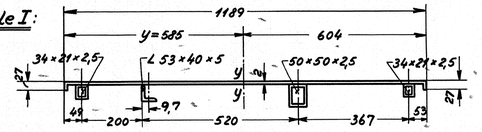
Søjle I:



□ 34×21×2,5: $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$ □ 80×50×2,5: $F = 6{,}25\,cm^2$ $Jy = 26\,cm^4$

L 53×40×5 $F = 4{,}46\,cm^2$; $Jy = 6{,}11\,cm^4$; $y = 9{,}7\,mm$.

$F = 2 \times 2{,}5 + 6{,}25 + 4{,}46 + (118{,}9 + 5{,}0) \times 0{,}2 = 5 + 6{,}25 + 4{,}46 + 24{,}78 = \underline{40{,}49\,cm^2}$

$y \sim \frac{2{,}5 \times 4{,}9 + 4{,}46 \times 25{,}87 + 24{,}78 \times 59{,}45 + 6{,}25 \times 76{,}9 + 2{,}5 \times 113{,}6}{40{,}49}$

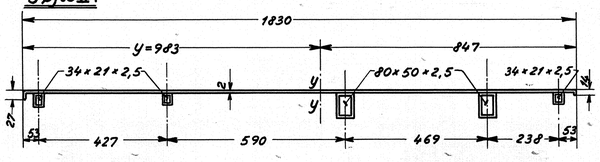
$y \sim 0{,}3 + 2{,}86 + 36{,}4 + 11{,}9 + 7{,}07 = 58{,}53\,cm \sim \underline{585\,mm}$

$Jy = 2 \times 1{,}62 + 2{,}5 \times (53{,}6^2 + 55{,}1^2) + 6{,}11 + 4{,}46 \times 32{,}63^2 + 26 - 6{,}25 \times 18{,}4^2 + \frac{1}{12} \times 0{,}2 \times 118{,}9^3 + 0{,}2 \times 118{,}9 \times 0{,}95^2 + 2 \times \frac{1}{12} \times 2{,}5 \times 0{,}2^3 + 2{,}5 \times 0{,}2 \times (58{,}4^2 + 60{,}3^2)$

$Jy = 3{,}24 + 14750 + 6{,}11 + 4780 + 26 + 2115 + 28000 + 204 + 0 + 3535$

$Jy = 53220{,}75\,cm^4 \sim \underline{53220\,cm^4}$; $Wy = \frac{53220}{60{,}4} = \underline{885\,cm^3}$.

Søjle II:



□ 34×21×2,5: $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$ □ 80×50×2,5. $F = 6{,}25\,cm^2$; $Jy = 26\,cm^4$

$F = 3 \times 2{,}5 + 2 \times 6{,}25 + 0{,}2 \times (183 + 3{,}7) = 7{,}5 + 12{,}5 + 37{,}34 = \underline{57{,}34\,cm^2}$

$y \sim \frac{2{,}5 \times (5{,}3 + 48 + 177{,}7) + 6{,}25 \times (107 + 153{,}9) + 37{,}34 \times 91{,}5}{57{,}34}$

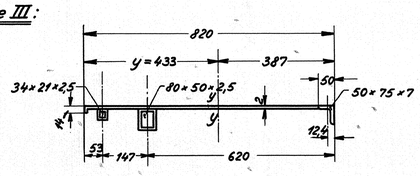
$y \sim 10{,}08 + 28{,}5 + 59{,}7 = 98{,}28\,cm \sim \underline{983\,mm}$

$Jy = 3 \times 1{,}62 + 2{,}5 \times (93^2 + 50{,}5^2 + 79{,}4^2) + 2 \times 26 + 6{,}25 (8{,}7^2 + 55{,}6^2) + \frac{1}{12} \times 0{,}2 \times 183^3 + 0{,}2 \times 183 \times 6{,}8^2 + \frac{1}{12} \times 2{,}5 \times 0{,}2^3 + 2{,}5 \times 0{,}2 \times 98{,}2^2 + \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 1{,}2 \times 84{,}6^3$

