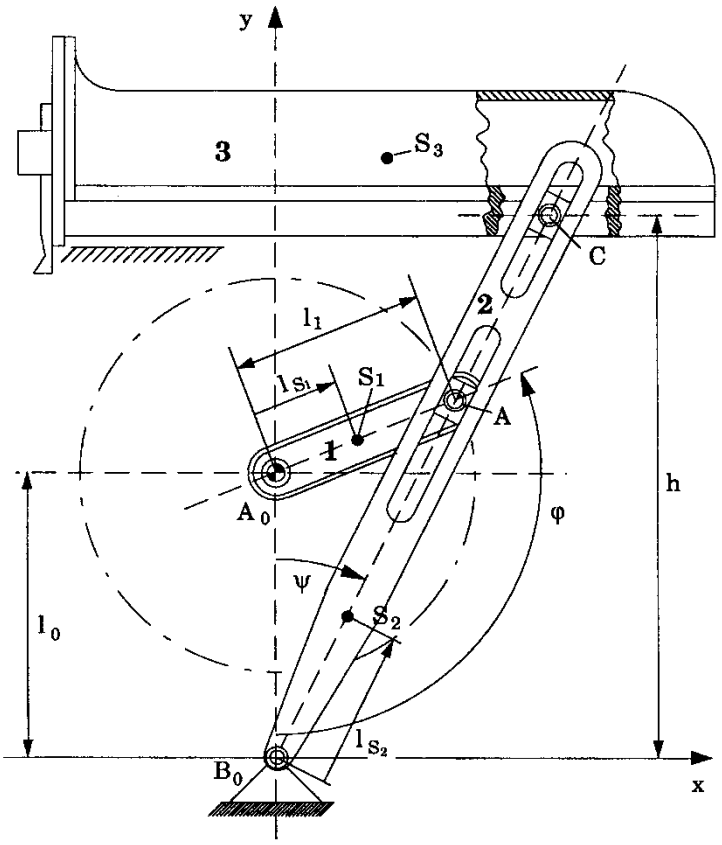
Task 1 Shaping Machine (Whitworth Mechanism)

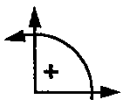
Task

For dimensioning the foundation of a shaping machine, the inertial forces must be determined. The masses of the sliders are negligible. The shaft rotates with constant rpm n_1.

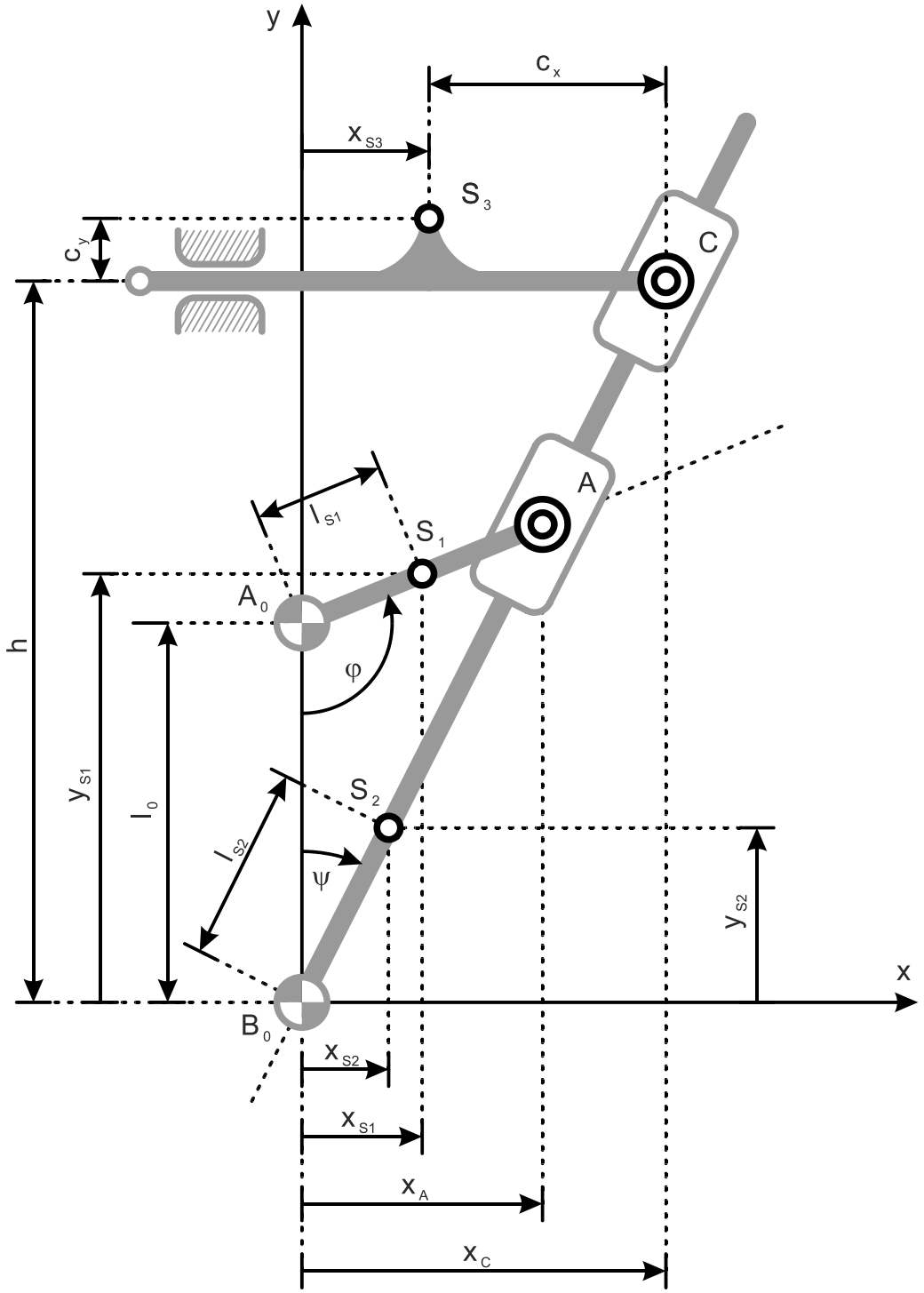
a) The components of translational accelerations of the centres of gravity S_1, S_2, and S_3 in x- and y- direction should be determined for the positions $\varphi = 0$ and $\varphi = \pi$ as well as for both dead positions.
b) The components of corresponding inertial forces should be determined for these positions



m_1	=	15	kg
m_2	=	30	kg
m_3	=	50	kg
l_0	=	400	mm
l_1	=	150	mm
l_{S1}	=	40	mm
l_{S2}	=	150	mm
h	=	650	mm
n_1	=	100	U/min



$\omega=\dot{\varphi}=2\pi f$	[1/s]	10,472			
$\lambda=\frac{l_1}{l_0}$	[-]	0,375			
φ	[°]	0	180	67,975	292,024
$\tan\psi$	[-]	0	0	0,405	-0,405
$\sin\psi$	[-]	0	0	0,375	-0,375
$\cos\psi$	[-]	1	1	0,927	0,927
$1/\cos^2\psi$	[-]	1	1	1,164	1,164
ψ'	[-]	0,6	-0,273	0	0
ψ''	[-]	0	0	-0,404	0,404
$\ddot{x}_{S1}$	[m/s^2]	0	0	-4,07	4,07
$\ddot{y}_{S1}$	[m/s^2]	4,39	-4,39	1,64	1,64
$\ddot{x}_{S2}$	[m/s^2]	0	0	-6,17	6,17
$\ddot{y}_{S2}$	[m/s^2]	-5,92	-1,22	2,49	2,49
$\ddot{x}_{S3}$	[m/s^2]	0	0	-33,5	33,5
F_{x_1}	[N]	0	0	61,0	-61,0
F_{y_1}	[N]	-65,8	65,8	-24,6	24,6
F_{x_2}	[N]	0	0	185,0	-184,0
F_{y_2}	[N]	177,7	36,7	-74,8	-74,8
F_{x_3}	[N]	0	0	1677	-1677
$\Sigma F_x=F_{x_1}+F_{x_2}+F_{x_3}$	[N]	0	0	1923	-1923
$\Sigma F_y=F_{y_1}+F_{y_2}$	[N]	111,9	102,5	-99,4	-99,4


y
x
c_x
x_{S3}
S_3
c_y
C
A
l_{S1}
S_1
A_0
h
φ
y_{S1}
l_0
S_2
l_{S2}
ψ
y_{S2}
B_0
x_{S2}
x_{S1}
x_A
x_C