa:  $(210 + 28) : 3860 + 5140 - 45 = 8955 \text{ kg}$ , idet der ikke regnes med virkningsgrad. Begge kræfter ligger ca. (18W-22.050)  $93 + 140 + 75 - 140 - 46 = 122 \text{ mm}$  under gitterets plan

lodrette tryk fra haandbremsen optages af dragerne

II og III:  $-N_8 = O_1 = \frac{4930 \times 122}{1290} = 466 \text{ kg}$   
 Lodret tryk fra luftbremse optages af dragerne VII og VIII og overføres af dragerne  $T_7 - T_8$  og  $O_3 - O_9$   
 $-T_7 = T_8 = -O_3 = O_9 = \frac{8955 \times 122}{2 \times 930} = 588 \text{ kg}$   
 $N_8 = -466 \text{ kg}$  giver:  $M_{XA} = -\frac{466 \times 94,8 \times 114,2}{293,2} = -17200 \text{ kg cm}$   
 $M \times B = -\frac{466 \times 94,8 \times 190,6}{293,2} = -28700 \text{ kg cm}$   
 $M \times D = -\frac{466 \times 73,6 \times 198,4}{293,2} = -23300 \text{ kg cm}$   
 $M \times C = -\frac{466 \times 94,8 \times 198,4}{293,2} = -29900 \text{ kg cm}$

Stk.	Betegnelse	Pos.	Material kvalit	Model nr. eller materiale størrelse	rå vægt	færdig vægt
4						
3						
2						
1						
Tegn. M. A.			Målestok:			
Kalk. B. F. 0/1-5/1			Norm.			
Dato			Rettelse		Indeks	
Anvendelse			Sykliste nr.			
Diesel-el. 500/550 HK. motorvogn.						
Tegningens benævnelse			Tegningens nummer			
Beregning af drager i undervogn.			18W-1.191.			