$Jy = 4{,}86 + 43800 + 52 + 19800 + 102100 + 1692 + 0 + 40 + 4820 + 0 + 1720$

$Jy = 173988{,}86\,cm^4 \sim \underline{173988\,cm^4}$ $Wy = \frac{173988}{98{,}3} = \underline{1770\,cm^3}$

Søjle III:



□ 34×21×2,5: $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$ □ 80×50×2,5: $F = 6{,}25\,cm^2$; $Jy = 26\,cm^4$

L 50×75×7: $F = 8{,}33\,cm^2$; $Jy = 16{,}4\,cm^4$; $y = 12{,}4\,mm$.

$F = 2{,}5 + 6{,}25 + 8{,}33 + 0{,}2 \times (82 - 5 + 1{,}2) = 2{,}5 + 6{,}25 + 8{,}33 + 15{,}64 = \underline{32{,}72\,cm^2}$

$y \sim \frac{2{,}5 \times 5{,}3 + 6{,}25 \times 20 + 8{,}33 \times 80{,}76 + 15{,}64 \times 38{,}5}{32{,}72}$

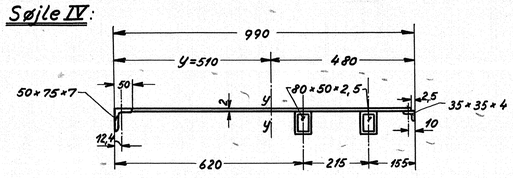
$y \sim 0{,}45 + 3{,}82 + 20{,}55 + 18{,}43 = 43{,}25\,cm \sim \underline{438\,mm}$

$Jy = 1{,}62 + 2{,}5 \times 38^2 + 26 + 6{,}25 \times 23{,}3^2 + 16{,}4 + 8{,}33 \times 37{,}46^2 + \frac{1}{12} \times 0{,}2 \times 77^3 + 0{,}2 \times 77 \times 4{,}8^2 + \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 1{,}2 \times 0{,}2 \times 43{,}2^2$

$Jy = 1{,}62 + 3610 + 26 + 3390 + 16{,}4 + 11700 + 7620 + 355 + 0 + 448$

$Jy = 27167{,}02\,cm^4 \sim \underline{27167\,cm^4}$; $Wy = \frac{27167}{43{,}3} = \underline{626\,cm^3}$

Søjle IV:



□ 80×50×2,5: $F = 6{,}25\,cm^2$; $Jy = 26\,cm^4$. L 50×75×7: $F = 8{,}33\,cm^2$; $Jy = 16{,}4\,cm^4$

L 35×35×4. $F = 2{,}67$; $Jy = 2{,}96\,cm^4$; $y = 10\,mm$.

$F = 8{,}33 + 2 \times 6{,}25 + 2{,}67 + 93{,}75 \times 0{,}2 = 8{,}33 + 12{,}5 + 2{,}67 + 18{,}75 = \underline{42{,}25\,cm^2}$

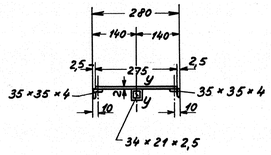
$y = \frac{8{,}33 \times 1{,}24 + 6{,}25 (62 + 83{,}5) + 2{,}67 \times 98 + 18{,}75 \times 51{,}88}{42{,}25}$

$y = 0{,}24 + 21{,}5 + 6{,}18 + 23{,}05 = 50{,}97\,cm \sim \underline{510\,mm}$.

$Jy = 16{,}4 + 8{,}33 \times 49{,}76^2 + 2 \times 26 + 6{,}25 \times (11^2 + 32{,}5^2) + 2{,}96 + 2{,}67 \times 47^2 + \frac{1}{12} \times 0{,}2 \times 93{,}75^3 + 18{,}75 \times 0{,}88^2 = 16{,}4 + 20600 + 52 + 7375 + 2{,}96 + 5900 + 13750 + 14{,}5$

$Jy = 47411{,}06\,cm^4 \sim \underline{47711}$ $Wy = \frac{47711}{51} = \underline{936\,cm^3}$.

