Appendix B

DESCRIPTION OF SECOND-ORDER TEST RUNS

WAMIT V6S includes additional 8 standard test runs illustrating the evaluation of various second-order quantities. It includes 4 low-order and 4 higher-order applications.

The following table gives relevant features of each test run. In this table the first column *tst* denotes the name of the test run. All of the corresponding input/output files (except FNAMES.WAM) are assigned the filenames TEST*tst*. (For example, the input POT file for the first test run listed below is TEST101.POT.) *tst* contains three digits starting with 1 for the second-order applications, the second digit is 0 for low-order test runs (ILOWHI=0), and 1 for higher-order test runs (ILOWHI=1). Test runs which are identical except for different input options are assigned the same number with a letter suffix. Thus TEST103(TEST113) and TEST103a(TEST113a) describe the same problem using different options to evaluate the second-order solution.

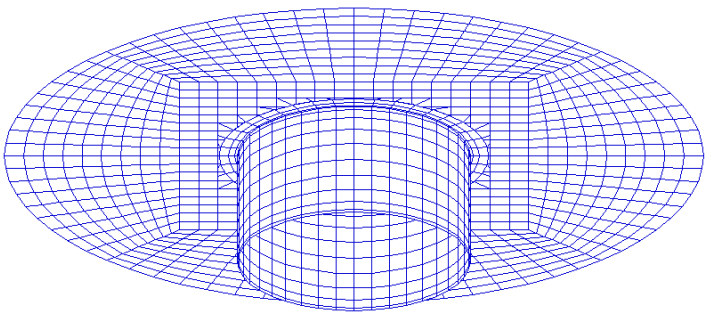
tst	geometry	ILOWHI	other parameters/comments
101	Bottom mounted cylinder	0	
102	Truncated cylinder	0	
103	Cylinder & spheroid	0	Free surface forcing ignored
103a	Cylinder & spheroid	0	
111	Bottom mounted cylinder	1	
112	Truncated cylinder	1	
113	Cylinder & spheroid	1	Free surface forcing ignored
113a	Cylinder & spheroid	1	

B.1 BOTTOM MOUNTED CYLINDER – TEST101

The first-order quantities including exciting forces, pressures and fluid velocities on the body, field pressures and wave elevation, field velocities, drift forces are evaluated. In addtion, the second-order quantities including quadratic forces, complete forces by direct and indirect methods, pressures on the body, field pressures, wave elevations are evaluated for a bottom mounted vertical circular cylinder of radius 1 meter and draft 1 meter, in finite water depth of 1 meter for two wave periods and two wave headings. Two second harmonic of unidirectional waves, a mean and a difference frequency of bidirectional waves are considered in the second-order computation (see PT2 file).

Using two planes of symmetry, only the first quadrant of the surface of the cylinder is discretized with 100 panels. 10 panels are distributed in the azimuthal and vertical directions with double cosine spacing in the latter. The characteristic length (ULEN) is set equal to the radius of the cylinder.

The free surface inside the inner circle of radius 3 meters is discretized automatically with 252 panels on the first quadrant. No intermediate region is considered and the partition radius is the same as the radius of inner circle. Perspective view of the body and the inner region of the free surface is shown below.



TEST101.GDF:

```
TEST101 Bottom mounted cylinder R=1 T=1 Cosine spacing
   1.000000       9.806650
          1           1
        100
  0.9876884      0.1564345      0.0000000E+00
   1.000000      0.0000000E+00  0.0000000E+00
   1.000000      0.0000000E+00 -2.7999997E-02
  0.9876884      0.1564345     -2.7999997E-02
```

TEST101.POT:

```
TEST101.POT  Bottom mounted Cylinder R=1, T=1, igdef=-1
 1.
 -1           1               IRAD, IDIFF
 2                            NPER (array PER follows)
0.4   0.8
 2                            NBETA (array BETA follows)
 0.  90.
 1                            NBODY
 test101.gdf
 0. 0. 0. 0.                  XBODY
 1  1  1  1  1  1             IMODE(1-6
 0                            NEWMDS
```

TEST101.FRC:

```
TEST101.FRC  Bottom mounted Cylinder R=1, T=1, igdef=-1
 0   0   1   0   3   2   2   2   2   1   1   1   1   1   1   0   (IOPTN 1-16)
 0.000000                                  VCG
 1.000000      .0000000      .0000000
 .0000000      1.000000      .0000000
 .0000000      .0000000      1.000000      XPRDCT
 0                                         NBETAH
 1
 1.044325      8.2290111E-02  0.0000000E+00
```

TEST101.PT2:

```
TEST101.PT2 -- PT2
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
1 1
2
1 1 1
1 1
2 2 1
```

