Cos(ϕ) compensation

P	7000	Load Power [Watt]
U	230	Load rms Line-Neutral voltage
cos(ϕ)	0.85	Load cos(ϕ)
Rcable/meter	0.01	Cable resistance per meter[Ω per meter]
Lcable/meter	1.0E-5	Cable inductance per meter[H per meter]
Cable length	25	Cable length [meter]

Calculate

Calculate nominal power

Load parameters P and cos(ϕ) are defined for U without cable

Apparent power per phase S[VA] = P/cos(ϕ)=8235[VA]
Q[VAR] = sqrt(S^2-P^2)=sqrt(8235*8235-7000*7000)=4338[VAR]
Inom[A] = S/U=8235/230=35.806[A]

Calculate load resistance
From P and I the load resistance is calculated:
R_{load}[ohm]=P/I^2=7000/(35.806*35.806)=5[ohm]

Calculate load inductance
From reactive power, the load inductance is calculated
X_{load}=Q/I^2=4338/(35.806*35.806)=3.384[ohm]
L_{load}[mH]=X_{load}/(2 π f)=3/314.15927=10.8[mH]

Calculate cable resistance and inductance
R_{cable}[mΩ]=R_{cable}[per meter]* length [per phase]=10*25=250[mΩ]
L_{cable}[mH]=L_{cable}[per meter]* length [per phase]=0.01*25=0.25[mH]
X_{cable}[Ω]=L_{cable}*2 π f=0.25*314.15927=0.079[Ω]
Z_{cable}[Ω]=sqrt(R_{cable}^2+X_{cable}^2)=sqrt(0.25*0+0.079*0)=0.262[Ω]

Calculate total resistance and inductance seen from the source
R_{tot}[Ω]=R_{cable}+R_{load}=0.25+5=5.71[Ω]

$L_{tot}[mH]=L_{cable}+L_{load}=0.25+0=11.021[mH]$
$X_{tot}[\Omega]=L_{tot}*2\ \pi\ f=11.021*314.15927=3.462[\Omega]$
$Z_{tot}[\Omega]=sqrt(R_{tot}^2+X_{tot}^2)=sqrt(5.71*6+3.462*3)=6.678[\Omega]$

Calculate new current
$Inew=U/Z_{tot}= 230/6.678=34.44[A]$

Calculate apparent power
$S=U*I_{new}= 230*34.443=7922[VA]$

Calculate Cable loss
$R_{cable}*Inew^2= 0*34.443*34.443=297[Watt]$

Calculate power delivered to the load
$R_{load}*Inew^2= 5*34.443*34.443=6477[Watt]$

Calculate Load voltage
$U_{load}new=U-Zcable*Inew = 230-0*34.443=221[Volt]$

Calculate new cos(ϕ)
$Cos(\phi) =(Pcable+Pload)/S = (297+6477)/7922=0.855$

Calculate Reactive power for calculating the compensation capacitor
$Q[VAR] = sqrt(S^2-(Pcable+Plaod)^2)=sqrt(7922*7922-6773.81*6773.81)=4107[VAR]$

Calculate compensation capacitor
$Xc = U^2/Q = 230*230/4107=13[\Omega]$
$C = 1/(2\pi*f*Xc) = 1/(314.15927*13=247[\mu F]$