Søjle V:



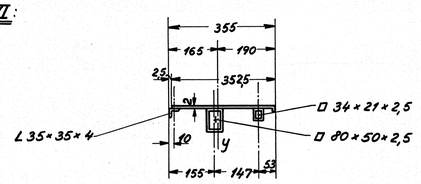
□ 34×21×2,5: $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$ L 35×35×4: $F = 2{,}67\,cm^2$; $Jy = 2{,}96\,cm^4$

$F = 2 \times 2{,}67 + 2{,}5 + 0{,}2 \times 27{,}5 = 5{,}34 + 2{,}5 + 5{,}5 = \underline{13{,}34\,cm^2}$ $y = \underline{140\,mm}$.

$Jy = 1{,}62 + 2 \times 2{,}96 + 2 \times 2{,}67 \times 13^2 + \frac{1}{12} \times 0{,}2 \times 27{,}5^3$

$Jy = 1{,}62 + 5{,}92 + 903 + 347 = 1257{,}54\,cm^4 \sim \underline{1258\,cm^4}$; $Wy = \frac{1258}{14} = \underline{90\,cm^3}$

Søjle VI:



□ 80×50×2,5: $F = 6{,}25\,cm^2$; $Jy = 26\,cm^4$; □ 34×21×2,5: $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$

L 35×35×4: $F \times 2{,}67\,cm^2$ $Jy = 2{,}96\,cm^4$.

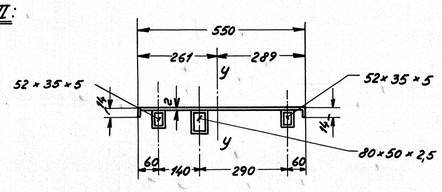
$F = 2{,}67 + 6{,}25 + 2{,}5 + 0{,}2 \times (35{,}25 + 1{,}2) = 2{,}67 + 6{,}25 + 2{,}5 + 7{,}05 + 0{,}24 = \underline{18{,}71\,cm^2}$

$y = \frac{2{,}67 \times 1{,}0 + 6{,}25 \times 16{,}5 + 2{,}5 \times 30{,}2 + 7{,}05 \times 17{,}875 + 0{,}24 \times 35{,}4}{18{,}71}$

$y = 0{,}14 + 5{,}18 + 4{,}03 + 6{,}73 + 0{,}45 = 16{,}53\,cm \sim \underline{165\,mm}$.

$Jy = 2{,}96 + 2{,}67 \times 15{,}5^2 + 26 + 6{,}25 \times 1{,}0^2 + 1{,}62 + 2{,}5 \times 13{,}7^2 + \frac{1}{12} \times 0{,}2 \times 35{,}25^3 + 7{,}05 \times 1{,}375^2 + \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 0{,}24 \times 18{,}9^2 = 2{,}96 + 641 + 26 + 6{,}25 + 1{,}62 + 469 + 730 + 13{,}33 + 0 + 85{,}8 = 1975{,}96 \sim 1976\,cm^4$ $Wy = \frac{1976}{19} \sim \underline{104\,cm^3}$

Søjle VII:



□ 52×35×5: $F = 7{,}7\,cm^2$ $Jy = 13{,}1\,cm^4$ □ 80×60×2,5: $F = 6{,}25\,cm^2$ $Jy = 26\,cm^4$

$F = 2 \times 7{,}7 + 6{,}25 + 0{,}2 \times (55 + 2{,}4) = 15{,}4 + 6{,}25 + 11 + 0{,}48 = 33{,}13\,cm^2$

$y = \frac{7{,}7 \times (6 + 49) + 6{,}25 \times 20 + 11{,}48 \times 27{,}5}{33{,}13}$

$y = 12{,}8 + 3{,}78 + 9{,}56 = 26{,}14\,cm \sim \underline{261\,mm}$.