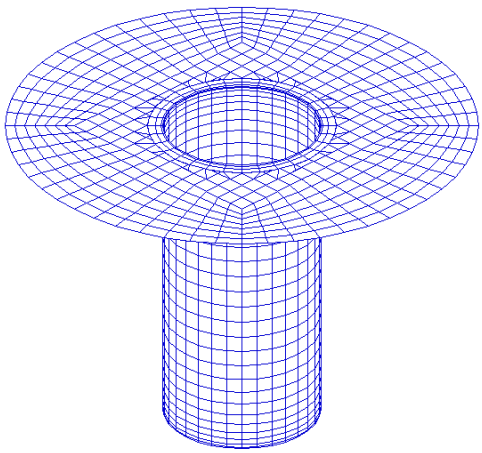
```
1 1
2
1 1 1
1 1
1 2  1
1 2

TEST101.FDF:
TEST101.FDF
  3.0000E+00    Inner radius (=Partition radius)
  -1.   1.      Auto Discretization, Scale=1.
   0            No intermediate region

TEST101.CFG:
 IPLTDAT=1
 ILOWGDF=1
 ILOWHI=0
 ISOR=1
 IALTPOT=2
 IRR=0
 ISOLVE=2
 KSPLIN=3
 IQUADO=3
 IQUADI=4
 IPERIO=3
 MONITR=0
 NUMHDR=1
 I2ND=1
 ILOG=1
 NOOUT= 1 1 1 1 0 1 1 1 1  1  1  1  0  1  1  1
 USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

B.2 TRUNCATED CIRCULAR CYLINDER – TEST102

The first-order exciting forces, drift forces and the second-order quadratic forces and complete second-order forces by direct and indirect methods are evaluated for a vertical circular cylinder of radius 8.435 meters and draft 35 meters, in infinite water depth for two wave periods and two wave headings. All sum- and difference frequency pairs and wave heading pairs are considered for the second-order forces.

Using two planes of symmetry, only the first quadrant of the surface of the cylinder is discretized with 320 panels. 8, 28, 12 panels are distributed in the azimuthal, vertical and radial directions with double cosine spacing on the side and cosine spacing toward the corner at the bottom. The characteristic length (ULEN) is set equal to the radius of the cylinder.

The free surface inside the inner circle of radius 25.305 meters, three times of the cylinder radius, is automatically discretized with 159 panels on the first quadrant. The intermediate region consists of two annuli of width 16.87 meters, two times the radius of the cylinder. On each annulus, $2^4 + 1$ nodes and 8 nodes Gauss quadratures are applied in azimuthal and radial direction, respectively. The partition circle coincides with the outside circle of the second annulus and its radius is 58.45 meters. Perspective view of the body and the inner region of the free surface is shown below.



```
TEST102.GDF:
TEST102.GDF -- Cylinder R=8.435 T=35 meters, Cosine spacing at corner and waterline
   8.435000       9.806650
            1           1
          320
   8.272924       1.645587      0.0000000E+00
   8.435000      0.0000000E+00  0.0000000E+00
   8.435000      0.0000000E+00 -0.1307399
   8.272924       1.645587     -0.1307399

TEST102.POT:
TEST102  (Cylinder R=8.435 T=35 in infinite depth water)
-1.  0.  0.  0.  0.
 -1  1
 1  1  1  1  1  1
 2
 7.8934  5.1207
 2
 0. 90.

TEST102.FRC:
TEST102 -- Linear, mean and second-order exciting forces
   0    0    1    0    0    0    0    2   2   1    1    1    0    0    0    0
         .0000000
         1.000000      .0000000      .0000000
         .0000000      1.000000      .0000000
         .0000000      .0000000      1.000000
          0
          0

TEST102.PT2:
TEST102  (All frequency and wave heading combinations)
 -1  1      IRAD2=-1 IDIF2=1 (Exciting force only)
 1 1 1 1 1 1
 2 2

TEST102.FDF:
TEST102  Single cylinder R=8.435, Inner radius= 3*R, partition radius= 7*R
   25.30500
    -1    1.0
    2    16.87   4     8

TEST102.CFG:
 IPLTDAT=1
```

```
MAXSCR=1024
ISOR=1
IQUAD=0
ILOG=1
IDIAG=0
IRR=0
NUMHDR=1
IALTPOT = 1    !  Alternative Form 1 POT/CFG
IALTFRC = 1    !  Alternative Form 1 FRC
I2ND=1
USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

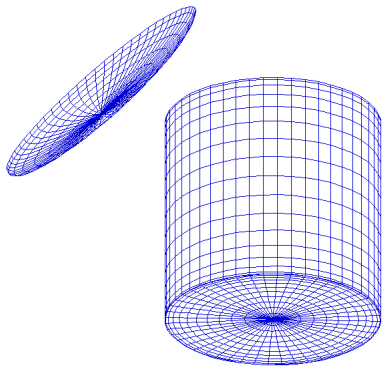
B.3 MULTIPLE BODIES (APPROXIMATION) – TEST103

The NBODY option is illustrated in this test run. The bodies are the same as TEST05. Body one is a circular cylinder of radius 1 meter and draft 2 meters. Body 2 is a spheroid of length 4 meters and maximum radius 0.25 meters. The gap between these two bodies is set equal to the beam of the spheroid (0.5 meters) and the origin of the global coordinate system is located at the mid-point of this gap. The relative locations of the two bodies and the orientation of the spheroid are specified in the GGDF file. One quadrant of the cylinder is discretized with 336 panels. 12,12 and 16 panels are distributed in the azimuthal, radial, and vertical directions using cosine spacing in radial and vertical directions. One quadrant of the spheroid is discretized with 128 panels. 16 and 8 panels are distributed in the longitudinal, and transverse directions.

