clear in case previously other sections/code was run

```
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
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

/ 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

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

/ background
draw shape=background material=0 perm=1 density=0
```

units

number of current turns

coil dimensions

density

for computation

drawing the yoke, labeled 1 on the diagram

Instructions to draw top half of "C"

return to the start

load material from database

current density = crrd

draw the coils

2

negative current

3

air/vacuum

mirrors, see figure (2)

drawing the background, ideally would go to ∞ but use reasonable estimate

can be quite close to iron as field lines "stay" in iron

```
  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

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

$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
```

← solver

← further away from "open" side

← # of iterations / tolerance of over relaxation method

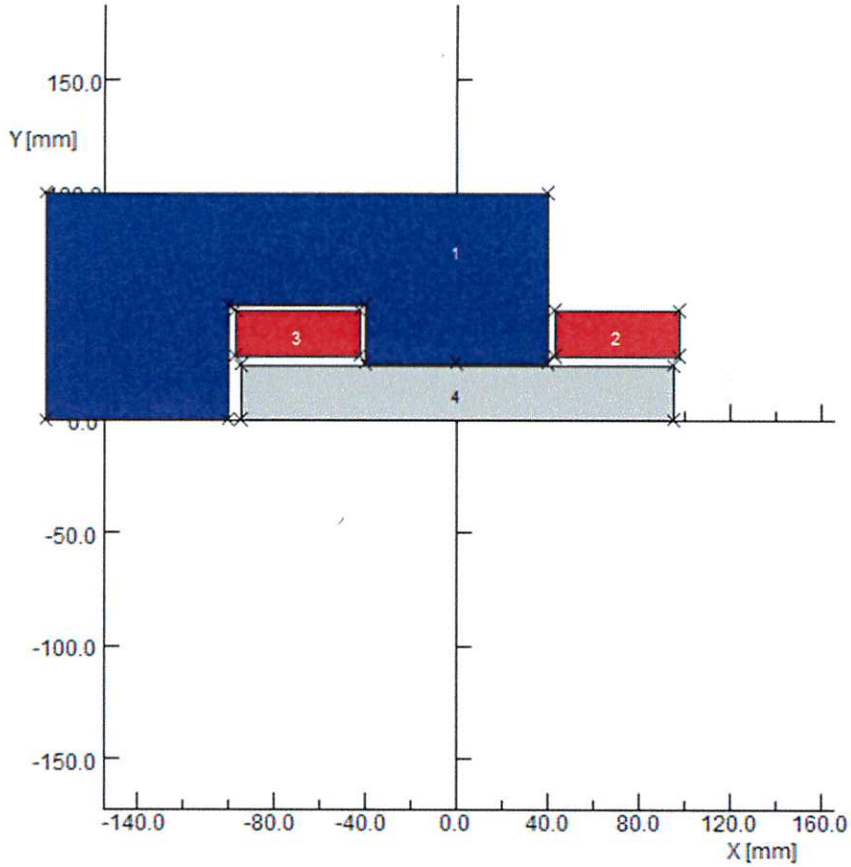
figure (3) plotted

calculate harmonics by integrating across field

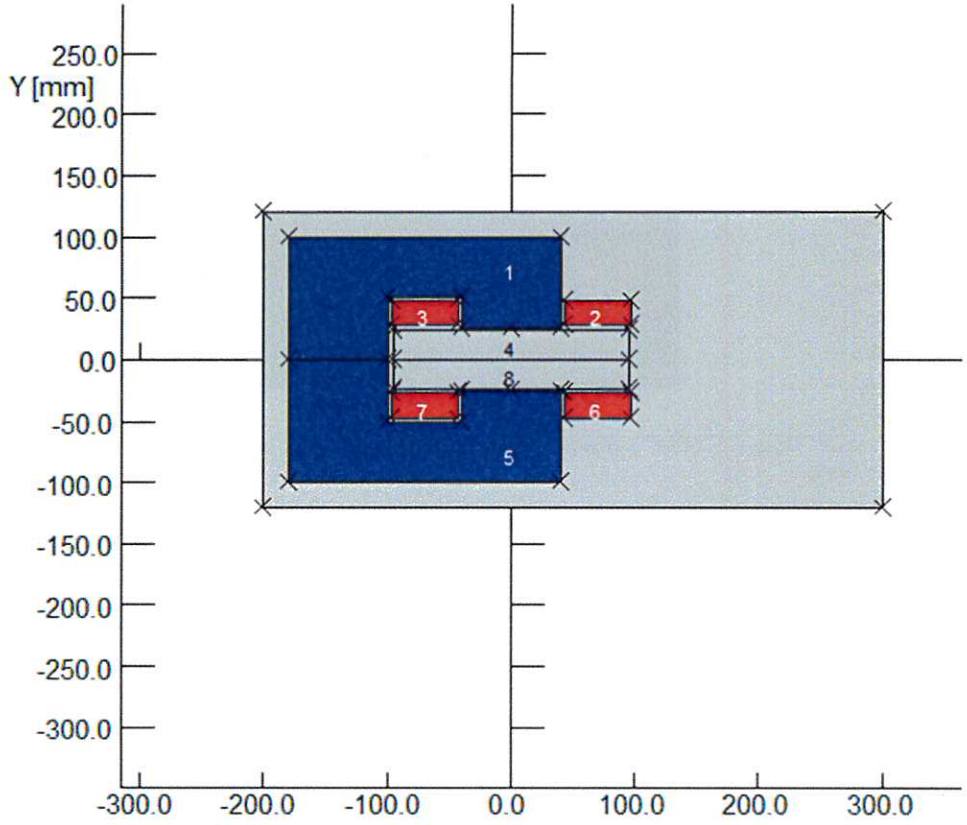
write harmonics to a file

plot delta B/B along a horizontal line

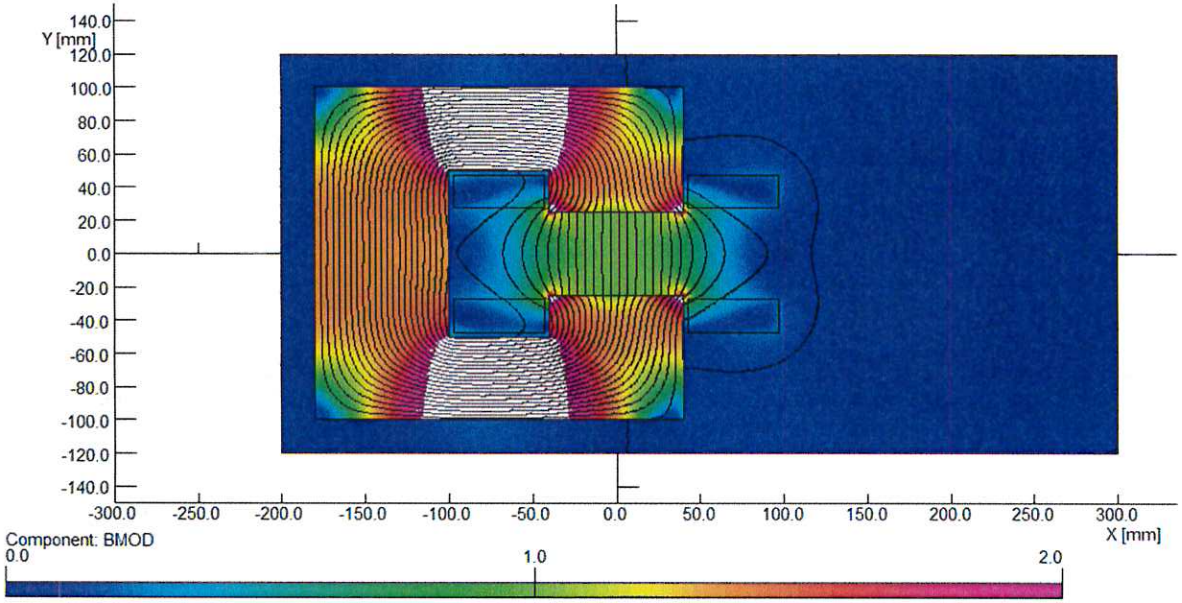
(1)


150.0
Y [mm]
1
2
3
4
-50.0
-100.0
-150.0
-140.0
-80.0
-40.0
0.0
40.0
80.0
120.0
160.0
X [mm]

(2)


250.0
Y [mm]
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
-200.0
-250.0
-300.0
1
2
3
4
5
6
7
8
-300.0
-200.0
-100.0
0.0
100.0
200.0
300.0

(3)


Y [mm]
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
-120.0
-140.0
-300.0
-250.0
-200.0
-150.0
-100.0
-50.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
X [mm]
Component: BMOD
0.0
1.0
2.0