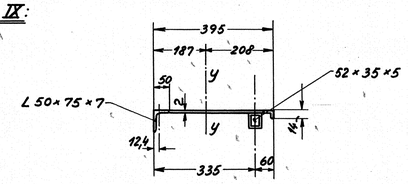
$Jy = 2 \times 13{,}1 + 7{,}7 \times (20{,}1^2 + 22{,}9^2) + 26 + 6{,}25 \times 6{,}1^2 + \frac{1}{12} \times 0{,}2 \times 55^3 + 11 \times 1{,}4^2 + 2 \times \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 0{,}24 \times (26^2 + 26{,}8^2)$

$Jy = 26{,}2 + 3118 + 4040 + 26 + 232 + 2765 + 21{,}6 + 0 + 162 + 199$

$Jy = 10589{,}8\,cm^4 \sim \underline{10590\,cm^4}$.

$Wy = \frac{10590}{28{,}9} = \underline{366\,cm^3}$.

Søjle IX:



□ 52×35×5: $F = 7{,}7\,cm^2$; $Jy = 13{,}1\,cm^4$ L 50×75×7: $F = 8{,}33\,cm^2$ $Jy = 16{,}4\,cm^4$

$F = 8{,}33 + 7{,}7 + 0{,}2 \times (34{,}5 + 1{,}2) = 8{,}33 + 7{,}7 + 6{,}9 + 0{,}24 = \underline{23{,}17\,cm^2}$

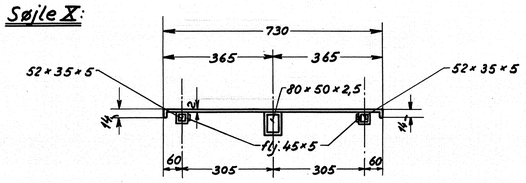
$y = \frac{8{,}33 \times 1{,}24 + 7{,}7 \times 33{,}5 + 6{,}9 \times 22{,}25 + 0{,}24 \times 39{,}4}{23{,}17}$

$y = 0{,}45 + 11{,}16 + 6{,}64 + 0{,}41 = 18{,}66\,cm \sim \underline{187\,mm}$.

$Jy = 16{,}4 + 8{,}33 \times 17{,}46^2 + 13{,}1 + 7{,}7 \times 14{,}8^2 + \frac{1}{12} \times 0{,}2 \times 34{,}5^3 + 6{,}9 \times 3{,}55^2 + \frac{1}{12} \times 12 \times 0{,}2^3 + 0{,}24 \times 20{,}7^2 = 16{,}4 + 2538 + 13{,}1 + 1687 + 685 + 87 + 0 + 103$

$Jy = 5129{,}5\,cm^4 \sim \underline{5130\,cm^4}$ $Wy = \frac{5130}{20{,}8} = \underline{247\,cm^3}$

Søjle X:



□ 52×35×5: $F = 7{,}7\,cm^2$; $Jy = 13{,}1\,cm^4$ □ 80×50×2,5: $F = 6{,}25\,cm^2$ $Jy = 26\,cm^4$

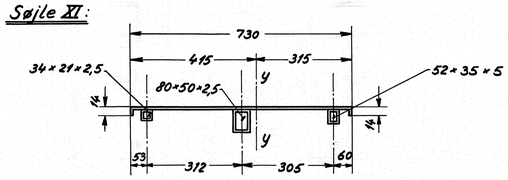
$F = 2 \times 7{,}7 + 6{,}25 + 0{,}2 \times (73 + 1{,}2 + 1{,}2) = 15{,}4 + 6{,}25 + 14{,}6 + 0{,}24 + 0{,}24 = \underline{36{,}73\,cm^2}$