The Alternative 1 input format is used for the POTEN subprogram and the Alternative 3 input format is used for FORCE. The vector IALTFRCN is included in TEST103.CFG to indicate that IALTFRC(1)=1 for the cylinder and IALTFRC(2)=2 for the spheroid in the separate FRC files.

The cylinder is fixed and the spheroid is free to move. The added-mass and damping coefficients and the first-order exciting forces, motions, wave elevations, field pressures, field velocities and mean drift forces are evaluated in infinite water depth for two wave periods and one wave heading (POT file). The second-order forces, wave elevations and field pressures are evaluated for all difference frequency pairs (PT2 file).

The forcing on the body due to the second-order incident wave and due to the first-order body motion of the spheriod are considered but the forcing on the free surface is ignored (FDF file).



```
TEST103.GDF:
TEST103.GDF -- GGDF file for use with IALTPOT=1 (Cylinder + Spheroid)
 -1. 9.80665
 2
 test103c.gdf
 1.25 0.0 0.0 0.0
 0   0   0   0   0   0    fixed
 test103s.gdf
 -0.5 0.0 0.0 90.0
 1   1   1   1   1   1    all modes are free

TEST103C.GDF: (first 8 lines only)
TEST103 & TEST103A    Cylinder R=1 T=2 Double cosines side, cosine bottom
   1.000000       9.806650
            1           1
          336
  0.0000000E+00  0.0000000E+00  -2.000000
  0.0000000E+00  0.0000000E+00  -2.000000
  0.1294095      1.7037088E-02  -2.000000
  0.1305262      0.0000000E+00  -2.000000

TEST103S.GDF: (first 8 lines only)
TEST103 TEST103A Spheriod L=2 R1=R2=0.25
   1.000000       9.806650
            1           1
          128
   1.990369      2.4504285E-02 -1.0927847E-08
   2.000000      0.0000000E+00 -1.0927847E-08
   1.961571      0.0000000E+00 -4.8772592E-02
   1.952125      2.4033442E-02 -4.8772592E-02

TEST103.POT:
TEST103.POT --  CYLINDER + SPHEROID, ILOWHI=0
 -1.0 0.0 0.0 0.0 0.0
 0   1                          Dummy (check TEST103.gdf)
 0  0  0  0  0  0               Dummy
 2
 8.971402  2.006403
 1
 0.0

TEST103.FRC:
TEST103.FRC -- Cylinder SPHEROID  , ILOWHI=0
  1  1  1  1  0  1  1  1  1  1  1  1  1  1  1  0
```

```
 1.0
test103C.frc
test103S.frc
 0
 1
 0.0001 0.0001 0.
```

```
TEST103C.FRC:
TEST 103 Cylinder
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0.000000
 1.000000       .0000000       .0000000
 .0000000       1.000000       .0000000
 .0000000       .0000000       1.000000
 0
 0
```

```
TEST103S.FRC:
TEST103S Floating Spheroid
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 1.         rho (water density)
 0. 0. 0.   XCG (center of grativity w.r.t. body coordinates)
 1          IMASS (radii of gyration are assumed 1)
 0.257621   0.         0.         0.         0.         0.
 0.         0.257621   0.         0.         0.         0.
 0.         0.         0.257621   0.         0.         0.
 0.         0.         0.         0.257621   0.         0.
 0.         0.         0.         0.         0.257621   0.
 0.         0.         0.         0.         0.         0.257621
 0      IDAMP (if damped change it to 1 and add 6 x 6 damping forces)
 0      ISITF (if restoring force applied change it to 1 and add 6 x 6 elements)
 0
 0
```

```
TEST103.PT2:
TEST103 -- PT2
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
0 2            (all difference frequency pairs)
```

```
TEST103.FDF:
TEST103  -- Free suface forcing not included (NPF,NTCL,NAL=0)
```

```
   5.    PARTR (irrelavant because no foricing considered)
   0        0    NPF, NTCL
   0             NAL

TEST103.CFG
 IPLTDAT=1
 MAXSCR=2000
 ISOR=1
 IQUAD=0
 ILOG=1
 IDIAG=0
 IRR=0
 NUMHDR=1
 NOOUT=0  1  1  1  0  1  1  1  1  1  1  1  0  1  1  0
 IALTPOT = 1    !  GDF names in GGDF file
 IALTFRC = 3    !  Alternative Form 3 FRC for GFRC TEST33.FRC
 IALTFRCN= 1 2  !  form 1 TEST103c.FRC and Form 2 spheriod TEST103s.FRC
 I2ND=1
 USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

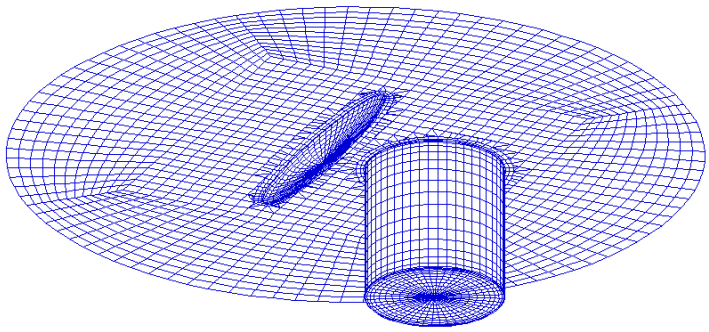
B.3A MULTIPLE BODIES – TEST103A

This test is the same as TEST103 except the free surface forcing is not ignored in the second-order computation.

The cylinder is fixed and the spheroid is free to move. The added-mass and damping coefficients and the first-order exciting forces, motions, wave elevations, field pressures, field velocities and mean drift forces are evaluated in infinite water depth for two wave periods and one wave heading.

The second-order forces, wave elevations and field pressures are evaluated for all difference frequency pairs (see PT2 file).

The free surface inside the inner circle of radius 5 meters is discretized automatically with 2052 panels over the entire inner region. No intermediate region is considered and the partition radius is the same as the radius of inner circle. Perspective view of the body and the inner region of the free surface is shown below.



```
TEST103A.GDF:
TEST103A.GDF -- GGDF file for use with IALTPOT=0 (Cylinder + Spheroid)
 -1. 9.80665
 2
 test103c.gdf
 1.25 0.0 0.0 0.0
 0   0   0   0   0   0    fixed
 test103s.gdf
 -0.5 0.0 0.0 90.0
 1   1   1   1   1   1    all modes are free

TEST103C.GDF: (first 8 lines only)
TEST103 & TEST103A    Cylinder R=1 T=2 Double cosines side, cosine bottom
   1.000000       9.806650
            1           1
          336
  0.0000000E+00  0.0000000E+00  -2.000000
  0.0000000E+00  0.0000000E+00  -2.000000
  0.1294095      1.7037088E-02  -2.000000
  0.1305262      0.0000000E+00  -2.000000

TEST103S.GDF: (first 8 lines only)
TEST103 TEST103A Spheriod L=2 R1=R2=0.25
   1.000000       9.806650
            1           1
          128
   1.990369      2.4504285E-02 -1.0927847E-08
   2.000000      0.0000000E+00 -1.0927847E-08
   1.961571      0.0000000E+00 -4.8772592E-02
   1.952125      2.4033442E-02 -4.8772592E-02

TEST103A.POT:
TEST103A.POT --  CYLINDER + SPHEROID, ILOWHI=0
 -1.0 0.0 0.0 0.0 0.0
 0   1                          Dummy (check TEST103.gdf)
 0  0  0  0  0  0               Dummy
 2
 8.971402  2.006403
 1
 0.0

TEST103A.FRC:
TEST103A.FRC -- Cylinder SPHEROID  , ILOWHI=0
  1  1  1  1  0  1  1  1  1  1  0  1  0  1  1  0
```

```
 1.0
test103C.frc
test103S.frc
 0
 1
 0.0001 0.0001 0.
```

```
TEST103C.FRC:
TEST 103 Cylinder
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0.000000
 1.000000       .0000000       .0000000
 .0000000       1.000000       .0000000
 .0000000       .0000000       1.000000
 0
 0
```

```
TEST103S.FRC:
TEST103S Floating Spheroid
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 1.         rho (water density)
 0. 0. 0.   XCG (center of grativity w.r.t. body coordinates)
 1          IMASS (radii of gyration are assumed 1)
 0.257621   0.         0.         0.         0.         0.
 0.         0.257621   0.         0.         0.         0.
 0.         0.         0.257621   0.         0.         0.
 0.         0.         0.         0.257621   0.         0.
 0.         0.         0.         0.         0.257621   0.
 0.         0.         0.         0.         0.         0.257621
 0      IDAMP (if damped change it to 1 and add 6 x 6 damping forces)
 0      ISITF (if restoring force applied change it to 1 and add 6 x 6 elements)
 0
 0
```

```
TEST103A.PT2:
TEST103 -- PT2
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
0 2            (all difference frequency pairs)
```

```
TEST103A.FDF:
TEST103A AND 113A
```

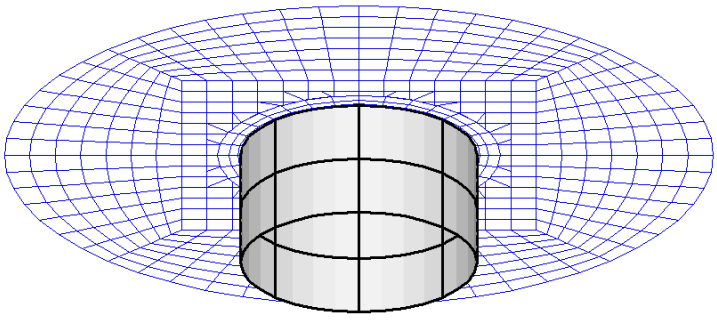
```
   5.    PARTR
   -1       1.5    AUTO-DISCRETIZATION, SCALE=1.5
   0             NAL

TEST103A.CFG
 IPLTDAT=1
 MAXSCR=2000
 ISOR=1
 IQUAD=0
 ILOG=1
 IDIAG=0
 IRR=0
 NUMHDR=1
 NOOUT=0  1  1  1  0  1  1  1  1  1  1  1  0  1  1  0
 IALTPOT = 1    !  GDF names in GGDF file
 IALTFRC = 3    !  Alternative Form 3 FRC for GFRC TEST33.FRC
 IALTFRCN= 1 2  !  form 1 TEST103c.FRC and Form 2 spheriod TEST103s.FRC
 I2ND=1
 USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

B.11 BOTTOM MOUNTED CYLINDER – TEST111

The test uses the same cylinder as in the low-order TEST101. The first-order quantities including exciting forces, pressures and fluid velocities on the body, field pressures and wave elevation, field velocities, drift forces are evaluated. In addtion, the second-order quantities including quadratic forces, complete forces by direct and indirect methods, pressures on the body, field pressures, wave elevations are evaluated for a bottom mounted vertical circular cylinder of radius 1 meter and draft 1 meter, in finite water depth of 1 meter for two wave periods and two wave headings. Two second harmonic of unidirectional waves, a mean and a difference frequency of bidirectional waves are considered in the second-order computation (see PT2 file).

Using two planes of symmetry, only the first quadrant of the surface of the cylinder is divided into 4 higher-order panels as shown below. The order of B-spline is set KSPLIN=3 in CFG file. Uniform mapping is used as the pressure and velocity are finite on the body surface.

The free surface inside the inner circle of radius 3 meters is discretized automatically with 159 panels on the first quadrant. No intermediate region is considered and the partition radius is the same as the radius of inner circle. Perspective view of the body and the inner region of the free surface is shown below.



```
TEST111.GDF:
TEST111 Bottom mounted cylinder R=1 T=1 -- analytic geometry (npatch=1)
1. 9.80665  ULEN GRAV
1  1        ISX  ISY
1  -1       NPATCH  IGDEF
2
1.0 1.     RADIUS, DRAFT
0          Uniform mapping

TEST111.SPL:
TEST111.spl - cylinder R=1 T=1. -- analytic geometry (npatch=1)
2  2        NU NV (Patch 1, side   u azimuthal v vertical)

TEST111.POT
 TEST111.POT  Cylinder R=1, T=1, igdef=-1
 1.
 -1           1               IRAD, IDIFF
 2                            NPER (array PER follows)
0.4 0.8
 2                          NBETA (array BETA follows)
 0. 90.
 1                            NBODY
 test111.gdf
 0. 0. 0  0.                  XBODY
 1  0  0  0  0  0             IMODE(1-6)
 0                            NEWMDS

TEST111.FRC:
TEST111.FRC  Bottom mounted Cylinder R=1, T=1.0, igdef=-1
 0   0   1   0   3   1   1   2   2   1   1   1   1   1   1   0   IOPTN(1-16)
 0.000000                                  VCG
 1.000000      .0000000      .0000000
 .0000000      1.000000      .0000000
 .0000000      .0000000      1.000000      XPRDCT
 0                                         NBETAH
 1                                         NFIELD
 1.044325      8.2290111E-02  0.0000000E+00  XFILED

TEST111.PT2:
TEST111.PT2 -- PT2
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
1 1
```

```
2
1 1 1
1 1
2 2 1
1 1
2
1 1 1
1 1
1 2  1
1 2
```

TEST111.FDF:

```
TEST111.FDF
  3.0000E+00    Inner radius (=Partition radius)
  -1.   1.      Auto Fdf, Scale=1.
   0            No intermediate region
```

TEST111.CFG:

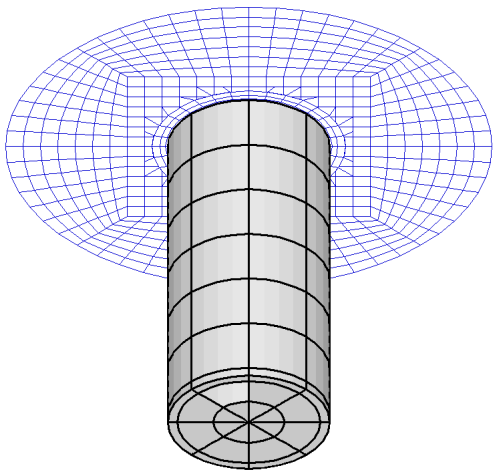
```
 IPLTDAT=4
 ILOWGDF=4
 ILOWHI=1
 IALTPOT=2
 IRR=0
 ISOLVE=1
 KSPLIN=3
 IQUADO=3
 IQUADI=4
 IPERIO=3
 MONITR=0
 NUMHDR=1
 I2ND=1
 IPOTEN=1
 ILOG=1
 NOOUT= 1 1 1 1 0 1 1 1 1  1  1  1  0  1  1  1
 USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

B.12 TRUNCATED CIRCULAR CYLINDER – TEST112

The test uses the same cylinder as in the low-order TEST102. The first-order exciting forces, drift forces and the second-order quadratic forces and complete second-order forces by direct and indirect methods are evaluated for a vertical circular cylinder of radius 8.435 meters and draft 35 meters, in infinite water depth for two wave periods and two wave headings. All sum- and difference frequency pairs and wave heading pairs are considered for the second-order forces.

Using two planes of symmetry, the first quadrant of the surface of the cylinder is represented with 4 patches including two narrow patches near the corner, one on the side and the other on the bottom. The width of these patches is 1 meter. Nonuniform mapping corresponding to the corner flow is used on these patches. The rest of each surface on the side and bottom is represented be a patch with unform mapping. 20 higher-order panels are specified on the first quadrant of the surface as shown in the following figure.

The free surface inside the inner circle of radius 25.305 meters, three times of the cylinder radius, is automatically discretized with 159 panels on the first quadrant. The intermediate region consists of two annuli with width of 16.87 meters, two times the radius of the cylinder. On each annulus, $2^4 + 1$ nodes and 8 nodes Gauss quadratures are applied in azimuthal and radial directions, respectively. The partition circle coincides with the outside circle of the second annulus and its radius is 58.45 meters. Perspective view of the body and the inner region of the free surface is shown below.



```
TEST112.GDF:
TEST112.GDF -- Cylinder R=8.435m D=35m, nonuniform mapping 1m from corner
     8.435       9.80665
     1           1
     4  -101
     1
     8.435 35. 1.  RADIUS, DRAFT, WIDTH OF CORNER PATCHES

TEST112.SPL:
TEST112.SPL -- 2 azimuthal, 6 side vertical, 2 bottom radial, 1 corner patches
2 6   Side above corner patch  (2 azimutal, 6 vertical)
2 1   Side corner patch        (2           1 vertical)
2 2   Bottom inside patch      (2           2 radial  )
2 1   Bottom corner patch      (2           1 radial

TEST112.POT:
TEST112.POT infinite depth, diffraction only
-1  0.  0.  0.  0.
 -1  1
 1  1  1  1  1  1
 2
 7.8934  5.1207
 2
 0. 90.

TEST112.FRC:
TEST112.FRC -- Linear, mean and second-order exciting forces
   0    0    1    0    0    0    0    2   2   1    1    1    0    0    0    0
        .0000000
        1.000000      .0000000      .0000000
        .0000000      1.000000      .0000000
        .0000000      .0000000      1.000000
         0
         0


TEST112.PT2:
TEST112  (All frequency and wave heading combinations)
 -1  1      IRAD2=-1 IDIF2=1 (Exciting force only)
 1 1 1 1 1 1
 2 2
```

```
TEST112.FDF
TEST112  Single cylinder R=8.435, Inner radius= 3*R, partition radius= 7*R
   25.30500
    -1    1.0
    2    16.87   4     8

TEST112.CFG:
 MAXSCR=1000
 IPLTDAT=4
 IQUAD=0
 ILOG=1
 IDIAG=0
 IRR=0
 ISOR=0
 NUMHDR=1
 IALTPOT = 1    !  Alternative Form 1 POT/CFG
 IALTFRC = 1    !  Alternative Form 1 FRC
 I2ND=1
 ILOWHI=1
 KSPLIN=3
 IQUADO=3
 IQUADI=4
 ISOLVE=1
 USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

B.13 MULTIPLE BODIES (APPROXIMATION) – TEST113

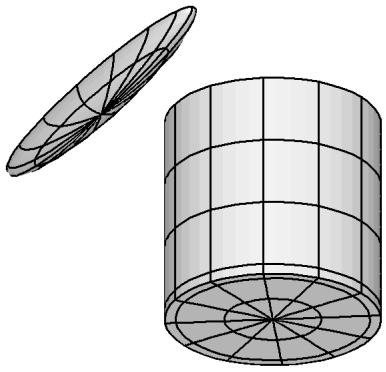
The bodies are the same as TEST103. One quadrant of the cylinder is represented with 4 patches. Nonuniform mapping corresponding to corner flows is used on the patches of width 0.1 meter at the corner. Uniform mapping is used on the other patches on the side and bottom. The first quadrant of the cylinder is represented by 21 higher order panels and that of the spheroid by 8 panels.

The Alternative 2 input format is used for the POTEN subprogram and the Alternative 3 input format is used for FORCE. The vector IALTFRCN is included in TEST113.CFG to indicate that IALTFRC(1)=1 for the cylinder and IALTFRC(2)=2 for the spheroid in the separate FRC files.

The cylinder is fixed and the spheroid is free to move. The added-mass and damping coefficients and the first-order exciting forces, motions, wave elevations, field pressures, field velocities and mean drift forces are evaluated in infinite water depth for two wave periods and one wave heading.

The second-order forces, wave elevations and field pressures are evaluated for all difference frequency pairs (see PT2 file). The forcing on the free surface is ignored. The forcing on the body due to the second-order incident wave and due to the first-order body motion of the spheriod are considered but that on the free surface is ignored (see FDF file).

Perspective view of the body and the inner region of the free surface is shown below.



```
TEST113C.GDF:
TEST113C cylinder R=1 T=2 -- analytic geometry (npatch=4)
1. 9.80665  ULEN GRAV
1  1        ISX  ISY
4  -13       NPATCH  IGDEF
1           NLINES
1.0 2. 0.1     RADIUS, DRAFT


TEST113S.GDF:
TEST113S spheroid  a=2, b=c=0.25 -- igdef=-4
1. 9.80665  ULEN GRAV
1  1        ISX  ISY
1  -4       NPATCH  IGDEF
1
2.0 0.25 0.25    A, B, C

TEST113.POT:
 TEST113.POT -- Cylinder + spheroid, ILOWHI=1
 -1.
 0           1               IRAD, IDIFF
 2                            NPER (array PER follows)
 8.971402  2.006403
 1                           NBETA (array BETA follows)
 0.
 2                            NBODY
 test113c.gdf
 1.25 0.0 0.0 0.0             XBODY
 0  0  0  0  0  0             IMODE(1-6)
 0                            NEWMDS
 test113s.gdf
 -0.5 0.0 0.0 90.0            XBODY
 1  1  1  1  1  1             IMODE(1-6)
 0                            NEWMDS

TEST113.FRC:
TEST113.FRC -- Cylinder SPHEROID
  1  1  1  1  0  1  1  1  1  1  1  1  1  1  0
  1.0
 test113C.frc
 test113S.frc
  0
  1
```

```
  0.0001 0.0001 0.

TEST113C.FRC:
 TESTS 103 and 113 Fixed Cylinder
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0.000000
 1.000000      .0000000      .0000000
 .0000000      1.000000      .0000000
 .0000000      .0000000      1.000000
 0
 0

TEST113S.FRC:
 TESTS 103 and 113 Floating Spheroid
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 1.        rho (water density)
 0. 0. 0.  XCG (center of gravity w.r.t. body coordinates)
 1         IMASS (radii of gyration are assumed 1)
 0.257621  0.        0.        0.        0.        0.
 0.        0.257621  0.        0.        0.        0.
 0.        0.        0.257621  0.        0.        0.
 0.        0.        0.        0.257621  0.        0.
 0.        0.        0.        0.        0.257621  0.
 0.        0.        0.        0.        0.        0.257621
 0     IDAMP (if damped change it to 1 and add 6 x 6 damping forces)
 0     ISITF (if restoring force applied change it to 1 and add 6 x 6 elements)
 0
 0

TEST113.PT2:
TEST103  AND TEST 113 -- PT2
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
0 2            (all difference frequency pairs)

TEST113.FDF:
TEST103 AND 113 -- Free suface forcing not included (NPF,NTCL,NAL=0)
   5.    PARTR (irrelavant because no foricing considered)
   0        0    NPF, NTCL
   0             NAL

TEST113.CFG:
```

```
ILOWGDF=4
IPLTDAT=4
MAXSCR=1000
ILOWHI=1
IALTPOT=2
IRR=0
ISOLVE=2
KSPLIN=3
IQUADO=3
IQUADI=4
IPERIO=1
NUMHDR=1
NOOUT=  0  1  1  1  0  1  1  1  1  1  1   1  0  1  1  0
IALTFRC = 3    !  Alternative Form 3 FRC
IALTFRCN= 1 2
I2ND=1
ILOG=1
USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```

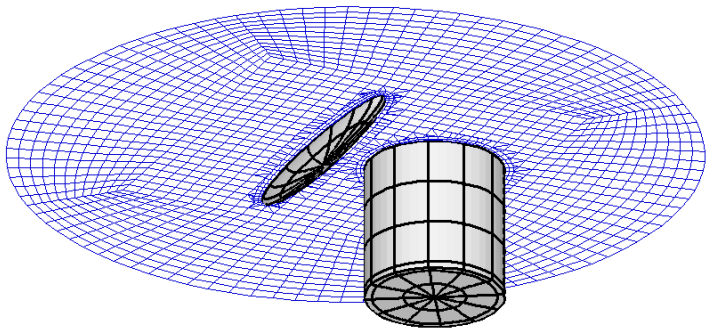
B.13A MULTIPLE BODIES – TEST113A

This test is the same as TEST113 except the free surface forcing is not ignored in the second-order computation.

The cylinder is fixed and the spheroid is free to move. The added-mass and damping coefficients and the first-order exciting forces, motions, wave elevations, field pressures, field velocities and mean drift forces are evaluated in infinite water depth for two wave periods and one wave heading.

The second-order forces, wave elevations and field pressures are evaluated for all difference frequency pairs (see PT2 file).

The free surface inside the inner circle of radius 5 meters is discretized automatically with 2052 panels over the entire inner region. No intermediate region is considered and the partition radius is the same as the radius of inner circle. Perspective view of the body and the inner region of the free surface is shown below.



