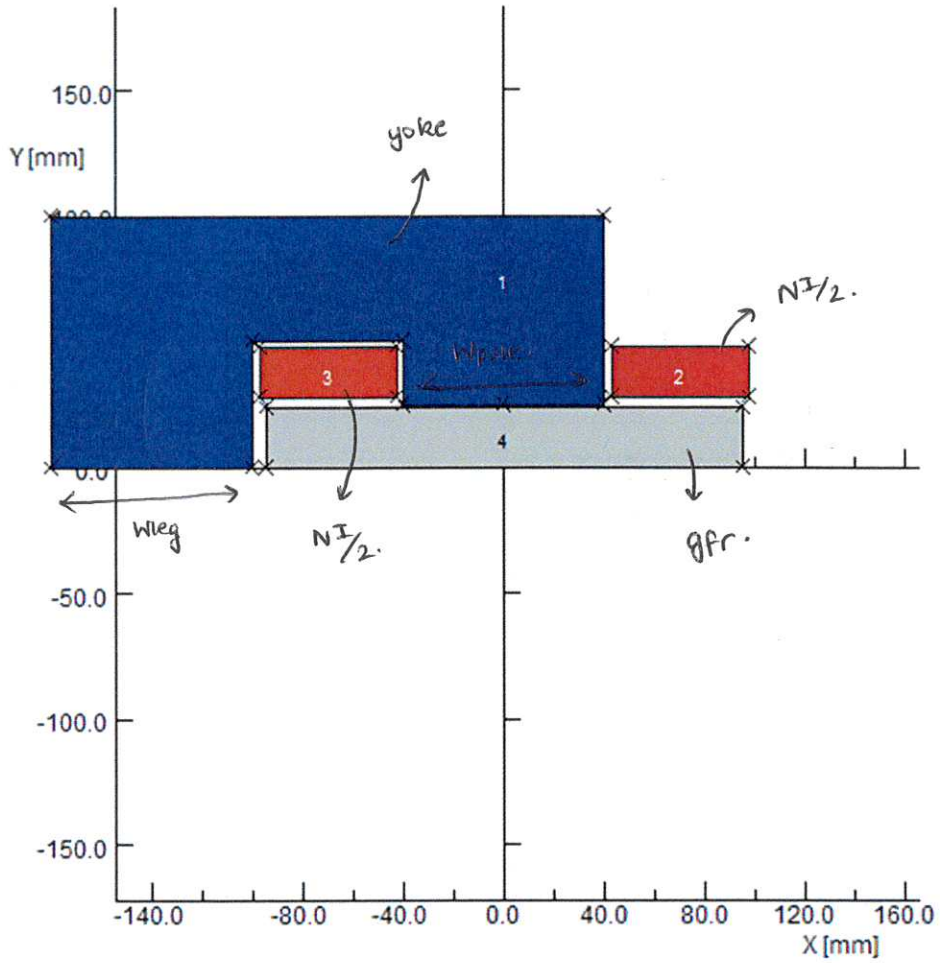
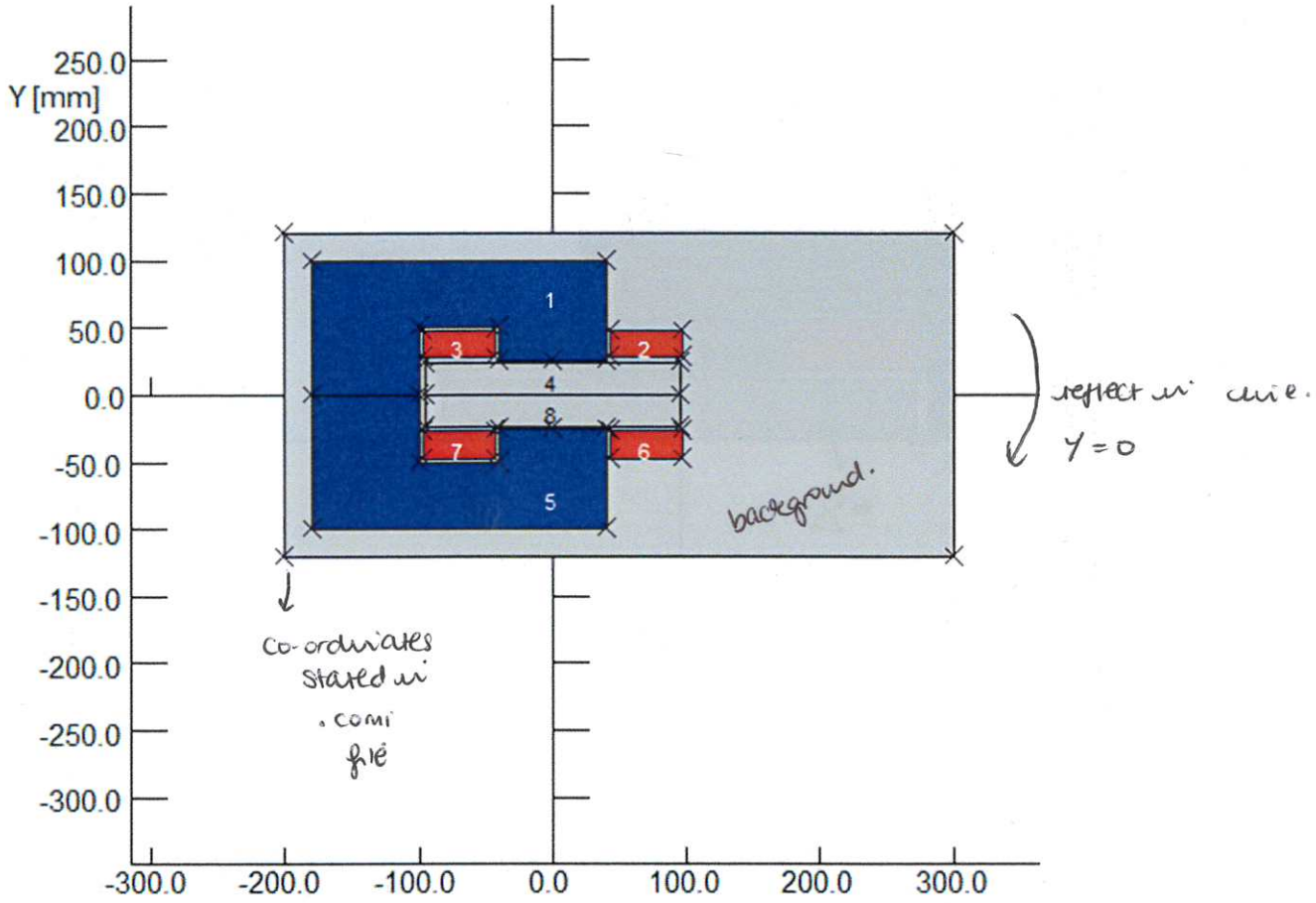
Dip_c.comi file: Showing yoke [1], coils [2,3], and good field region [4].

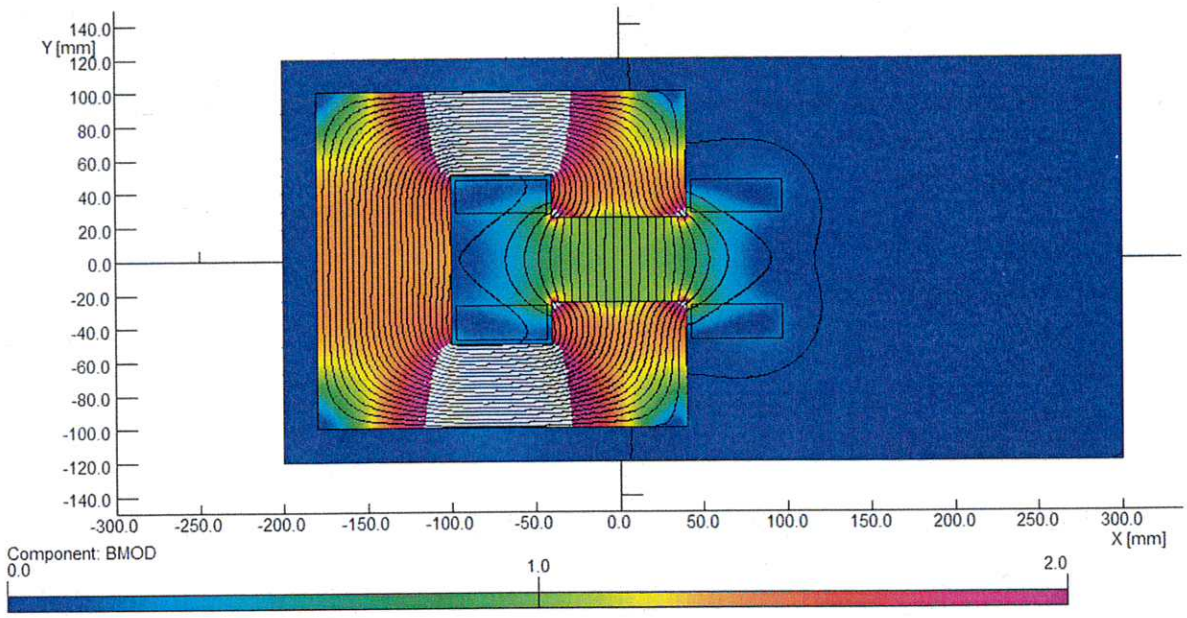


Dip_c_full.comi file: Showing yoke [1,5], coils [2,3,6,7], and good field region [4,8].

After mirroring the solution found in Dip_c.comi.



Dip_c_full.comi file: Showing magnetic flux lines and magnetic flux density for the C shaped dipole.



Dip_c_full.comi annotated file:

```
clear
yes

set symmetry=xy solution=at element=quadratic field=magnetic
units length=mm flux=tesla field=am vector=wbm conductivity=smm curd=amm2 force=newton
energy=joule power=watt mass=kg scalar=amp
section fixedaspect=yes

/ parameters
$string filename 'dip_C_full'
#ni=3*20000
#coil_w=54
#coil_h=20
#crrd=#ni/(2*#coil_w*#coil_h)

#mu=1000

#mshf=0.75 |/ meshing factor

/ yoke
draw shape=polygon material=3 n=0 perm=#mu density=0
 cart xp=0 yp=25
 cart xp=-40 n=#mshf*40
 cart yp=50 n=#mshf*15
 cart xp=-100 n=#mshf*20
 cart yp=0 n=#mshf*20
 cart xp=xp-80 n=#mshf*20
 cart yp=100 n=#mshf*25
 cart xp=40 n=#mshf*45
 cart yp=25 n=#mshf*25
 fini n=#mshf*40
quitdraw

/ material properties
bhdata material=3 type=isotropic
 loadbh file='iron_M1200-100A'
quitbh

/ coil
draw material=1 density=#crrd perm=1
 cart xp=43 yp=27.5
 cart xp=xp+#coil_w n=#mshf*20
 cart yp=yp+#coil_h n=#mshf*10
 cart xp=xp-#coil_w n=#mshf*20
 fini n=#mshf*10
```

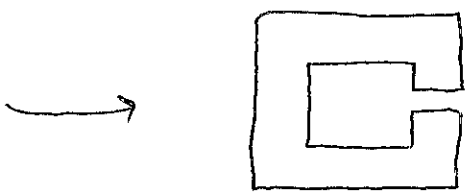
← ampère turns
← coil width
← coil height
← current density

← permeability

← how many points along a line to perform calculations.

↓ units and cartesian axes

↘ iron



} describe material for yoke.

← specify one corner of coil

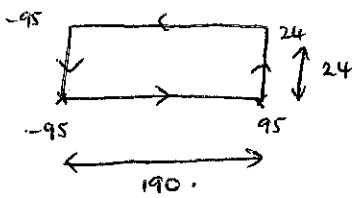
← use already allocated height and width of coil.

```
quitdraw
draw material=1 density=-#crrd perm=1
 cart xp=-43 yp=27.5
 cart xp=xp-#coil_w n=#mshf*20
 cart yp=yp+#coil_h n=#mshf*10
 cart xp=xp+#coil_w n=#mshf*20
 fini n=#mshf*10
quitdraw
```

draw second coil
← again specify only one corner.

```
/ gfr
draw material=0 perm=1 density=0
 cart xp=-95 yp=0
 cart xp=95 n=#mshf*190
 cart yp=24 n=#mshf*24
 cart xp=-95 n=#mshf*190
 fini n=#mshf*24
quitdraw
```

← good field region.




```
/ copies
copy reg1=1 reg2=4 dx=0 dy=0 mirror=yes theta=0
```

Reflect in the line $y = 0$.

```
/ background
draw shape=background material=0 perm=1 density=0
 cart xp=-200 yp=-120
 cart xp=300 n=#mshf*60 f=v
 cart yp=120 n=#mshf*60 f=v
 cart xp=-200 n=#mshf*60 f=v
 fini n=#mshf*60 f=v
quitdraw
```

Specify background material and size.

```
/ solve
solve type=st
 data linear=no niterations=50 tolerance=1.0e-04 ittype=newton restart=yes
quitsolve
```

produces .st file

```
$exist '&filename&.op2'
$if fileexists eq 1
 write file='&filename&.op2' solvenow=yes
 yes
$elif fileexists eq 0
 write file='&filename&.op2' solvenow=yes
$end if

/ post-processing
point method=cart xp=0 yp=0
$cons #Bc By

/ display options for post-processing
```

```
reco reg1=1 reg2=* material=all not=any mesh=no background=yes phase=no erase=yes fill=material
nodes=none label=no axes=yes
reconstruct xmin=-300 xmax=300 ymin=-150 ymax=150 reg1=1 reg2=* material=all not=any
mesh=no background=yes phase=no erase=yes fill=material nodes=none label=no axes=yes
section fixedaspect=yes

/ plot of field + flux lines
$cons #b_from 0
$cons #b_to 2
contour component=bmod style=zone label=values automatic=no start=#b_from finish=#b_to
lines=100 reg1=1 reg2=* material=all not=any deformed=no homogeneity=no erase=yes
contour component=pot style=line label=no automatic=yes lines=20 colour=text reg1=1 reg2=*
material=all not=any deformed=no homogeneity=no erase=no

/ harmonics computation
#r_ref=17   |/ reference radius for the multipoles
#r_sampl=17 |/ radius where to sample the field
#np=2000    |/ number of points to be used in the integral
#i_harm=0
$parameter #integrand 1/pi*1/#r_sampl*Br*sin(#i_harm*th/180*pi)
$do #i_harm 1 21 1
  circle p1=0 p2=360 radius=#r_sampl np=#np xcentre=0 ycentre=0 component=#integrand
  $constant #big_b%int(#i_harm) integral*(#r_ref/#r_sampl)**(#i_harm-1)
$end do
$do #i_harm 1 21 1
  $constant #small_b%int(#i_harm) 10000*#big_b%int(#i_harm)/#big_b1
$end do

/ write harmonics to file
$open stream=1 file='&filename&.dat' authority=overwrite redirect=no
$format number=2 type=string string=' ' variable=yes
$format number=1 type=expo width=0 variable=no
$assign 1
$write stream=1 #big_b%int(1)
$do #i_harm 2 21 1
  $write stream=1 #small_b%int(#i_harm)
$end do
$close stream=1

/ deltaB/B plot
line x1=-17 y1=0 y2=y1 x2=17 np=100 curvature=0 component=by homogeneity=yes xref=0 yref=0
erase=yes print=no automatic=yes
```

fills .dat file full of harmonics values e.g b1, b2...

← file to check for homogeneity in field