$Jy = 2 \times 13{,}1 + 2 \times 7{,}7 \times 30{,}5^2 + 26 + \frac{1}{12} \times 0{,}2 \times 73^3 + 2 \times \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 0{,}48 \times 36{,}4^2 + 2 \times \frac{1}{12} \times 4{,}5 \times 0{,}5^3 + 2 \times 0{,}5 \times 4{,}5 \times 27{,}65^2$

$Jy = 26{,}2 + 14330 + 26 + 6480 + 0 + 636{,}0 + 0 + 3440 = 24938{,}2 \sim \underline{24938\,cm^4}$

$Wy = \frac{24938}{36{,}5} = \underline{685\,cm^3}$.

Søjle XI:



□ 80×50×2,5: $F = 6{,}25\,cm^2$ $Jy = 26\,cm^4$ □ 52×35×5: $F = 7{,}7\,cm^2$; $Jy = 13{,}1\,cm^4$

□ 34×21×2,5: $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$

$F = 2{,}5 + 6{,}25 + 7{,}7 + 0{,}2 \times (73 + 2{,}4) = 2{,}5 + 6{,}25 + 7{,}7 + 14{,}6 + 0{,}48 \sim \underline{31{,}53\,cm^2}$

$y = \frac{2{,}5 \times 5{,}3 + 6{,}25 \times 36{,}5 + 7{,}7 \times 67 + 15{,}08 \times 36{,}5}{31{,}53}$

$y = 0{,}42 + 7{,}24 + 16{,}38 + 17{,}48 = 41{,}52\,cm \sim \underline{415\,mm}$.

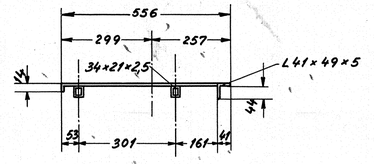
$Jy = 1{,}62 + 2{,}5 \times 36{,}2^2 + 26 + 6{,}25 \times 5^2 + 13{,}1 + 7{,}7 \times 25{,}5^2 + \frac{1}{12} \times 0{,}2 \times 73^3 + 14{,}6 \times 5^2 + 2 \times \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 0{,}24 \times (41{,}4^2 + 31{,}4^2)$

$Jy = 1{,}62 + 3278 + 26 + 156{,}4 + 13{,}1 + 5010 + 6480 + 365 + 0 + 412 + 237$

$Jy = 15979{,}12\,cm^4 \sim \underline{15979\,cm^4}$

$Wy = \frac{15979}{41{,}5} = \underline{384\,cm^3}$.

Søjle XII:



□ 34×21×2,5 $F = 2{,}5\,cm^2$; $Jy = 1{,}62\,cm^4$

$F = 2 \times 2{,}5 + 0{,}2 \times (51{,}5 + 1{,}2) + 0{,}5 \times (4{,}1 + 4{,}4) = 5 + 10{,}3 + 0{,}24 + 2{,}05 + 2{,}2 = \underline{1979\,cm^2}$

$y = \frac{2{,}5 \times (5{,}3 + 35{,}4) + 10{,}3 \times 25{,}75 + 0{,}24 \times 0{,}1 + 2{,}05 \times 53{,}55 + 2{,}2 \times 51{,}75}{19{,}79}$

$y = 0{,}67 + 4{,}48 + 13{,}4 + 0 + 5{,}55 + 5{,}75 = 29{,}85\,cm \sim \underline{299\,mm}$.

$Jy = 2 \times 1{,}62 + 2{,}5 \times (24{,}6^2 + 5{,}5^2) + \frac{1}{12} \times 1{,}2 \times 0{,}2^3 + 0{,}24 \times 29{,}8^2 + \frac{1}{12} \times 0{,}2 \times 51{,}5^3 + 10{,}3 \times 4{,}15^2 + \frac{1}{12} \times 0{,}5 \times 4{,}1^3 + 2{,}05 \times 23{,}65^2 + \frac{1}{12} \times 4{,}4 \times 0{,}5^3 + 2{,}2 \times 21{,}85^2$

$Jy = 3{,}24 + 1513 + 75{,}6 + 0 + 213{,}5 + 2280 + 177{,}5 + 2{,}87 + 1150 + 0 + 1052$

$Jy = 6467{,}71\,cm^4 \sim \underline{6467\,cm^4}$

$W = \frac{6467}{29{,}9} = \underline{216\,cm^3}$.