```
TEST113C.GDF:
TEST113C cylinder R=1 T=2 -- analytic geometry (npatch=4)
1. 9.80665  ULEN GRAV
1  1        ISX  ISY
4  -13       NPATCH  IGDEF
1           NLINES
1.0 2. 0.1     RADIUS, DRAFT, WIDTH OF CONNER PATCHES


TEST113S.GDF:
TEST113S spheroid  a=2, b=c=0.25 -- igdef=-4
1. 9.80665  ULEN GRAV
1  1        ISX  ISY
1  -4       NPATCH  IGDEF
1
2.0 0.25 0.25    A, B, C

TEST113A.POT:
 TEST113A.POT -- Cylinder + spheroid, ILOWHI=1
 -1.
 0           1               IRAD, IDIFF
 2                            NPER (array PER follows)
 8.971402  2.006403
 1                           NBETA (array BETA follows)
 0.
 2                            NBODY
 test113c.gdf
 1.25 0.0 0.0 0.0             XBODY
 0  0  0  0  0  0             IMODE(1-6)
 0                            NEWMDS
 test113s.gdf
 -0.5 0.0 0.0 90.0            XBODY
 1  1  1  1  1  1             IMODE(1-6)
 0                            NEWMDS

TEST113A.FRC:
TEST113A.FRC -- Cylinder SPHEROID
  1  1  1  1  0  1  1  1  1  1  0  1  0  1  1  0
  1.0
 test113C.frc
 test113S.frc
  0
  1
```

```
  0.0001 0.0001 0.

TEST113C.FRC:
 TESTS 103 and 113 Fixed Cylinder
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0.000000
 1.000000      .0000000      .0000000
 .0000000      1.000000      .0000000
 .0000000      .0000000      1.000000
 0
 0

TEST113S.FRC:
 TESTS 103 and 113 Floating Spheroid
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 1.        rho (water density)
 0. 0. 0.  XCG (center of gravity w.r.t. body coordinates)
 1         IMASS (radii of gyration are assumed 1)
 0.257621  0.        0.        0.        0.        0.
 0.        0.257621  0.        0.        0.        0.
 0.        0.        0.257621  0.        0.        0.
 0.        0.        0.        0.257621  0.        0.
 0.        0.        0.        0.        0.257621  0.
 0.        0.        0.        0.        0.        0.257621
 0     IDAMP (if damped change it to 1 and add 6 x 6 damping forces)
 0     ISITF (if restoring force applied change it to 1 and add 6 x 6 elements)
 0
 0

TEST113A.PT2:
TEST103/TEST103A  AND TEST113/TEST113A -- PT2
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
-1  1          (diffraction for second-order force for all modes)
1 1 1 1 1 1
0 2            (all difference frequency pairs)

TEST113A.FDF:
TEST103A AND 113A -- Free suface forcing not included (NPF,NTCL,NAL=0)
   5.    PARTR
   -1        1    NPF, NTCL
   0             NAL

TEST113.CFG:
```

```
ILOWGDF=4
IPLTDAT=4
MAXSCR=1000
ILOWHI=1
IALTPOT=2
IRR=0
ISOLVE=2
KSPLIN=3
IQUADO=3
IQUADI=4
IPERIO=1
NUMHDR=1
NOOUT=  0  1  1  1  0  1  1  1  1  1  1   1  0  1  1  0
IALTFRC = 3    !  Alternative Form 3 FRC
IALTFRCN= 1 2
I2ND=1
ILOG=1
USERID_PATH=\WAMITv6   (directory for *.exe, *.dll, and userid.wam)
```