<u>Belastning forsat fra tegning nr. 18W-1.140.</u>

2) bagage med 50% overlast $1{,}5 \times 1600 = \underline{2400\,kg}$.

Fordeles over 4115 mm. fra 4342 − 2750 = 1545 mm bag A til 5660 bag A. $P_2 = \frac{2400}{2 \times 4115} = \underline{2{,}92\,kg/cm \sim 1200\,kg}$.

3) passagerer m. 50% overlast: $2780 \times 1{,}5 = 4170\,kg$. Sofaer ca. 700 kg, ved kedelside 320 kg. Passagerer og sofaer fordeles over 9090 mm. Fra 1875 bag B til 7215 foran B.

Ved kedelside: $\frac{320 \times 2466}{2932} + \frac{380 \times 766}{2932} + \frac{4170}{2} = 270 + 100 + 2085 = 2455\,kg$

$P_3 = \frac{2455}{909} = \underline{2{,}7\,kg/cm}$.

4) restvægten fordeles jævnt over 19700 mm. med halvdelen pr. side. Restvægten udgør (18W-1.130):

$(17400 - 1600 - 700 - 930) + (550 - 425) + 800 + 250 + 200 + 600 = 14170 + 125 + 1950 = 16145\,kg$ pr. side 8072 kg $P_4 = \frac{8072}{1970} \sim \underline{4{,}1\,kg/cm}$.

<u>Samlet belastning ved kedelside:</u>

$P_I = P_{II} = \underline{512\,kg}$. $P_{III} = \underline{375\,kg}$ $P_{IV} = 290 + 193 = \underline{483\,kg}$ $P_V = \underline{247\,kg}$

$P_{VI} = 8 + 23 = \underline{31\,kg}$. $P_{VII} = 535 + 75 + 101 = \underline{711\,kg}$ $P_{VIII} = 135 + 16 = \underline{151\,kg}$.

$P_{IX} = 1125 + 132 + 365 + 87 + 84 = \underline{1793\,kg}$ $P_X = 1125 + 05 + 126 + 84 + 31 + 146 = \underline{1778\,kg}$. $P_{XI} = 77 + 137 + 121 = \underline{335\,kg}$ $P_{XII} = 106 + 87 + 31 + 60 + 87 = \underline{371\,kg}$ $P_{XIII} = 9 + 235 + 65 = \underline{309}$ $P_{XIV} = \underline{90\,kg}$

$P_1 = \underline{0{,}39\,kg/cm \sim 550\,kg}$ fordelt over 14195 mm. mellem A og B

$P_2 = \underline{2{,}92\,kg/cm \sim 1200\,kg}$ fordelt over 4115 mm. fra 1545 bag A til 5660 bag A.

$P_3 = \underline{2{,}70\,kg/cm \sim 2455\,kg}$ fordelt over 9090 mm. fra 1875 bag B til 7215 foran B.

$P_4 = \underline{4{,}1\,kg/cm \sim 8072\,kg}$ fordelt over 19700 mm.

Tegn. F.U. 18/11-50	Rev.		Afd.	IV L	Måleslok: 1:10
Kalk. D.F. 20/3-50	Norm. Ma.N.	Dato			
Dato	Rettelse			Indeks	FRICHS
Anvendelse					Stykliste nr.
Diesel-el. 500/550 HK-Mo. motorvogn.					
Tegningens benævnelse					Tegningens nummer
Beregning af vognside.					18W - 1.141.
					Indeks: