Liquefaction Resistance

November 26, 2018

```
In [1]: import numpy as np
        import matplotlib.pyplot as plt
        import pandas as pd
        import time
```

1 References

[1] Youd, T. L., Idriss, I. M., Andrus, R. D., Arango, I., Castro, G., Christian, J. T., Dobry, R., Finn, W. D. L., Harder, L. F., Hynes, M. E., Ishihara, K., Koester, J. P., Liao, S. S. C., Marcuson, W. F., Martin, G. R., Mitchell, J. K., Moriwaki, Y., Power, M. S., Robertson, P. K., Seed, R. B., and Stokoe, K. H. (2001). Liquefaction resistance of soils: summary report from the 1996 NCEER and 1998 NCEER/NSF workshops on evaluation of liquefaction resistance of soils, J. Geotechnical and Geoenvironmental Eng., ASCE 127(10), 817–33.
[2] Boulanger, R. W., and Idriss, I. M. (2014). CPT and SPT Based Liquefaction Triggering Procedures, Report No. UCD/CGN-14/01, Department of Civil & Environmental Engineering, College of Engineering, University of California at Davis

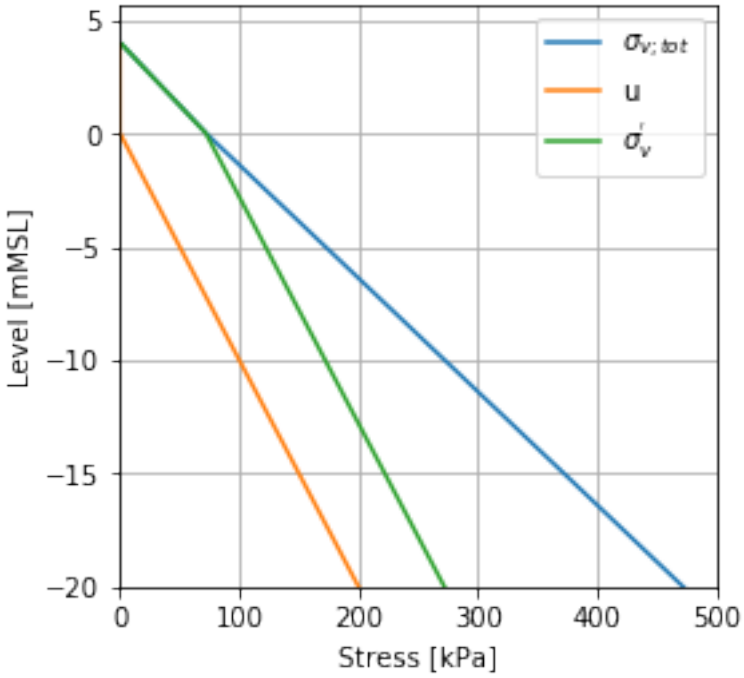
2 Input Parameters

2.1 Stress State

```
In [2]: GL = 4.03; WL = 0;  g_sat = 20; g_unsat = 18; g_w = 10
```

```
In [37]: dz=0.1;
         Depth = np.arange(dz,34.4,dz); Level = GL-Depth;
         sigV = np.zeros(len(Depth));sigVTot = np.zeros(len(Depth)); u = np.zeros(len(Depth));
         sigVTot[0] = g_unsat*dz
         for i in np.arange(1,len(Depth),1):
             if Level[i]>WL:
                 sigVTot[i] = sigVTot[i-1]+g_unsat*dz;
                 u[i] = 0;
             else:
                 sigVTot[i] = sigVTot[i-1]+(g_sat)*dz;
                 u[i] = u[i-1] + g_w*dz;

         sigV = sigVTot - u;
         z = Depth;
         plt.figure(figsize=(4,4))
         plt.plot(sigVTot,Level,u,Level,sigV,Level)
         plt.legend(['$\sigma_{v;tot}$','u','$\sigma_{v}^{\'}$']);
         plt.ylabel('Level [mMSL]'); plt.xlabel('Stress [kPa]')
         plt.xlim(0,500);plt.ylim(-20,);plt.grid();
         plt.show();
```



2.2 Seismic

```
In [4]: amax_g = 0.24 ; Mw = 8.2 ; FS = 1.3
        #qc-Dr correlation
        C0 = 157; C1 = 0.55; C2 = 2.41; # Baldi NC
        #C0 = 181; C1 = 0.55; C2 = 2.41; # Baldi OC/NC
```

3 NCEER Method

```
In [30]: #Idriss revised, 1995
         MSF_id = 10**2.24/Mw**2.56
         #Andrus and Stokoe, 1997
         MSF_am = (Mw/7.5)**-2.56
         MSF = max(MSF_id,MSF_am)

         rd = np.clip((1-0.4113*z**0.5 + 0.04052*z + 0.001753*z**1.5) /
                      (1 - 0.4177*z**0.5 + 0.05729*z -
                       0.006205*z**1.5 + 0.001210*z**2),0,1) #TF. Blake
         CSR = 0.65*amax_g*np.divide(sigVTot,sigV)*rd;
         f = 0.7; #0.6-0.7 for Dr=60-80%, 0.7-0.8 for Dr=40-60%
         Ksig = np.clip((sigV/100)**(f-1),0,1)
         CSR75 = CSR/(MSF*Ksig)
         CRR75 = FS*CSR75
         qc1Ncs = np.cbrt((CRR75 - 0.08)/93)*1000; #cubic root

         #Ic = 2.6 #1.31 to 2.6 for sand15
         #Kc = max(-0.403*Ic**4+5.581*Ic**3-21.63*Ic**2+33.75*Ic-17.88,1)
         #qc1N = qc1Ncs/Kc

         n = 0.5 #n=1 for clay, 0.5 for sand, 0.75 for silt/sandy silt/silty sand
```

```
Cq = np.clip((100/sigV)**n,0,1.7);
#qc = qc1N/Cq*100/1000

#FC = [5,10,15];
#alpha = np.zeros(3,); beta = alpha;
#for i in np.arange(0,3,1):
#    alpha[i] = np.exp(1.76-190/FC[i]**2)
#    beta[i] = 0.99+FC[i]**1.5/1000
#alpha = np.clip(alpha, 0, 5)
#beta = np.clip(beta, 1, 1.2)
#qc_FC = alpha + beta*qc

#Yi, F., 2014, Estimating soil fines contents from CPT data
Ic5 = 1.59;
Ic10 = (10-5)/(12-5)*(1.83-1.59)+1.59;
Ic15 = (15-12)/(35-12)*(2.276-1.83)+1.83
Ic_FC = np.array([Ic5, Ic10, Ic15]);

#Idriss and Boulanger, 2015
FC = np.array([5,10,15])
Ic_FC = (FC+137)/80;

Kc = np.clip(-0.403*Ic_FC**4+5.581*Ic_FC**3-
             21.63*Ic_FC**2+33.75*Ic_FC-17.88,1,100)
qc1N = np.zeros((len(sigV),len(Ic_FC)));
qc = np.zeros((len(sigV),len(Ic_FC))); Dr = np.zeros((len(sigV),len(Ic_FC)))
plt.figure(figsize=(15,10))
for i in np.arange(0,len(Ic_FC),1):
    qc1N[:,i] = qc1Ncs/Kc[i]
    qc[:,i] = qc1N[:,i]/Cq*100/1000
    plt.subplot(121)
    plt.plot(qc[:,i],Level,label = 'FC = %.f %%' %FC[i])
    Dr[:,i] = (1/C2)*np.log(qc[:,i]*1000/(C0*(sigV)**C1))*100
    Dr[Depth<1,i] = 0
    plt.subplot(122)
    plt.plot(Dr[:,i],Level,label = 'FC = %.f %%' %FC[i])

plt.subplot(121);
plt.title('NCEER Method')
plt.ylabel('Level [mMSL]'); plt.xlabel('Cone Resistance $q_c$ [MPa]')
plt.grid(); plt.legend(); plt.xlim(0,50);plt.ylim(-20,5)
plt.subplot(122)
plt.ylabel('Level [mMSL]'); plt.xlabel('Relative Density $D_r$ [%]')
plt.grid(); plt.xticks(np.arange(0, 110, step=10));plt.xlim(60,100);plt.ylim(-20,5);
plt.show()

Nceer= pd.DataFrame()
Nceer['MSF'] = MSF*np.ones(len(sigV)); Nceer['Ksig'] = Ksig; Nceer['rd'] = rd;
Nceer['CSR75'] = CSR75; Nceer['CRR75'] = CRR75; Nceer['qc1Ncs'] = qc1Ncs;
for i in np.arange(0,len(Ic_FC),1):
    Nceer['qc1N FC%.f%%' %FC[i]] = qc1N[:,i];
    Nceer['qc FC%.f%%' %FC[i]] = qc[:,i];
```

```
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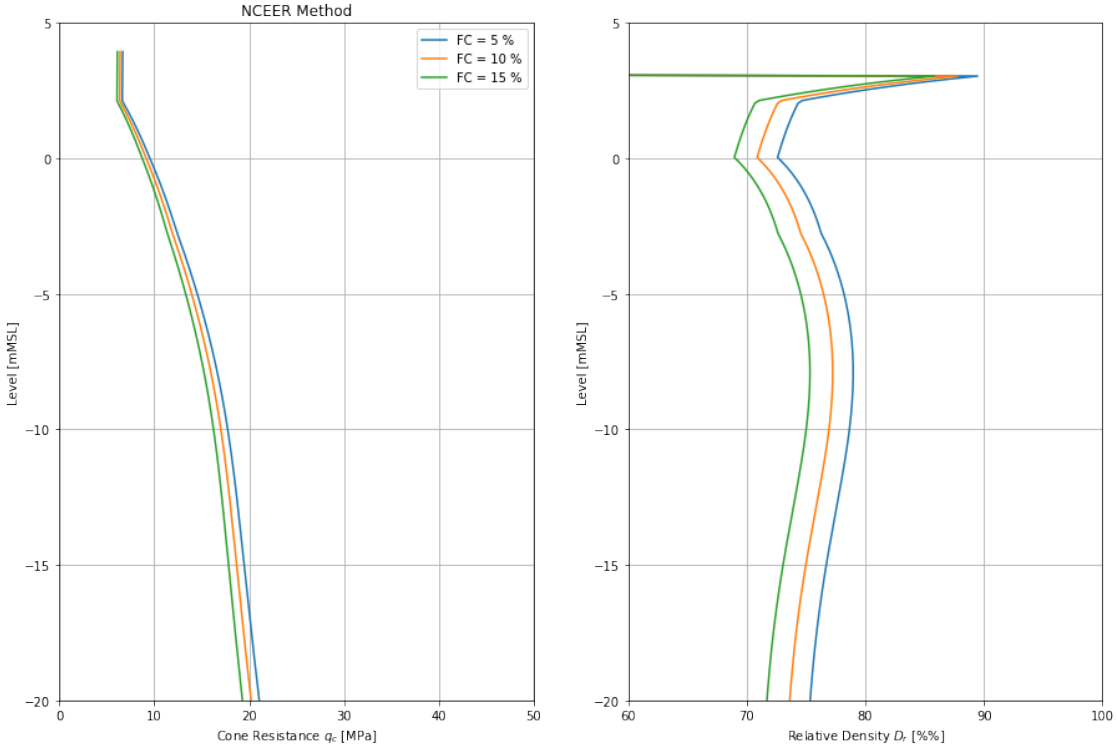
```

```
warnings.warn(message, mplDeprecation, stacklevel=1)
```



4 Idriss and Boulanger

```
In [32]: def correct_qc1Ncs(CRR75):
             #CRR = f(qc1Ncs^4) = f(ax^4+bx^3+cx^2+dx+e) --> solving system to derive qc1Ncs
             aa = (1/137)**4; bb = (-1/140)**3;
             cc = (1/1000)**2; dd = 1/113;
             ee = -2.8-np.log(CRR75)
             pp = (8*aa*cc - 3*bb**2) / (8*aa**2);
             qq = (bb**3 - 4*aa*bb*cc + 8*aa**2*dd)/(8*aa**3);
             Delta0 = cc**2-3*bb*dd + 12*aa*ee;
             Delta1 = 2*cc**3-9*bb*cc*dd+27*bb**2*ee+27*aa*dd**2-72*aa*cc*ee
             QQ = (0.5*(Delta1+(Delta1**2-4*Delta0**3)**0.5))**(1/3);
             SS = 0.5*(-2/3*pp+1/(3*aa)*(QQ+Delta0/QQ))**0.5
             qc1Ncs_correct = -bb/(4*aa) - SS + 0.5*(-4*SS**2 - 2*pp + qq/SS)**0.5
             return qc1Ncs_correct

         #Idriss and Boulanger, 1999
         MSF_idb = min(6.9*np.exp(-Mw/4)-0.058,1.8)
         MSF = MSF_idb

         rd = np.exp((-1.012-1.126*np.sin(z/11.73+5.133))+(0.106+0.118*np.sin(z/11.28+5.142))*Mw)
         CSR = 0.65*amax_g*np.divide(sigVTot,sigV)*rd

         qc1Ncs_0 = 100*np.ones(len(sigV)); #Initialization
         Csig_0 = 1/(37.3-8.24*qc1Ncs_0**0.264); Csig_0 = np.clip(Csig_0,0,0.3)
         Ksig_0 = 1-Csig_0*np.log(sigV/100); Ksig_0 = np.clip(Ksig_0,0,1.1)
```

```
CSR75_0 = CSR/(MSF*Ksig_0)
CRR75_0 = CSR75_0*FS
qc1Ncs_1 = correct_qc1Ncs(CRR75_0)

while max(np.abs(qc1Ncs_1-qc1Ncs_0)) > 0.001:
    qc1Ncs_0 = qc1Ncs_1
    Csig_0 = 1/(37.3-8.24*qc1Ncs_0**0.264); Csig_0 = np.clip(Csig_0,0,0.3)
    Ksig_0 = 1-Csig_0*np.log(sigV/100); Ksig_0 = np.clip(Ksig_0,0,1.1)
    CSR75_0 = CSR/(MSF*Ksig_0)
    CRR75_0 = CSR75_0*FS
    qc1Ncs_1 = correct_qc1Ncs(CRR75_0)
qc1Ncs = qc1Ncs_1;

m = 1.338 - 0.249*qc1Ncs**0.264
Cn = (100/sigV)**m; Cn = np.clip(Cn,0,1.7);

FC = np.arange(5,16,5);
qc1N = np.zeros((len(sigV),len(FC)));
qc = np.zeros((len(sigV),len(FC)));
Dr = np.zeros((len(sigV),len(FC)))
plt.figure(figsize=(15,10))
for i in np.arange(0,len(FC),1):
    qc1N[:,i] = (qc1Ncs-11.9) / (1+np.exp(1.63-(9.7/(FC[i]+2))-(15.7/(FC[i]+2))**2)/14.6)
    qc[:,i] = qc1N[:,i]*100/Cn/1000 #[MPa]
    plt.subplot(121)
    plt.plot(qc[:,i],Level,label = 'FC = %.f %%' %FC[i])
    Dr[:,i] = (1/C2)*np.log(qc[:,i]*1000/(C0*(sigV)**C1))*100
    Dr[Depth<1,i] = 0
    plt.subplot(122)
    plt.plot(Dr[:,i],Level,label = 'FC = %.f %%' %FC[i])

plt.subplot(121);
plt.title('Idriss and Boulanger')
plt.ylabel('Level [mMSL]'); plt.xlabel('Cone Resistance $q_c$ [MPa]')
plt.grid(); plt.legend(); plt.xlim(0,50);plt.ylim(-20,5)
plt.subplot(122)
plt.ylabel('Level [mMSL]'); plt.xlabel('Relative Density $D_r$ [%%]')
plt.grid(); plt.xticks(np.arange(0, 110, step=10));plt.xlim(60,100);plt.ylim(-20,5);

plt.show()

IdBo = pd.DataFrame()
IdBo['MSF'] = MSF*np.ones(len(sigV)); IdBo['Ksig'] = Ksig_0; IdBo['rd'] = rd;
IdBo['CSR75'] = CSR75_0; IdBo['CRR75'] = CRR75_0; IdBo['qc1Ncs'] = qc1Ncs;
for i in np.arange(0,len(Ic_FC),1):
    IdBo['qc1N FC%.f%%' %FC[i]] = qc1N[:,i];
    IdBo['qc FC%.f%%' %FC[i]] = qc[:,i];
```

```
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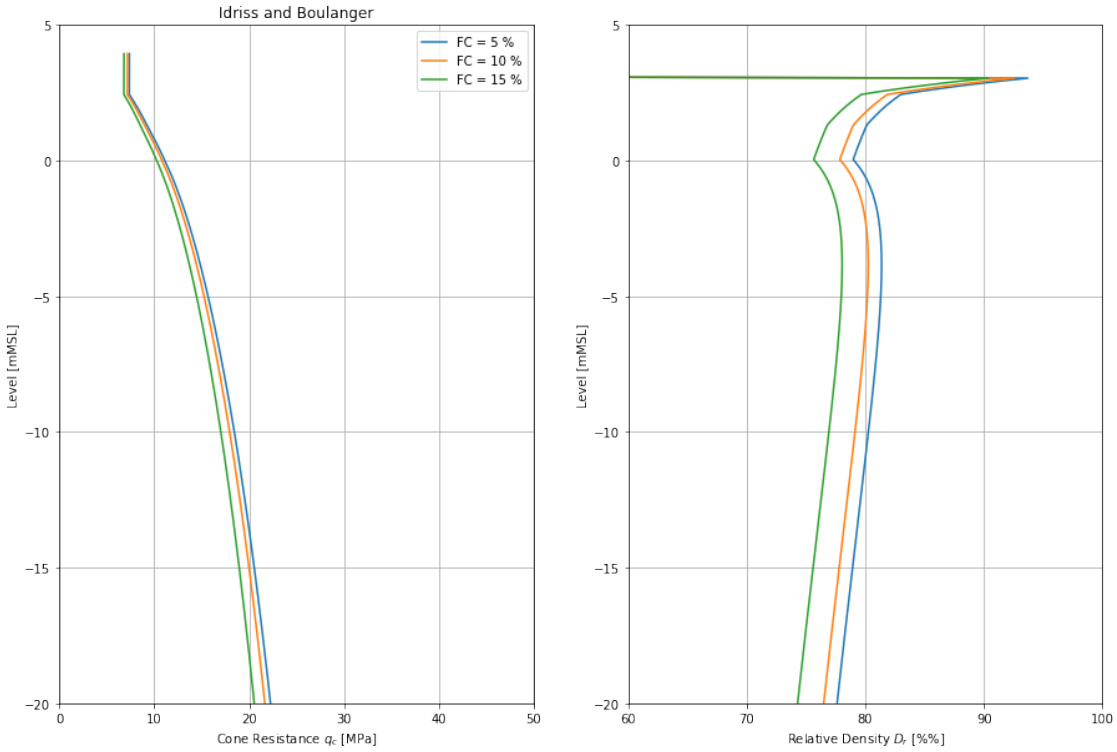
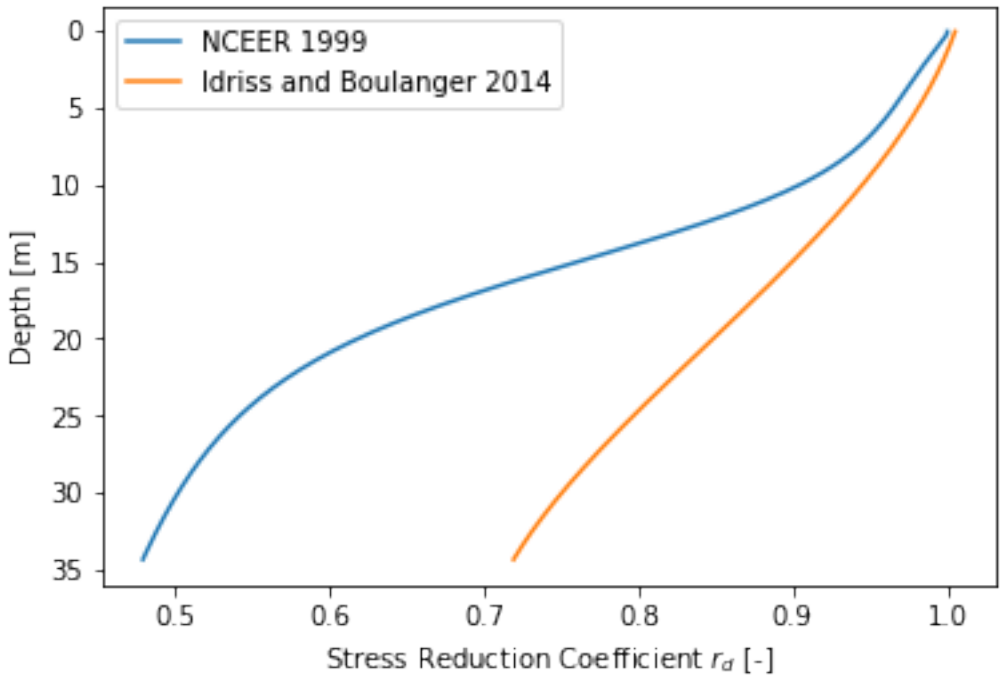
  warnings.warn(message, mplDeprecation, stacklevel=1)
```



In [23]:
```
plt.plot(Nceer['rd'],z,IdBo['rd'],z)
plt.legend(['NCEER 1999','Idriss and Boulanger 2014']);plt.gca().invert_yaxis()
plt.ylabel('Depth [m]'); plt.xlabel('Stress Reduction Coefficient $r_d$ [-]')
plt.show()
```



5 CPT criteria for evaluating Liquefaction Resistance

5.1 Graphs

In [24]:
```
# Boulanger and Idriss
MSF_idb = min(6.9*np.exp(-Mw/4)-0.058,1.8)
MSF = MSF_idb

# NCEER
rd = np.clip((1-0.4113*z**0.5 + 0.04052*z + 0.001753*z**1.5) /
             (1 - 0.4177*z**0.5 + 0.05729*z - 0.006205*z**1.5
              + 0.001210*z**2),0,1) #TF. Blake
CSR = 0.65*amax_g*np.divide(sigVTot,sigV)*rd;
f = 0.7; Ksig = np.clip((sigV/100)**(f-1),0,1) #0.6-0.7 for Dr=60-80%, 0.7-0.8 for Dr=40-60%
CSR75 = CSR/(MSF*Ksig)
CRR75 = FS*CSR75
qc1Ncs = np.cbrt((CRR75 - 0.08)/93)*1000; #cubic root

# Boulanger and Idriss
m = 1.338 - 0.249*qc1Ncs**0.264
Cq = np.clip((100/sigV)**m,0,1.7);

# NCEER
FC = np.array([5,10,15])
Ic_FC = (FC+137)/80; #Correlation Idriss and Boulanger, 2015
Kc = np.clip(-0.403*Ic_FC**4+5.581*Ic_FC**3-
             21.63*Ic_FC**2+33.75*Ic_FC-17.88,1,100)
qc1N = np.zeros((len(sigV),len(Ic_FC)));
qc = np.zeros((len(sigV),len(Ic_FC)));
Dr = np.zeros((len(sigV),len(Ic_FC)))
plt.figure(figsize=(15,10))
for i in np.arange(0,len(Ic_FC),1):
    qc1N[:,i] = qc1Ncs/Kc[i]
    qc[:,i] = qc1N[:,i]/Cq*100/1000
    Dr[:,i] = (1/C2)*np.log(qc[:,i]*1000/(C0*(sigV)**C1))*100
    Dr[Depth<1,i] = 0

    #Graphs
    plt.subplot(121)
    plt.plot(qc[:,i],Level,label = 'FC = %.f %%' %FC[i])
    plt.subplot(122)
    plt.plot(Dr[:,i],Level,label = 'FC = %.f %%' %FC[i])

#Graphs
plt.subplot(121);
plt.title('Design Curves')
plt.ylabel('Level [mMSL]'); plt.xlabel('Cone Resistance $q_c$ [MPa]')
plt.grid(); plt.legend(); plt.xlim(0,50);plt.ylim(-20,5)
plt.subplot(122)
plt.ylabel('Level [mMSL]'); plt.xlabel('Relative Density $D_r$ [%%]')
plt.grid(); plt.xticks(np.arange(0, 110, step=10));plt.xlim(60,100);plt.ylim(-20,5);
plt.show()

Output = pd.DataFrame()
```

```
        Output['rd'] = rd;
        Output['CSR'] = CSR;
        Output['Ksigma'] = Ksig;
        Output['CSR75=CSR/(MSF*Ksigma)'] = CSR75;
        Output['CRR75=FS*CSR75'] = CRR75;
        Output['qc1Ncs'] = qc1Ncs;
        Output['m'] = m;
        Output['Cn'] = Cq;
        Output['qc1N FC5%'] = qc1N[:,0];
        Output['qc FC5%'] = qc[:,0];
        Output['Dr FC5%'] = Dr[:,0];
        Output['qc1N FC10%'] = qc1N[:,1];
        Output['qc FC10%'] = qc[:,1];
        Output['Dr FC10%'] = Dr[:,1];
        Output['qc1N FC15%'] = qc1N[:,2];
        Output['qc FC15%'] = qc[:,2];
        Output['Dr FC15%'] = Dr[:,2];
```

```
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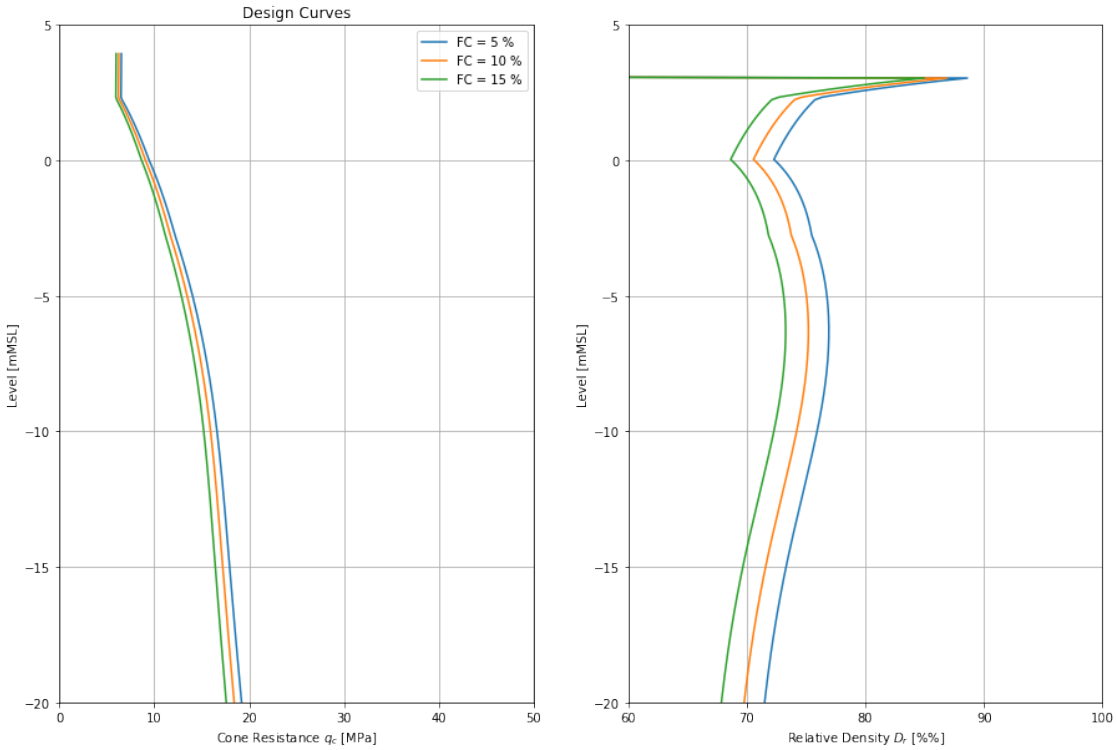
  warnings.warn(message, mplDeprecation, stacklevel=1)
```



5.2 Summary Results qc Vs depth for several FC%

```
In [25]: output = pd.DataFrame()
         output['Levels'] = np.arange(0.0,-22.0,-2.0);
         output['FC5'] = np.zeros(len(output['Levels']));
         output['FC10'] = np.zeros(len(output['Levels']));
         output['FC15'] = np.zeros(len(output['Levels']))
         k=0
```

```
        for i in np.arange(0,-22,-2):
            output['FC5'][k] = qc[np.round(Level,1)==i,0]
            output['FC10'][k] = qc[np.round(Level,1)==i,1]
            output['FC15'][k] = qc[np.round(Level,1)==i,2]
            k = k+1;

        round(output,2)
```

Out[25]:

	Levels	FC5	FC10	FC15
0	0.0	9.42	9.03	8.63
1	-2.0	11.52	11.05	10.55
2	-4.0	13.24	12.71	12.13
3	-6.0	14.69	14.10	13.46
4	-8.0	15.80	15.15	14.47
5	-10.0	16.60	15.93	15.21
6	-12.0	17.20	16.50	15.76
7	-14.0	17.70	16.98	16.21
8	-16.0	18.18	17.44	16.65
9	-18.0	18.68	17.92	17.11
10	-20.0	19.20	18.42	17.58

5.3 Detailed Results

In [27]:
```
with pd.option_context('display.max_rows', None, 'display.max_columns', None):
    print(Output)
```

```
          rd       CSR    Ksigma  CSR75=CSR/(MSF*Ksigma)  CRR75=FS*CSR75  \
0   1.000000  0.156000  1.000000                0.187890        0.244258
1   1.000000  0.156000  1.000000                0.187890        0.244258
2   0.999585  0.155935  1.000000                0.187813        0.244156
3   0.998890  0.155827  1.000000                0.187682        0.243987
4   0.998156  0.155712  1.000000                0.187544        0.243807
5   0.997400  0.155594  1.000000                0.187402        0.243623
6   0.996631  0.155474  1.000000                0.187257        0.243435
7   0.995854  0.155353  1.000000                0.187112        0.243245
8   0.995074  0.155232  1.000000                0.186965        0.243054
9   0.994292  0.155110  1.000000                0.186818        0.242864
10  0.993512  0.154988  1.000000                0.186671        0.242673
11  0.992734  0.154866  1.000000                0.186525        0.242483
12  0.991958  0.154746  1.000000                0.186380        0.242293
13  0.991187  0.154625  1.000000                0.186235        0.242105
14  0.990420  0.154505  1.000000                0.186090        0.241918
15  0.989657  0.154387  1.000000                0.185947        0.241731
16  0.988900  0.154268  1.000000                0.185805        0.241546
17  0.988147  0.154151  1.000000                0.185663        0.241362
18  0.987399  0.154034  1.000000                0.185523        0.241180
19  0.986657  0.153918  1.000000                0.185383        0.240998
20  0.985919  0.153803  1.000000                0.185245        0.240818
21  0.985186  0.153689  1.000000                0.185107        0.240639
22  0.984458  0.153576  1.000000                0.184970        0.240462
23  0.983735  0.153463  1.000000                0.184834        0.240285
24  0.983016  0.153350  1.000000                0.184699        0.240109
25  0.982301  0.153239  1.000000                0.184565        0.239935
26  0.981590  0.153128  1.000000                0.184431        0.239761
27  0.980883  0.153018  1.000000                0.184299        0.239588
```

28	0.980179	0.152908	1.000000	0.184166	0.239416
29	0.979478	0.152799	1.000000	0.184035	0.239245
30	0.978779	0.152690	1.000000	0.183903	0.239074
31	0.978083	0.152581	1.000000	0.183773	0.238904
32	0.977389	0.152473	1.000000	0.183642	0.238735
33	0.976697	0.152365	1.000000	0.183512	0.238566
34	0.976006	0.152257	1.000000	0.183382	0.238397
35	0.975316	0.152149	1.000000	0.183253	0.238228
36	0.974626	0.152042	1.000000	0.183123	0.238060
37	0.973936	0.151934	1.000000	0.182993	0.237891
38	0.973245	0.151826	1.000000	0.182864	0.237723
39	0.972554	0.151718	1.000000	0.182734	0.237554
40	0.971862	0.153687	1.000000	0.185105	0.240636
41	0.971167	0.155597	1.000000	0.187405	0.243626
42	0.970470	0.157449	1.000000	0.189636	0.246527
43	0.969770	0.159246	1.000000	0.191801	0.249341
44	0.969067	0.160991	1.000000	0.193902	0.252072
45	0.968360	0.162684	1.000000	0.195941	0.254724
46	0.967648	0.164329	1.000000	0.197922	0.257298
47	0.966931	0.165925	1.000000	0.199845	0.259798
48	0.966208	0.167476	1.000000	0.201713	0.262226
49	0.965479	0.168982	1.000000	0.203527	0.264585
50	0.964744	0.170446	1.000000	0.205289	0.266876
51	0.964000	0.171867	1.000000	0.207002	0.269102
52	0.963249	0.173249	1.000000	0.208665	0.271265
53	0.962488	0.174591	1.000000	0.210282	0.273366
54	0.961719	0.175895	1.000000	0.211853	0.275408
55	0.960939	0.177162	1.000000	0.213379	0.277392
56	0.960148	0.178393	1.000000	0.214862	0.279320
57	0.959346	0.179589	1.000000	0.216302	0.281193
58	0.958531	0.180752	1.000000	0.217702	0.283012
59	0.957703	0.181880	1.000000	0.219061	0.284780
60	0.956862	0.182977	1.000000	0.220382	0.286497
61	0.956006	0.184041	1.000000	0.221664	0.288164
62	0.955135	0.185075	1.000000	0.222909	0.289782
63	0.954248	0.186078	1.000000	0.224118	0.291353
64	0.953344	0.187052	1.000000	0.225290	0.292878
65	0.952423	0.187997	1.000000	0.226428	0.294357
66	0.951483	0.188913	1.000000	0.227531	0.295791
67	0.950524	0.189801	1.000000	0.228601	0.297181
68	0.949545	0.190661	0.997019	0.230324	0.299421
69	0.948546	0.191495	0.994077	0.232015	0.301620
70	0.947525	0.192301	0.991172	0.233676	0.303779
71	0.946481	0.193082	0.988303	0.235306	0.305897
72	0.945414	0.193837	0.985470	0.236905	0.307976
73	0.944323	0.194566	0.982671	0.238473	0.310015
74	0.943207	0.195270	0.979907	0.240011	0.312015
75	0.942065	0.195950	0.977176	0.241519	0.313975
76	0.940897	0.196604	0.974478	0.242997	0.315896
77	0.939701	0.197235	0.971812	0.244445	0.317779
78	0.938478	0.197841	0.969177	0.245863	0.319622
79	0.937225	0.198424	0.966573	0.247252	0.321427
80	0.935942	0.198983	0.963999	0.248611	0.323194
81	0.934629	0.199519	0.961454	0.249940	0.324921

82	0.933284	0.200031	0.958938	0.251239	0.326611
83	0.931907	0.200521	0.956451	0.252509	0.328262
84	0.930497	0.200987	0.953991	0.253749	0.329874
85	0.929053	0.201431	0.951558	0.254960	0.331448
86	0.927575	0.201853	0.949152	0.256141	0.332983
87	0.926062	0.202252	0.946772	0.257292	0.334480
88	0.924512	0.202629	0.944418	0.258414	0.335939
89	0.922927	0.202983	0.942089	0.259507	0.337359
90	0.921304	0.203316	0.939785	0.260569	0.338740
91	0.919643	0.203627	0.937505	0.261602	0.340083
92	0.917944	0.203916	0.935248	0.262606	0.341387
93	0.916206	0.204183	0.933015	0.263579	0.342653
94	0.914429	0.204429	0.930805	0.264523	0.343880
95	0.912611	0.204653	0.928618	0.265437	0.345068
96	0.910754	0.204856	0.926452	0.266321	0.346218
97	0.908855	0.205038	0.924309	0.267176	0.347328
98	0.906915	0.205198	0.922186	0.268000	0.348400
99	0.904934	0.205338	0.920085	0.268795	0.349434
100	0.902911	0.205456	0.918004	0.269560	0.350428
101	0.900846	0.205554	0.915943	0.270295	0.351384
102	0.898739	0.205631	0.913903	0.271000	0.352300
103	0.896589	0.205688	0.911881	0.271676	0.353179
104	0.894397	0.205724	0.909879	0.272322	0.354018
105	0.892162	0.205740	0.907896	0.272938	0.354819
106	0.889885	0.205736	0.905932	0.273524	0.355581
107	0.887565	0.205712	0.903986	0.274081	0.356305
108	0.885203	0.205668	0.902058	0.274608	0.356991
109	0.882799	0.205605	0.900147	0.275106	0.357638
110	0.880353	0.205522	0.898254	0.275575	0.358248
111	0.877865	0.205420	0.896378	0.276015	0.358819
112	0.875336	0.205299	0.894519	0.276426	0.359353
113	0.872766	0.205160	0.892677	0.276808	0.359850
114	0.870156	0.205002	0.890850	0.277161	0.360310
115	0.867505	0.204825	0.889040	0.277486	0.360732
116	0.864816	0.204631	0.887246	0.277784	0.361119
117	0.862088	0.204418	0.885467	0.278053	0.361469
118	0.859322	0.204188	0.883704	0.278294	0.361783
119	0.856518	0.203942	0.881956	0.278509	0.362061
120	0.853679	0.203678	0.880223	0.278696	0.362305
121	0.850803	0.203397	0.878504	0.278857	0.362514
122	0.847894	0.203101	0.876800	0.278992	0.362689
123	0.844950	0.202788	0.875110	0.279100	0.362830
124	0.841974	0.202460	0.873434	0.279183	0.362938
125	0.838967	0.202117	0.871772	0.279241	0.363014
126	0.835929	0.201759	0.870123	0.279274	0.363057
127	0.832862	0.201386	0.868488	0.279284	0.363069
128	0.829767	0.200999	0.866867	0.279269	0.363050
129	0.826645	0.200599	0.865258	0.279231	0.363000
130	0.823497	0.200186	0.863662	0.279170	0.362922
131	0.820326	0.199759	0.862079	0.279088	0.362814
132	0.817132	0.199321	0.860508	0.278983	0.362678
133	0.813916	0.198870	0.858949	0.278857	0.362515
134	0.810680	0.198408	0.857403	0.278711	0.362324
135	0.807426	0.197935	0.855869	0.278545	0.362108

136	0.804155	0.197451	0.854346	0.278359	0.361867
137	0.800868	0.196957	0.852836	0.278155	0.361601
138	0.797567	0.196453	0.851336	0.277932	0.361311
139	0.794253	0.195940	0.849848	0.277692	0.360999
140	0.790928	0.195419	0.848372	0.277434	0.360665
141	0.787594	0.194889	0.846906	0.277161	0.360309
142	0.784251	0.194351	0.845451	0.276871	0.359933
143	0.780902	0.193806	0.844007	0.276567	0.359537
144	0.777548	0.193254	0.842574	0.276248	0.359123
145	0.774190	0.192695	0.841151	0.275916	0.358691
146	0.770830	0.192131	0.839739	0.275570	0.358242
147	0.767470	0.191561	0.838336	0.275212	0.357776
148	0.764111	0.190985	0.836944	0.274843	0.357295
149	0.760754	0.190406	0.835562	0.274462	0.356800
150	0.757400	0.189822	0.834189	0.274070	0.356291
151	0.754052	0.189234	0.832827	0.273669	0.355770
152	0.750710	0.188643	0.831474	0.273258	0.355236
153	0.747377	0.188050	0.830130	0.272839	0.354691
154	0.744052	0.187453	0.828796	0.272412	0.354135
155	0.740738	0.186855	0.827471	0.271977	0.353571
156	0.737436	0.186255	0.826155	0.271536	0.352997
157	0.734147	0.185654	0.824848	0.271088	0.352415
158	0.730872	0.185052	0.823550	0.270635	0.351826
159	0.727612	0.184450	0.822261	0.270177	0.351230
160	0.724369	0.183847	0.820980	0.269715	0.350629
161	0.721144	0.183245	0.819709	0.269248	0.350022
162	0.717936	0.182643	0.818445	0.268778	0.349411
163	0.714749	0.182042	0.817190	0.268305	0.348797
164	0.711582	0.181443	0.815944	0.267830	0.348179
165	0.708436	0.180844	0.814705	0.267353	0.347559
166	0.705313	0.180248	0.813475	0.266875	0.346937
167	0.702213	0.179654	0.812252	0.266395	0.346314
168	0.699137	0.179062	0.811038	0.265915	0.345690
169	0.696085	0.178473	0.809831	0.265436	0.345066
170	0.693058	0.177887	0.808632	0.264956	0.344443
171	0.690058	0.177304	0.807441	0.264477	0.343821
172	0.687084	0.176725	0.806258	0.264000	0.343200
173	0.684137	0.176149	0.805081	0.263524	0.342581
174	0.681218	0.175577	0.803913	0.263050	0.341965
175	0.678327	0.175008	0.802751	0.262578	0.341351
176	0.675465	0.174445	0.801597	0.262109	0.340741
177	0.672632	0.173885	0.800450	0.261642	0.340135
178	0.669828	0.173330	0.799310	0.261179	0.339533
179	0.667053	0.172779	0.798177	0.260719	0.338935
180	0.664309	0.172234	0.797051	0.260263	0.338342
181	0.661595	0.171693	0.795932	0.259811	0.337754
182	0.658911	0.171158	0.794819	0.259363	0.337172
183	0.656258	0.170627	0.793714	0.258919	0.336595
184	0.653636	0.170102	0.792615	0.258480	0.336024
185	0.651045	0.169582	0.791522	0.258046	0.335460
186	0.648484	0.169068	0.790436	0.257617	0.334902
187	0.645955	0.168559	0.789357	0.257193	0.334351
188	0.643457	0.168056	0.788283	0.256774	0.333806
189	0.640990	0.167558	0.787216	0.256361	0.333269

190	0.638554	0.167066	0.786156	0.255953	0.332739
191	0.636149	0.166580	0.785101	0.255551	0.332217
192	0.633775	0.166100	0.784053	0.255155	0.331701
193	0.631432	0.165625	0.783010	0.254765	0.331194
194	0.629120	0.165156	0.781974	0.254380	0.330694
195	0.626838	0.164694	0.780943	0.254002	0.330203
196	0.624587	0.164236	0.779919	0.253630	0.329719
197	0.622367	0.163785	0.778900	0.253264	0.329243
198	0.620176	0.163340	0.777887	0.252904	0.328775
199	0.618015	0.162900	0.776879	0.252551	0.328316
200	0.615884	0.162467	0.775878	0.252204	0.327865
201	0.613783	0.162039	0.774881	0.251863	0.327421
202	0.611711	0.161617	0.773891	0.251528	0.326987
203	0.609668	0.161200	0.772906	0.251200	0.326560
204	0.607653	0.160790	0.771926	0.250878	0.326142
205	0.605667	0.160385	0.770951	0.250563	0.325732
206	0.603710	0.159986	0.769982	0.250254	0.325330
207	0.601780	0.159592	0.769018	0.249951	0.324936
208	0.599877	0.159204	0.768060	0.249654	0.324551
209	0.598002	0.158821	0.767106	0.249364	0.324173
210	0.596154	0.158444	0.766158	0.249080	0.323804
211	0.594332	0.158073	0.765214	0.248802	0.323443
212	0.592537	0.157707	0.764276	0.248531	0.323090
213	0.590767	0.157346	0.763343	0.248265	0.322745
214	0.589024	0.156990	0.762414	0.248006	0.322408
215	0.587305	0.156640	0.761491	0.247753	0.322078
216	0.585611	0.156295	0.760572	0.247505	0.321757
217	0.583942	0.155955	0.759658	0.247264	0.321443
218	0.582297	0.155619	0.758749	0.247028	0.321136
219	0.580676	0.155289	0.757844	0.246798	0.320838
220	0.579078	0.154964	0.756944	0.246574	0.320546
221	0.577504	0.154644	0.756049	0.246356	0.320262
222	0.575952	0.154328	0.755158	0.246143	0.319986
223	0.574423	0.154017	0.754272	0.245936	0.319716
224	0.572916	0.153711	0.753390	0.245734	0.319454
225	0.571430	0.153409	0.752513	0.245537	0.319198
226	0.569966	0.153112	0.751640	0.245346	0.318950
227	0.568523	0.152819	0.750772	0.245160	0.318708
228	0.567101	0.152531	0.749908	0.244979	0.318473
229	0.565699	0.152246	0.749048	0.244804	0.318245
230	0.564317	0.151967	0.748192	0.244633	0.318023
231	0.562955	0.151691	0.747341	0.244467	0.317807
232	0.561612	0.151419	0.746494	0.244306	0.317598
233	0.560288	0.151151	0.745651	0.244150	0.317395
234	0.558982	0.150888	0.744812	0.243998	0.317198
235	0.557695	0.150628	0.743977	0.243852	0.317007
236	0.556426	0.150372	0.743146	0.243709	0.316822
237	0.555175	0.150119	0.742320	0.243571	0.316643
238	0.553941	0.149871	0.741497	0.243438	0.316469
239	0.552724	0.149626	0.740678	0.243308	0.316301
240	0.551524	0.149384	0.739863	0.243183	0.316138
241	0.550340	0.149146	0.739052	0.243062	0.315981
242	0.549172	0.148912	0.738244	0.242945	0.315829
243	0.548021	0.148680	0.737441	0.242832	0.315682

244	0.546884	0.148452	0.736641	0.242723	0.315540
245	0.545763	0.148228	0.735845	0.242618	0.315403
246	0.544657	0.148006	0.735053	0.242517	0.315271
247	0.543566	0.147788	0.734265	0.242419	0.315144
248	0.542489	0.147572	0.733480	0.242324	0.315022
249	0.541426	0.147360	0.732698	0.242234	0.314904
250	0.540377	0.147151	0.731921	0.242146	0.314790
251	0.539341	0.146944	0.731147	0.242062	0.314681
252	0.538319	0.146740	0.730376	0.241982	0.314576
253	0.537310	0.146539	0.729609	0.241904	0.314476
254	0.536314	0.146341	0.728845	0.241830	0.314379
255	0.535330	0.146145	0.728085	0.241759	0.314287
256	0.534359	0.145952	0.727329	0.241691	0.314198
257	0.533400	0.145762	0.726575	0.241626	0.314113
258	0.532453	0.145574	0.725825	0.241563	0.314032
259	0.531517	0.145388	0.725079	0.241504	0.313955
260	0.530593	0.145205	0.724335	0.241447	0.313881
261	0.529680	0.145024	0.723595	0.241393	0.313811
262	0.528778	0.144846	0.722859	0.241342	0.313744
263	0.527886	0.144669	0.722125	0.241293	0.313681
264	0.527005	0.144495	0.721395	0.241246	0.313620
265	0.526135	0.144323	0.720668	0.241203	0.313563
266	0.525275	0.144154	0.719944	0.241161	0.313509
267	0.524424	0.143986	0.719223	0.241122	0.313458
268	0.523583	0.143820	0.718505	0.241085	0.313410
269	0.522752	0.143656	0.717791	0.241050	0.313365
270	0.521930	0.143495	0.717079	0.241018	0.313323
271	0.521118	0.143335	0.716371	0.240987	0.313283
272	0.520314	0.143177	0.715665	0.240959	0.313247
273	0.519519	0.143021	0.714963	0.240933	0.313212
274	0.518733	0.142866	0.714264	0.240908	0.313181
275	0.517956	0.142714	0.713567	0.240886	0.313151
276	0.517186	0.142563	0.712873	0.240865	0.313124
277	0.516425	0.142413	0.712183	0.240846	0.313100
278	0.515672	0.142266	0.711495	0.240829	0.313078
279	0.514927	0.142120	0.710810	0.240814	0.313058
280	0.514189	0.141975	0.710128	0.240800	0.313040
281	0.513459	0.141832	0.709449	0.240788	0.313024
282	0.512736	0.141691	0.708772	0.240777	0.313010
283	0.512020	0.141551	0.708099	0.240768	0.312999
284	0.511312	0.141412	0.707428	0.240761	0.312989
285	0.510611	0.141275	0.706760	0.240755	0.312981
286	0.509916	0.141140	0.706094	0.240750	0.312975
287	0.509228	0.141005	0.705432	0.240747	0.312971
288	0.508547	0.140872	0.704772	0.240745	0.312968
289	0.507872	0.140740	0.704114	0.240744	0.312967
290	0.507203	0.140610	0.703460	0.240745	0.312968
291	0.506541	0.140481	0.702808	0.240747	0.312971
292	0.505884	0.140353	0.702158	0.240750	0.312974
293	0.505234	0.140226	0.701511	0.240754	0.312980
294	0.504589	0.140100	0.700867	0.240759	0.312987
295	0.503951	0.139975	0.700225	0.240765	0.312995
296	0.503318	0.139852	0.699586	0.240773	0.313005
297	0.502690	0.139729	0.698950	0.240781	0.313016

298	0.502068	0.139608	0.698315	0.240791	0.313028
299	0.501451	0.139488	0.697684	0.240801	0.313041
300	0.500839	0.139369	0.697054	0.240812	0.313056
301	0.500232	0.139250	0.696428	0.240824	0.313072
302	0.499631	0.139133	0.695803	0.240837	0.313089
303	0.499034	0.139017	0.695182	0.240851	0.313107
304	0.498442	0.138901	0.694562	0.240866	0.313126
305	0.497855	0.138787	0.693945	0.240881	0.313146
306	0.497273	0.138673	0.693330	0.240898	0.313167
307	0.496695	0.138560	0.692718	0.240914	0.313189
308	0.496122	0.138448	0.692108	0.240932	0.313212
309	0.495553	0.138337	0.691500	0.240950	0.313236
310	0.494988	0.138227	0.690895	0.240969	0.313260
311	0.494427	0.138118	0.690291	0.240989	0.313286
312	0.493871	0.138009	0.689691	0.241009	0.313312
313	0.493319	0.137901	0.689092	0.241030	0.313339
314	0.492771	0.137794	0.688496	0.241051	0.313367
315	0.492227	0.137688	0.687901	0.241073	0.313395
316	0.491686	0.137582	0.687310	0.241096	0.313424
317	0.491150	0.137477	0.686720	0.241119	0.313454
318	0.490617	0.137373	0.686132	0.241142	0.313485
319	0.490088	0.137269	0.685547	0.241166	0.313516
320	0.489562	0.137166	0.684964	0.241190	0.313547
321	0.489040	0.137064	0.684383	0.241215	0.313580
322	0.488522	0.136962	0.683804	0.241240	0.313612
323	0.488007	0.136861	0.683227	0.241266	0.313645
324	0.487495	0.136761	0.682652	0.241292	0.313679
325	0.486987	0.136661	0.682080	0.241318	0.313713
326	0.486481	0.136562	0.681509	0.241344	0.313748
327	0.485979	0.136463	0.680941	0.241371	0.313783
328	0.485480	0.136365	0.680374	0.241399	0.313818
329	0.484985	0.136267	0.679810	0.241426	0.313854
330	0.484492	0.136170	0.679247	0.241454	0.313890
331	0.484002	0.136074	0.678687	0.241482	0.313927
332	0.483515	0.135978	0.678129	0.241510	0.313963
333	0.483031	0.135882	0.677572	0.241539	0.314001
334	0.482550	0.135787	0.677018	0.241568	0.314038
335	0.482071	0.135693	0.676466	0.241597	0.314076
336	0.481596	0.135599	0.675915	0.241626	0.314113
337	0.481123	0.135505	0.675366	0.241655	0.314152
338	0.480652	0.135412	0.674820	0.241685	0.314190
339	0.480185	0.135319	0.674275	0.241714	0.314228
340	0.479719	0.135227	0.673732	0.241744	0.314267
341	0.479257	0.135135	0.673191	0.241774	0.314306
342	0.478796	0.135044	0.672652	0.241804	0.314345

	qc1Ncs	m	Cn	qc1N FC5%	qc FC5%	Dr FC5%	\
0	120.878079	0.455044	1.700000	111.016031	6.530355	0.000000	
1	120.878079	0.455044	1.700000	111.016031	6.530355	0.000000	
2	120.853206	0.455092	1.700000	110.993187	6.529011	0.000000	
3	120.811536	0.455172	1.700000	110.954917	6.526760	0.000000	
4	120.767512	0.455257	1.700000	110.914484	6.524381	0.000000	
5	120.722106	0.455345	1.700000	110.872783	6.521928	0.000000	
6	120.675873	0.455434	1.700000	110.830322	6.519431	0.000000	

7	120.629159	0.455524	1.700000	110.787419	6.516907	0.000000
8	120.582191	0.455615	1.700000	110.744283	6.514370	0.000000
9	120.535127	0.455706	1.700000	110.701059	6.511827	88.606849
10	120.488077	0.455797	1.700000	110.657847	6.509285	86.415521
11	120.441120	0.455888	1.700000	110.614722	6.506748	84.413610
12	120.394315	0.455978	1.700000	110.571736	6.504220	82.570781
13	120.347704	0.456068	1.700000	110.528927	6.501702	80.863452
14	120.301316	0.456158	1.700000	110.486324	6.499196	79.272929
15	120.255172	0.456247	1.700000	110.443945	6.496703	77.784140
16	120.209288	0.456336	1.700000	110.401804	6.494224	76.384755
17	120.163670	0.456425	1.672628	110.359908	6.597996	75.738103
18	120.118324	0.456512	1.632010	110.318262	6.759655	75.508599
19	120.073250	0.456600	1.594381	110.276865	6.916593	75.290349
20	120.028444	0.456687	1.559387	110.235715	7.069171	75.082269
21	119.983901	0.456773	1.526729	110.194806	7.217706	74.883426
22	119.939613	0.456859	1.496156	110.154131	7.362478	74.693010
23	119.895571	0.456944	1.467451	110.113683	7.503738	74.510312
24	119.851763	0.457029	1.440430	110.073448	7.641710	74.334708
25	119.808175	0.457114	1.414931	110.033417	7.776594	74.165648
26	119.764793	0.457198	1.390815	109.993574	7.908571	74.002640
27	119.721601	0.457282	1.367959	109.953906	8.037806	73.845248
28	119.678581	0.457366	1.346256	109.914396	8.164448	73.693077
29	119.635716	0.457449	1.325611	109.875028	8.288632	73.545774
30	119.592985	0.457532	1.305939	109.835784	8.410483	73.403018
31	119.550369	0.457615	1.287165	109.796644	8.530115	73.264518
32	119.507844	0.457697	1.269221	109.757589	8.647632	73.130008
33	119.465389	0.457780	1.252048	109.718597	8.763131	72.999246
34	119.422979	0.457862	1.235590	109.679648	8.876702	72.872009
35	119.380591	0.457945	1.219799	109.640718	8.988425	72.748093
36	119.338198	0.458027	1.204630	109.601783	9.098378	72.627307
37	119.295773	0.458110	1.190042	109.562820	9.206631	72.509478
38	119.253290	0.458193	1.176000	109.523803	9.313251	72.394444
39	119.210720	0.458276	1.162468	109.484706	9.418298	72.282052
40	119.983185	0.456774	1.154597	110.194148	9.543945	72.517165
41	120.722978	0.455343	1.146950	110.873584	9.666820	72.737473
42	121.432092	0.453977	1.139513	111.524844	9.787060	72.944073
43	122.112344	0.452673	1.132276	112.149596	9.904790	73.137952
44	122.765395	0.451425	1.125229	112.749367	10.020126	73.320005
45	123.392766	0.450231	1.118362	113.325553	10.133173	73.491042
46	123.995855	0.449088	1.111666	113.879438	10.244031	73.651799
47	124.575947	0.447992	1.105134	114.412202	10.352791	73.802945
48	125.134226	0.446941	1.098757	114.924933	10.459538	73.945092
49	125.671784	0.445932	1.092529	115.418633	10.564350	74.078798
50	126.189630	0.444963	1.086444	115.894230	10.667302	74.204577
51	126.688700	0.444032	1.080494	116.352582	10.768461	74.322896
52	127.169858	0.443137	1.074675	116.794484	10.867891	74.434189
53	127.633908	0.442276	1.068980	117.220674	10.965652	74.538852
54	128.081596	0.441447	1.063406	117.631836	11.061800	74.637252
55	128.513614	0.440650	1.057946	118.028608	11.156387	74.729726
56	128.930609	0.439882	1.052598	118.411581	11.249462	74.816588
57	129.333181	0.439143	1.047355	118.781308	11.341070	74.898125
58	129.721889	0.438430	1.042215	119.138303	11.431255	74.974607
59	130.097257	0.437744	1.037174	119.483046	11.520057	75.046281
60	130.459771	0.437082	1.032228	119.815983	11.607514	75.113377

61	130.809886	0.436445	1.027373	120.137534	11.693661	75.176111
62	131.148027	0.435830	1.022607	120.448087	11.778533	75.234680
63	131.474591	0.435237	1.017926	120.748008	11.862159	75.289270
64	131.789950	0.434666	1.013328	121.037638	11.944571	75.340054
65	132.094451	0.434116	1.008809	121.317295	12.025796	75.387193
66	132.388418	0.433585	1.004367	121.587278	12.105859	75.430835
67	132.672155	0.433074	1.000000	121.847866	12.184787	75.471122
68	133.126684	0.432256	0.995708	122.265312	12.279232	75.564422
69	133.569943	0.431461	0.991492	122.672407	12.372502	75.653562
70	134.002212	0.430687	0.987350	123.069408	12.464617	75.738694
71	134.423750	0.429935	0.983279	123.456555	12.555597	75.819960
72	134.834803	0.429203	0.979277	123.834072	12.645461	75.897493
73	135.235602	0.428490	0.975341	124.202170	12.734224	75.971418
74	135.626360	0.427797	0.971471	124.561048	12.821905	76.041852
75	136.007281	0.427123	0.967663	124.910891	12.908517	76.108906
76	136.378555	0.426467	0.963915	125.251873	12.994076	76.172685
77	136.740358	0.425829	0.960227	125.584158	13.078595	76.233285
78	137.092859	0.425209	0.956595	125.907899	13.162086	76.290800
79	137.436213	0.424606	0.953019	126.223241	13.244562	76.345318
80	137.770569	0.424020	0.949497	126.530318	13.326034	76.396919
81	138.096064	0.423451	0.946027	126.829257	13.406513	76.445683
82	138.412829	0.422897	0.942608	127.120177	13.486009	76.491683
83	138.720984	0.422360	0.939238	127.403192	13.564531	76.534988
84	139.020646	0.421838	0.935915	127.678405	13.642088	76.575664
85	139.311921	0.421332	0.932640	127.945916	13.718688	76.613774
86	139.594911	0.420840	0.929409	128.205818	13.794341	76.649376
87	139.869713	0.420364	0.926222	128.458199	13.869052	76.682528
88	140.136417	0.419902	0.923078	128.703143	13.942830	76.713281
89	140.395107	0.419455	0.919975	128.940728	14.015681	76.741688
90	140.645865	0.419023	0.916912	129.171028	14.087612	76.767797
91	140.888768	0.418604	0.913889	129.394113	14.158629	76.791653
92	141.123889	0.418199	0.910903	129.610051	14.228737	76.813301
93	141.351297	0.417808	0.907955	129.818905	14.297943	76.832783
94	141.571059	0.417430	0.905043	130.020738	14.366251	76.850140
95	141.783239	0.417066	0.902166	130.215607	14.433668	76.865410
96	141.987899	0.416716	0.899323	130.403569	14.500198	76.878630
97	142.185099	0.416378	0.896513	130.584680	14.565847	76.889836
98	142.374896	0.416053	0.893735	130.758992	14.630619	76.899064
99	142.557347	0.415742	0.890989	130.926558	14.694518	76.906346
100	142.732509	0.415443	0.888274	131.087429	14.757551	76.911715
101	142.900435	0.415156	0.885588	131.241655	14.819721	76.915204
102	143.061181	0.414882	0.882931	131.389286	14.881034	76.916842
103	143.214800	0.414621	0.880303	131.530371	14.941494	76.916659
104	143.361347	0.414371	0.877702	131.664962	15.001107	76.914686
105	143.500876	0.414134	0.875127	131.793107	15.059876	76.910951
106	143.633442	0.413909	0.872579	131.914858	15.117807	76.905483
107	143.759102	0.413695	0.870057	132.030265	15.174906	76.898310
108	143.877911	0.413494	0.867559	132.139382	15.231177	76.889459
109	143.989929	0.413304	0.865085	132.242261	15.286626	76.878958
110	144.095215	0.413125	0.862634	132.338956	15.341258	76.866835
111	144.193829	0.412958	0.860207	132.429525	15.395080	76.853117
112	144.285836	0.412803	0.857802	132.514025	15.448097	76.837830
113	144.371298	0.412658	0.855418	132.592515	15.500315	76.821003
114	144.450284	0.412524	0.853056	132.665057	15.551741	76.802662

115	144.522863	0.412402	0.850714	132.731714	15.602382	76.782835
116	144.589105	0.412290	0.848393	132.792551	15.652244	76.761548
117	144.649085	0.412188	0.846091	132.847638	15.701335	76.738830
118	144.702880	0.412097	0.843809	132.897044	15.749662	76.714709
119	144.750568	0.412017	0.841545	132.940841	15.797234	76.689212
120	144.792232	0.411946	0.839300	132.979106	15.844057	76.662368
121	144.827955	0.411886	0.837072	133.011915	15.890140	76.634206
122	144.857826	0.411836	0.834862	133.039349	15.935493	76.604753
123	144.881935	0.411795	0.832669	133.061491	15.980124	76.574039
124	144.900376	0.411764	0.830492	133.078427	16.024042	76.542095
125	144.913243	0.411742	0.828332	133.090244	16.067257	76.508948
126	144.920637	0.411730	0.826188	133.097035	16.109778	76.474630
127	144.922659	0.411726	0.824059	133.098892	16.151617	76.439172
128	144.919414	0.411732	0.821946	133.095911	16.192783	76.402603
129	144.911008	0.411746	0.819847	133.088192	16.233288	76.364955
130	144.897553	0.411769	0.817764	133.075834	16.273142	76.326260
131	144.879161	0.411800	0.815694	133.058943	16.312356	76.286549
132	144.855947	0.411839	0.813639	133.037622	16.350944	76.245854
133	144.828028	0.411886	0.811597	133.011982	16.388915	76.204207
134	144.795526	0.411941	0.809569	132.982131	16.426283	76.161642
135	144.758561	0.412003	0.807554	132.948182	16.463061	76.118191
136	144.717258	0.412073	0.805553	132.910249	16.499259	76.073887
137	144.671744	0.412150	0.803564	132.868448	16.534893	76.028763
138	144.622146	0.412234	0.801588	132.822896	16.569973	75.982852
139	144.568593	0.412324	0.799624	132.773713	16.604515	75.936189
140	144.511217	0.412421	0.797673	132.721018	16.638531	75.888807
141	144.450150	0.412525	0.795733	132.664934	16.672035	75.840740
142	144.385526	0.412634	0.793806	132.605582	16.705041	75.792021
143	144.317478	0.412749	0.791890	132.543086	16.737562	75.742684
144	144.246143	0.412870	0.789986	132.477570	16.769613	75.692763
145	144.171654	0.412996	0.788093	132.409159	16.801207	75.642292
146	144.094150	0.413127	0.786212	132.337978	16.832358	75.591304
147	144.013765	0.413263	0.784341	132.264151	16.863082	75.539832
148	143.930635	0.413404	0.782482	132.187804	16.893392	75.487910
149	143.844898	0.413550	0.780634	132.109062	16.923302	75.435571
150	143.756689	0.413700	0.778797	132.028049	16.952826	75.382848
151	143.666142	0.413853	0.776970	131.944890	16.981979	75.329774
152	143.573393	0.414011	0.775154	131.859708	17.010775	75.276379
153	143.478574	0.414172	0.773349	131.772625	17.039228	75.222697
154	143.381818	0.414336	0.771554	131.683763	17.067351	75.168759
155	143.283256	0.414504	0.769769	131.593242	17.095159	75.114595
156	143.183018	0.414675	0.767995	131.501182	17.122666	75.060237
157	143.081232	0.414848	0.766231	131.407701	17.149885	75.005714
158	142.978023	0.415024	0.764477	131.312913	17.176830	74.951056
159	142.873518	0.415202	0.762733	131.216934	17.203513	74.896292
160	142.767838	0.415382	0.761000	131.119875	17.229949	74.841450
161	142.661103	0.415564	0.759276	131.021849	17.256150	74.786559
162	142.553431	0.415748	0.757563	130.922962	17.282128	74.731645
163	142.444939	0.415934	0.755859	130.823321	17.307897	74.676735
164	142.335739	0.416120	0.754165	130.723030	17.333469	74.621854
165	142.225941	0.416308	0.752482	130.622191	17.358856	74.567029
166	142.115654	0.416497	0.750808	130.520902	17.384069	74.512283
167	142.004983	0.416686	0.749143	130.419259	17.409120	74.457641
168	141.894029	0.416876	0.747489	130.317358	17.434021	74.403125

169	141.782893	0.417067	0.745844	130.215289	17.458783	74.348758
170	141.671670	0.417258	0.744209	130.113140	17.483415	74.294561
171	141.560454	0.417449	0.742584	130.010998	17.507929	74.240554
172	141.449334	0.417639	0.740968	129.908944	17.532335	74.186759
173	141.338399	0.417830	0.739362	129.807060	17.556643	74.133194
174	141.227732	0.418020	0.737765	129.705422	17.580862	74.079878
175	141.117414	0.418210	0.736178	129.604105	17.605001	74.026828
176	141.007523	0.418399	0.734600	129.503179	17.629070	73.974061
177	140.898134	0.418588	0.733032	129.402714	17.653077	73.921594
178	140.789317	0.418775	0.731473	129.302776	17.677030	73.869441
179	140.681141	0.418962	0.729924	129.203426	17.700937	73.817618
180	140.573672	0.419147	0.728384	129.104725	17.724806	73.766137
181	140.466972	0.419331	0.726854	129.006730	17.748644	73.715013
182	140.361099	0.419514	0.725333	128.909495	17.772459	73.664257
183	140.256110	0.419696	0.723821	128.813071	17.796257	73.613881
184	140.152057	0.419875	0.722319	128.717507	17.820045	73.563895
185	140.048991	0.420054	0.720825	128.622850	17.843829	73.514311
186	139.946958	0.420230	0.719341	128.529142	17.867614	73.465137
187	139.846004	0.420405	0.717867	128.436424	17.891406	73.416382
188	139.746169	0.420578	0.716401	128.344735	17.915211	73.368054
189	139.647492	0.420749	0.714944	128.254109	17.939033	73.320160
190	139.550010	0.420918	0.713497	128.164580	17.962877	73.272708
191	139.453755	0.421085	0.712059	128.076178	17.986748	73.225703
192	139.358759	0.421250	0.710629	127.988933	18.010650	73.179150
193	139.265050	0.421413	0.709209	127.902869	18.034587	73.133056
194	139.172654	0.421574	0.707797	127.818011	18.058562	73.087423
195	139.081594	0.421732	0.706395	127.734380	18.082579	73.042256
196	138.991892	0.421888	0.705001	127.651997	18.106641	72.997558
197	138.903567	0.422042	0.703616	127.570878	18.130751	72.953332
198	138.816635	0.422193	0.702240	127.491039	18.154911	72.909579
199	138.731113	0.422342	0.700873	127.412494	18.179125	72.866302
200	138.647012	0.422489	0.699514	127.335254	18.203394	72.823502
201	138.564343	0.422633	0.698164	127.259331	18.227721	72.781179
202	138.483117	0.422775	0.696822	127.184731	18.252107	72.739335
203	138.403339	0.422914	0.695489	127.111462	18.276554	72.697968
204	138.325017	0.423050	0.694165	127.039530	18.301064	72.657079
205	138.248153	0.423185	0.692849	126.968937	18.325638	72.616666
206	138.172750	0.423316	0.691541	126.899686	18.350276	72.576729
207	138.098810	0.423446	0.690242	126.831779	18.374981	72.537265
208	138.026332	0.423572	0.688951	126.765214	18.399753	72.498274
209	137.955314	0.423697	0.687668	126.699990	18.424592	72.459752
210	137.885754	0.423818	0.686393	126.636105	18.449499	72.421698
211	137.817646	0.423938	0.685127	126.573554	18.474475	72.384108
212	137.750986	0.424054	0.683868	126.512332	18.499519	72.346980
213	137.685767	0.424169	0.682618	126.452434	18.524633	72.310310
214	137.621982	0.424280	0.681375	126.393853	18.549815	72.274096
215	137.559621	0.424390	0.680141	126.336580	18.575066	72.238332
216	137.498677	0.424497	0.678914	126.280608	18.600386	72.203017
217	137.439137	0.424601	0.677695	126.225926	18.625774	72.168144
218	137.380992	0.424703	0.676484	126.172525	18.651229	72.133710
219	137.324230	0.424803	0.675280	126.120394	18.676753	72.099712
220	137.268838	0.424900	0.674084	126.069521	18.702343	72.066143
221	137.214802	0.424995	0.672896	126.019894	18.727999	72.033000
222	137.162110	0.425087	0.671715	125.971501	18.753721	72.000278

223	137.110747	0.425178	0.670541	125.924328	18.779507	71.967971
224	137.060697	0.425266	0.669375	125.878362	18.805357	71.936075
225	137.011946	0.425351	0.668216	125.833589	18.831270	71.904585
226	136.964479	0.425435	0.667065	125.789994	18.857245	71.873495
227	136.918278	0.425516	0.665920	125.747562	18.883281	71.842801
228	136.873328	0.425595	0.664783	125.706279	18.909377	71.812496
229	136.829611	0.425672	0.663653	125.666130	18.935531	71.782577
230	136.787111	0.425747	0.662529	125.627097	18.961743	71.753036
231	136.745811	0.425820	0.661413	125.589166	18.988011	71.723869
232	136.705692	0.425890	0.660304	125.552321	19.014334	71.695070
233	136.666738	0.425959	0.659201	125.516544	19.040711	71.666633
234	136.628929	0.426026	0.658105	125.481821	19.067140	71.638554
235	136.592249	0.426090	0.657016	125.448133	19.093621	71.610827
236	136.556680	0.426153	0.655933	125.415465	19.120151	71.583446
237	136.522202	0.426214	0.654858	125.383801	19.146730	71.556405
238	136.488798	0.426273	0.653788	125.353122	19.173356	71.529699
239	136.456449	0.426330	0.652725	125.323413	19.200028	71.503323
240	136.425138	0.426385	0.651669	125.294656	19.226744	71.477271
241	136.394846	0.426438	0.650618	125.266835	19.253503	71.451538
242	136.365554	0.426490	0.649574	125.239933	19.280304	71.426117
243	136.337245	0.426540	0.648537	125.213933	19.307145	71.401005
244	136.309899	0.426588	0.647505	125.188819	19.334024	71.376195
245	136.283501	0.426635	0.646480	125.164574	19.360941	71.351682
246	136.258030	0.426680	0.645460	125.141182	19.387893	71.327460
247	136.233469	0.426723	0.644447	125.118625	19.414880	71.303525
248	136.209801	0.426765	0.643440	125.096888	19.441900	71.279872
249	136.187008	0.426805	0.642438	125.075954	19.468951	71.256494
250	136.165072	0.426844	0.641442	125.055808	19.496032	71.233388
251	136.143975	0.426881	0.640452	125.036432	19.523142	71.210548
252	136.123701	0.426917	0.639468	125.017813	19.550280	71.187968
253	136.104233	0.426952	0.638490	124.999932	19.577443	71.165645
254	136.085553	0.426985	0.637517	124.982776	19.604632	71.143572
255	136.067645	0.427016	0.636549	124.966329	19.631843	71.121747
256	136.050491	0.427047	0.635587	124.950576	19.659076	71.100162
257	136.034077	0.427076	0.634631	124.935500	19.686330	71.078815
258	136.018385	0.427103	0.633680	124.921089	19.713603	71.057700
259	136.003400	0.427130	0.632734	124.907326	19.740893	71.036812
260	135.989106	0.427155	0.631793	124.894198	19.768201	71.016148
261	135.975486	0.427179	0.630858	124.881690	19.795524	70.995703
262	135.962527	0.427202	0.629928	124.869788	19.822860	70.975472
263	135.950212	0.427224	0.629003	124.858477	19.850210	70.955451
264	135.938527	0.427245	0.628084	124.847746	19.877571	70.935636
265	135.927456	0.427264	0.627169	124.837578	19.904943	70.916022
266	135.916986	0.427283	0.626259	124.827963	19.932323	70.896606
267	135.907103	0.427300	0.625354	124.818885	19.959712	70.877384
268	135.897791	0.427317	0.624454	124.810333	19.987108	70.858352
269	135.889037	0.427332	0.623559	124.802294	20.014509	70.839505
270	135.880828	0.427347	0.622669	124.794754	20.041915	70.820840
271	135.873150	0.427360	0.621783	124.787703	20.069324	70.802353
272	135.865990	0.427373	0.620902	124.781127	20.096735	70.784041
273	135.859334	0.427385	0.620026	124.775014	20.124148	70.765899
274	135.853171	0.427396	0.619155	124.769354	20.151561	70.747925
275	135.847488	0.427406	0.618288	124.764134	20.178974	70.730114
276	135.842271	0.427415	0.617425	124.759344	20.206384	70.712464

277	135.837510	0.427423	0.616567	124.754971	20.233792	70.694970
278	135.833193	0.427431	0.615714	124.751006	20.261196	70.677630
279	135.829307	0.427438	0.614865	124.747437	20.288595	70.660441
280	135.825841	0.427444	0.614020	124.744253	20.315989	70.643399
281	135.822784	0.427449	0.613180	124.741446	20.343376	70.626501
282	135.820125	0.427454	0.612344	124.739004	20.370755	70.609744
283	135.817853	0.427458	0.611512	124.736918	20.398126	70.593124
284	135.815958	0.427461	0.610684	124.735177	20.425488	70.576641
285	135.814429	0.427464	0.609860	124.733773	20.452840	70.560289
286	135.813256	0.427466	0.609041	124.732695	20.480181	70.544066
287	135.812428	0.427468	0.608226	124.731935	20.507510	70.527971
288	135.811937	0.427469	0.607414	124.731484	20.534827	70.511999
289	135.811772	0.427469	0.606607	124.731333	20.562130	70.496148
290	135.811924	0.427469	0.605804	124.731472	20.589420	70.480417
291	135.812384	0.427468	0.605004	124.731895	20.616695	70.464801
292	135.813143	0.427466	0.604209	124.732592	20.643954	70.449299
293	135.814192	0.427465	0.603417	124.733555	20.671197	70.433908
294	135.815522	0.427462	0.602629	124.734776	20.698423	70.418626
295	135.817125	0.427459	0.601845	124.736248	20.725631	70.403451
296	135.818992	0.427456	0.601065	124.737963	20.752822	70.388379
297	135.821115	0.427452	0.600289	124.739913	20.779993	70.373410
298	135.823487	0.427448	0.599516	124.742092	20.807145	70.358540
299	135.826100	0.427443	0.598746	124.744491	20.834277	70.343768
300	135.828945	0.427438	0.597981	124.747104	20.861389	70.329092
301	135.832015	0.427433	0.597219	124.749924	20.888478	70.314509
302	135.835304	0.427427	0.596460	124.752945	20.915547	70.300018
303	135.838804	0.427421	0.595705	124.756159	20.942592	70.285616
304	135.842508	0.427414	0.594954	124.759561	20.969615	70.271301
305	135.846409	0.427408	0.594206	124.763143	20.996615	70.257073
306	135.850500	0.427400	0.593461	124.766901	21.023590	70.242928
307	135.854776	0.427393	0.592720	124.770828	21.050541	70.228866
308	135.859228	0.427385	0.591982	124.774917	21.077468	70.214884
309	135.863853	0.427377	0.591248	124.779164	21.104368	70.200980
310	135.868642	0.427368	0.590517	124.783563	21.131243	70.187153
311	135.873591	0.427359	0.589789	124.788107	21.158092	70.173402
312	135.878692	0.427350	0.589064	124.792793	21.184914	70.159725
313	135.883942	0.427341	0.588343	124.797614	21.211709	70.146120
314	135.889334	0.427332	0.587625	124.802566	21.238476	70.132585
315	135.894862	0.427322	0.586910	124.807643	21.265216	70.119119
316	135.900521	0.427312	0.586198	124.812841	21.291927	70.105722
317	135.906307	0.427302	0.585489	124.818155	21.318609	70.092390
318	135.912214	0.427291	0.584784	124.823580	21.345263	70.079123
319	135.918237	0.427280	0.584081	124.829111	21.371887	70.065920
320	135.924371	0.427270	0.583381	124.834745	21.398481	70.052779
321	135.930611	0.427259	0.582685	124.840476	21.425045	70.039699
322	135.936954	0.427247	0.581991	124.846301	21.451579	70.026679
323	135.943394	0.427236	0.581301	124.852215	21.478083	70.013717
324	135.949926	0.427224	0.580613	124.858215	21.504555	70.000812
325	135.956548	0.427213	0.579928	124.864296	21.530996	69.987963
326	135.963254	0.427201	0.579246	124.870455	21.557406	69.975169
327	135.970040	0.427189	0.578567	124.876688	21.583783	69.962428
328	135.976903	0.427177	0.577891	124.882991	21.610129	69.949740
329	135.983838	0.427164	0.577218	124.889360	21.636443	69.937104
330	135.990842	0.427152	0.576547	124.895793	21.662723	69.924518

331	135.997911	0.427140	0.575879	124.902285	21.688972	69.911982
332	136.005041	0.427127	0.575214	124.908833	21.715187	69.899494
333	136.012229	0.427114	0.574552	124.915435	21.741369	69.887053
334	136.019472	0.427101	0.573892	124.922086	21.767517	69.874659
335	136.026765	0.427089	0.573235	124.928785	21.793632	69.862310
336	136.034106	0.427076	0.572581	124.935527	21.819713	69.850007
337	136.041492	0.427062	0.571929	124.942310	21.845760	69.837747
338	136.048919	0.427049	0.571280	124.949131	21.871773	69.825529
339	136.056384	0.427036	0.570634	124.955988	21.897752	69.813354
340	136.063885	0.427023	0.569990	124.962877	21.923696	69.801220
341	136.071419	0.427010	0.569349	124.969795	21.949605	69.789127
342	136.078982	0.426996	0.568710	124.976741	21.975480	69.777073

	qc1N FC10%	qc FC10%	Dr FC10%	qc1N FC15%	qc FC15%	Dr FC15%
0	106.495695	6.264453	0.000000	101.677101	5.981006	0.000000
1	106.495695	6.264453	0.000000	101.677101	5.981006	0.000000
2	106.473781	6.263164	0.000000	101.656178	5.979775	0.000000
3	106.437070	6.261004	0.000000	101.621128	5.977713	0.000000
4	106.398283	6.258723	0.000000	101.584097	5.975535	0.000000
5	106.358280	6.256369	0.000000	101.545903	5.973288	0.000000
6	106.317548	6.253973	0.000000	101.507014	5.971001	0.000000
7	106.276392	6.251552	0.000000	101.467721	5.968689	0.000000
8	106.235013	6.249118	0.000000	101.428213	5.966365	0.000000
9	106.193548	6.246679	86.881951	101.388625	5.964037	84.960688
10	106.152096	6.244241	84.690622	101.349049	5.961709	82.769359
11	106.110727	6.241807	82.688711	101.309551	5.959385	80.767448
12	106.069491	6.239382	80.845882	101.270181	5.957069	78.924619
13	106.028425	6.236966	79.138554	101.230973	5.954763	77.217291
14	105.987556	6.234562	77.548031	101.191954	5.952468	75.626768
15	105.946903	6.232171	76.059242	101.153140	5.950185	74.137978
16	105.906478	6.229793	74.659857	101.114544	5.947914	72.738593
17	105.866289	6.329340	74.013205	101.076173	6.042957	72.091941
18	105.826338	6.484416	73.783701	101.038030	6.191017	71.862437
19	105.786627	6.634964	73.565450	101.000115	6.334753	71.644187
20	105.747152	6.781329	73.357371	100.962427	6.474496	71.436107
21	105.707909	6.923816	73.158528	100.924959	6.610535	71.237264
22	105.668890	7.062694	72.968112	100.887706	6.743129	71.046848
23	105.630088	7.198202	72.785414	100.850660	6.872506	70.864150
24	105.591492	7.330556	72.609810	100.813811	6.998871	70.688547
25	105.553091	7.459947	72.440749	100.777146	7.122408	70.519486
26	105.514871	7.586551	72.277742	100.740656	7.243283	70.356479
27	105.476818	7.710524	72.120349	100.704324	7.361647	70.199086
28	105.438917	7.832009	71.968179	100.668138	7.477635	70.046915
29	105.401152	7.951136	71.820876	100.632082	7.591373	69.899612
30	105.363505	8.068026	71.678120	100.596139	7.702973	69.756856
31	105.325959	8.182787	71.539619	100.560292	7.812541	69.618356
32	105.288494	8.295519	71.405110	100.524522	7.920173	69.483846
33	105.251090	8.406315	71.274348	100.488810	8.025956	69.353084
34	105.213727	8.515261	71.147111	100.453137	8.129973	69.225847
35	105.176382	8.622436	71.023194	100.417482	8.232298	69.101931
36	105.139033	8.727911	70.902409	100.381823	8.333001	68.981145
37	105.101656	8.831757	70.784580	100.346138	8.432148	68.863317
38	105.064228	8.934035	70.669545	100.310403	8.529798	68.748282
39	105.026723	9.034805	70.557154	100.274595	8.626008	68.635890

40	105.707278	9.155336	70.792267	100.924357	8.741086	68.871004
41	106.359049	9.273208	71.012575	101.546637	8.853625	69.091312
42	106.983791	9.388552	71.219174	102.143111	8.963750	69.297911
43	107.583104	9.501488	71.413054	102.715308	9.071576	69.491790
44	108.158453	9.612128	71.595107	103.264624	9.177209	69.673844
45	108.711178	9.720572	71.766144	103.792340	9.280747	69.844881
46	109.242510	9.826916	71.926900	104.299631	9.382279	70.005637
47	109.753582	9.931247	72.078046	104.787578	9.481890	70.156783
48	110.245435	10.033648	72.220193	105.257177	9.579657	70.298930
49	110.719033	10.134193	72.353900	105.709346	9.675652	70.432637
50	111.175264	10.232952	72.479678	106.144934	9.769943	70.558415
51	111.614953	10.329992	72.597998	106.564729	9.862593	70.676735
52	112.038862	10.425374	72.709291	106.969457	9.953659	70.788027
53	112.447698	10.519154	72.813954	107.359795	10.043196	70.892690
54	112.842119	10.611387	72.912354	107.736369	10.131256	70.991090
55	113.222735	10.702123	73.004828	108.099763	10.217886	71.083565
56	113.590114	10.791408	73.091689	108.450520	10.303131	71.170426
57	113.944787	10.879286	73.173227	108.789145	10.387033	71.251964
58	114.287246	10.965799	73.249709	109.116109	10.469631	71.328445
59	114.617951	11.050985	73.321383	109.431851	10.550963	71.400119
60	114.937332	11.134881	73.388479	109.736781	10.631063	71.467216
61	115.245790	11.217520	73.451212	110.031281	10.709963	71.529949
62	115.543698	11.298936	73.509782	110.315710	10.787695	71.588518
63	115.831407	11.379158	73.564372	110.590401	10.864287	71.643109
64	116.109244	11.458214	73.615156	110.855667	10.939766	71.693893
65	116.377514	11.536131	73.662294	111.111799	11.014157	71.741031
66	116.636504	11.612935	73.705937	111.359070	11.087486	71.784674
67	116.886481	11.688648	73.746224	111.597737	11.159774	71.824960
68	117.286929	11.779248	73.839523	111.980066	11.246274	71.918260
69	117.677449	11.868720	73.928664	112.352915	11.331698	72.007400
70	118.058285	11.957085	74.013796	112.716520	11.416064	72.092533
71	118.429667	12.044360	74.095062	113.071098	11.499391	72.173799
72	118.791813	12.130564	74.172595	113.416858	11.581695	72.251332
73	119.144923	12.215714	74.246520	113.753991	11.662991	72.325256
74	119.489188	12.299824	74.316954	114.082679	11.743296	72.395690
75	119.824786	12.382910	74.384008	114.403092	11.822622	72.462745
76	120.151884	12.464985	74.447786	114.715390	11.900984	72.526523
77	120.470639	12.546062	74.508387	115.019723	11.978392	72.587123
78	120.781198	12.626154	74.565902	115.316230	12.054860	72.644639
79	121.083700	12.705272	74.620419	115.605044	12.130398	72.699156
80	121.378273	12.783427	74.672021	115.886289	12.205017	72.750758
81	121.665040	12.860628	74.720785	116.160081	12.278726	72.799521
82	121.944115	12.936887	74.766784	116.426529	12.351534	72.845521
83	122.215606	13.012212	74.810089	116.685735	12.423450	72.888826
84	122.479613	13.086611	74.850766	116.937796	12.494483	72.929502
85	122.736231	13.160093	74.888875	117.182804	12.564640	72.967612
86	122.985551	13.232665	74.924478	117.420843	12.633928	73.003214
87	123.227656	13.304334	74.957629	117.651993	12.702355	73.036366
88	123.462626	13.375108	74.988383	117.876332	12.769926	73.067120
89	123.690537	13.444993	75.016790	118.093930	12.836649	73.095527
90	123.911459	13.513994	75.042899	118.304856	12.902529	73.121635
91	124.125461	13.582119	75.066755	118.509175	12.967571	73.145491
92	124.332606	13.649373	75.088403	118.706948	13.031782	73.167140
93	124.532957	13.715761	75.107885	118.898233	13.095166	73.186622

94	124.726571	13.781288	75.125242	119.083087	13.157728	73.203978
95	124.913505	13.845960	75.140511	119.261563	13.219474	73.219248
96	125.093815	13.909781	75.153731	119.433714	13.280407	73.232468
97	125.267551	13.972757	75.164938	119.599589	13.340533	73.243674
98	125.434765	14.034891	75.174165	119.759238	13.399856	73.252902
99	125.595508	14.096189	75.181448	119.912708	13.458381	73.260184
100	125.749829	14.156655	75.186817	120.060046	13.516111	73.265554
101	125.897775	14.216294	75.190305	120.201298	13.573052	73.269042
102	126.039394	14.275110	75.191943	120.336509	13.629207	73.270680
103	126.174735	14.333109	75.191761	120.465727	13.684581	73.270498
104	126.303846	14.390294	75.189788	120.588995	13.739178	73.268524
105	126.426773	14.446670	75.186053	120.706361	13.793004	73.264790
106	126.543566	14.502242	75.180585	120.817869	13.846062	73.259321
107	126.654275	14.557016	75.173412	120.923568	13.898357	73.252148
108	126.758948	14.610996	75.164561	121.023506	13.949894	73.243297
109	126.857638	14.664187	75.154060	121.117730	14.000679	73.232797
110	126.950397	14.716595	75.141937	121.206292	14.050715	73.220674
111	127.037278	14.768225	75.128219	121.289242	14.100009	73.206955
112	127.118337	14.819083	75.112932	121.366633	14.148566	73.191669
113	127.193631	14.869175	75.096105	121.438520	14.196392	73.174841
114	127.263219	14.918507	75.077764	121.504960	14.243492	73.156500
115	127.327162	14.967086	75.057936	121.566009	14.289873	73.136673
116	127.385522	15.014918	75.036650	121.621729	14.335541	73.115386
117	127.438366	15.062010	75.013932	121.672182	14.380502	73.092669
118	127.485760	15.108370	74.989811	121.717431	14.424764	73.068547
119	127.527774	15.154004	74.964314	121.757545	14.468333	73.043051
120	127.564480	15.198921	74.937470	121.792590	14.511217	73.016207
121	127.595953	15.243128	74.909307	121.822639	14.553424	72.988044
122	127.622270	15.286634	74.879854	121.847765	14.594962	72.958591
123	127.643511	15.329447	74.849141	121.868045	14.635838	72.927878
124	127.659757	15.371577	74.817196	121.883556	14.676062	72.895933
125	127.671094	15.413032	74.784050	121.894380	14.715641	72.862786
126	127.677608	15.453822	74.749732	121.900599	14.754586	72.828469
127	127.679389	15.493958	74.714273	121.902300	14.792905	72.793010
128	127.676530	15.533448	74.677705	121.899570	14.830608	72.756441
129	127.669125	15.572303	74.640057	121.892499	14.867705	72.718793
130	127.657270	15.610534	74.601362	121.881182	14.904207	72.680098
131	127.641067	15.648152	74.561650	121.865711	14.940123	72.640387
132	127.620614	15.685168	74.520955	121.846184	14.975464	72.599692
133	127.596018	15.721594	74.479309	121.822701	15.010241	72.558046
134	127.567382	15.757440	74.436744	121.795361	15.044466	72.515480
135	127.534816	15.792720	74.393292	121.764268	15.078149	72.472029
136	127.498427	15.827445	74.348988	121.729526	15.111303	72.427725
137	127.458328	15.861627	74.303864	121.691241	15.143938	72.382601
138	127.414632	15.895279	74.257954	121.649521	15.176068	72.336691
139	127.367451	15.928415	74.211291	121.604476	15.207704	72.290028
140	127.316902	15.961046	74.163909	121.556214	15.238859	72.242646
141	127.263101	15.993185	74.115842	121.504847	15.269544	72.194578
142	127.206166	16.024847	74.067123	121.450488	15.299773	72.145859
143	127.146215	16.056044	74.017786	121.393249	15.329559	72.096522
144	127.083367	16.086790	73.967865	121.333245	15.358913	72.046601
145	127.017741	16.117097	73.917393	121.270589	15.387850	71.996130
146	126.949458	16.146981	73.866405	121.205395	15.416381	71.945142
147	126.878637	16.176453	73.814934	121.137779	15.444520	71.893670

148	126.805399	16.205529	73.763012	121.067855	15.472280	71.841748
149	126.729863	16.234221	73.710673	120.995737	15.499674	71.789410
150	126.652149	16.262543	73.657950	120.921539	15.526715	71.736687
151	126.572376	16.290509	73.604875	120.845375	15.553415	71.683612
152	126.490662	16.318133	73.551481	120.767359	15.579789	71.630218
153	126.407125	16.345427	73.497799	120.687601	15.605848	71.576535
154	126.321881	16.372405	73.443861	120.606215	15.631605	71.522597
155	126.235047	16.399081	73.389697	120.523309	15.657074	71.468434
156	126.146735	16.425468	73.335339	120.438993	15.682267	71.414075
157	126.057060	16.451578	73.280816	120.353375	15.707196	71.359552
158	125.966131	16.477426	73.226158	120.266561	15.731874	71.304894
159	125.874060	16.503023	73.171394	120.178656	15.756313	71.250130
160	125.780954	16.528382	73.116552	120.089763	15.780525	71.195289
161	125.686919	16.553516	73.061660	119.999982	15.804522	71.140397
162	125.592058	16.578437	73.006746	119.909414	15.828315	71.085483
163	125.496475	16.603157	72.951836	119.818155	15.851916	71.030573
164	125.400267	16.627687	72.896956	119.726301	15.875337	70.975693
165	125.303534	16.652040	72.842131	119.633944	15.898588	70.920867
166	125.206369	16.676227	72.787385	119.541176	15.921680	70.866122
167	125.108866	16.700258	72.732743	119.448084	15.944624	70.811479
168	125.011114	16.724145	72.678227	119.354755	15.967430	70.756963
169	124.913200	16.747898	72.623859	119.261272	15.990109	70.702596
170	124.815211	16.771528	72.569662	119.167716	16.012669	70.648399
171	124.717228	16.795044	72.515656	119.074166	16.035121	70.594393
172	124.619329	16.818456	72.461861	118.980698	16.057474	70.540597
173	124.521594	16.841774	72.408296	118.887384	16.079737	70.487032
174	124.424094	16.865007	72.354980	118.794296	16.101918	70.433716
175	124.326902	16.888163	72.301930	118.701502	16.124027	70.380666
176	124.230086	16.911252	72.249163	118.609067	16.146071	70.327899
177	124.133712	16.934281	72.196695	118.517053	16.168058	70.275432
178	124.037843	16.957259	72.144543	118.425522	16.189996	70.223279
179	123.942538	16.980192	72.092719	118.334529	16.211892	70.171456
180	123.847856	17.003090	72.041239	118.244131	16.233753	70.119975
181	123.753851	17.025957	71.990114	118.154380	16.255587	70.068851
182	123.660575	17.048803	71.939358	118.065324	16.277398	70.018095
183	123.568078	17.071632	71.888982	117.977012	16.299194	69.967719
184	123.476405	17.094451	71.838997	117.889488	16.320981	69.917734
185	123.385602	17.117266	71.789413	117.802793	16.342764	69.868149
186	123.295710	17.140083	71.740239	117.716968	16.364548	69.818975
187	123.206767	17.162906	71.691483	117.632050	16.386339	69.770220
188	123.118811	17.185742	71.643155	117.548073	16.408141	69.721892
189	123.031875	17.208594	71.595262	117.465071	16.429959	69.673998
190	122.945992	17.231467	71.547809	117.383073	16.451798	69.626546
191	122.861190	17.254366	71.500804	117.302108	16.473661	69.579541
192	122.777497	17.277295	71.454252	117.222202	16.495552	69.532988
193	122.694937	17.300257	71.408157	117.143378	16.517475	69.486894
194	122.613534	17.323256	71.362524	117.065659	16.539433	69.441261
195	122.533309	17.346295	71.317358	116.989063	16.561430	69.396094
196	122.454280	17.369377	71.272660	116.913610	16.583468	69.351396
197	122.376464	17.392505	71.228433	116.839315	16.605549	69.307170
198	122.299876	17.415682	71.184681	116.766192	16.627677	69.263417
199	122.224529	17.438910	71.141404	116.694255	16.649854	69.220140
200	122.150435	17.462191	71.098604	116.623513	16.672082	69.177340
201	122.077602	17.485527	71.056281	116.553976	16.694362	69.135018

202	122.006040	17.508920	71.014436	116.485652	16.716697	69.093173
203	121.935755	17.532372	70.973070	116.418547	16.739087	69.051806
204	121.866751	17.555884	70.932180	116.352665	16.761535	69.010917
205	121.799033	17.579457	70.891768	116.288011	16.784042	68.970504
206	121.732602	17.603092	70.851830	116.224586	16.806608	68.930567
207	121.667460	17.626791	70.812367	116.162391	16.829234	68.891103
208	121.603605	17.650554	70.773375	116.101426	16.851922	68.852112
209	121.541037	17.674382	70.734853	116.041689	16.874672	68.813590
210	121.479753	17.698275	70.696799	115.983177	16.897484	68.775536
211	121.419749	17.722234	70.659210	115.925888	16.920359	68.737946
212	121.361020	17.746259	70.622082	115.869817	16.943296	68.700818
213	121.303561	17.770349	70.585412	115.814958	16.966297	68.664149
214	121.247365	17.794506	70.549197	115.761304	16.989361	68.627934
215	121.192425	17.818729	70.513434	115.708850	17.012488	68.592171
216	121.138731	17.843018	70.478118	115.657586	17.035677	68.556855
217	121.086276	17.867372	70.443246	115.607504	17.058930	68.521982
218	121.035049	17.891791	70.408812	115.558595	17.082244	68.487549
219	120.985041	17.916275	70.374813	115.510849	17.105620	68.453550
220	120.936239	17.940823	70.341245	115.464256	17.129058	68.419981
221	120.888633	17.965435	70.308102	115.418804	17.152556	68.386838
222	120.842210	17.990109	70.275379	115.374481	17.176114	68.354116
223	120.796958	18.014846	70.243073	115.331277	17.199731	68.321809
224	120.752864	18.039643	70.211177	115.289178	17.223406	68.289913
225	120.709914	18.064501	70.179687	115.248171	17.247139	68.258423
226	120.668094	18.089418	70.148597	115.208243	17.270929	68.227334
227	120.627390	18.114394	70.117903	115.169381	17.294775	68.196639
228	120.587788	18.139427	70.087598	115.131571	17.318675	68.166335
229	120.549273	18.164516	70.057678	115.094799	17.342629	68.136415
230	120.511830	18.189661	70.028137	115.059050	17.366636	68.106874
231	120.475443	18.214859	69.998970	115.024310	17.390695	68.077707
232	120.440098	18.240111	69.970171	114.990564	17.414803	68.048908
233	120.405779	18.265414	69.941735	114.957797	17.438961	68.020472
234	120.372469	18.290767	69.913656	114.925994	17.463167	67.992392
235	120.340153	18.316169	69.885928	114.895141	17.487420	67.964665
236	120.308815	18.341620	69.858547	114.865221	17.511719	67.937284
237	120.278440	18.367116	69.831506	114.836220	17.536062	67.910243
238	120.249010	18.392658	69.804801	114.808122	17.560448	67.883537
239	120.220511	18.418244	69.778425	114.780912	17.584877	67.857161
240	120.192925	18.443872	69.752373	114.754574	17.609345	67.831109
241	120.166237	18.469542	69.726639	114.729094	17.633853	67.805376
242	120.140430	18.495251	69.701219	114.704455	17.658399	67.779956
243	120.115489	18.520999	69.676106	114.680642	17.682982	67.754843
244	120.091398	18.546784	69.651296	114.657641	17.707600	67.730033
245	120.068140	18.572604	69.626783	114.635435	17.732253	67.705520
246	120.045700	18.598459	69.602562	114.614011	17.756938	67.681298
247	120.024062	18.624347	69.578627	114.593351	17.781654	67.657364
248	120.003210	18.650267	69.554973	114.573443	17.806401	67.633710
249	119.983128	18.676217	69.531596	114.554270	17.831177	67.610333
250	119.963802	18.702195	69.508490	114.535818	17.855980	67.587226
251	119.945216	18.728202	69.485649	114.518073	17.880810	67.564386
252	119.927354	18.754234	69.463070	114.501020	17.905664	67.541806
253	119.910202	18.780292	69.440746	114.484644	17.930543	67.519483
254	119.893745	18.806373	69.418674	114.468931	17.955444	67.497411
255	119.877967	18.832476	69.396848	114.453867	17.980366	67.475585

256	119.862855	18.858600	69.375264	114.439439	18.005308	67.454000
257	119.848394	18.884744	69.353917	114.425632	18.030269	67.432653
258	119.834569	18.910907	69.332801	114.412433	18.055248	67.411538
259	119.821367	18.937086	69.311914	114.399828	18.080243	67.390651
260	119.808773	18.963282	69.291250	114.387804	18.105253	67.369986
261	119.796774	18.989492	69.270804	114.376348	18.130278	67.349541
262	119.785356	19.015716	69.250573	114.365447	18.155315	67.329310
263	119.774507	19.041952	69.230552	114.355088	18.180364	67.309289
264	119.764212	19.068199	69.210737	114.345259	18.205423	67.289474
265	119.754459	19.094456	69.191124	114.335947	18.230492	67.269860
266	119.745235	19.120722	69.171708	114.327140	18.255569	67.250445
267	119.736527	19.146995	69.152486	114.318827	18.280654	67.231222
268	119.728323	19.173275	69.133453	114.310994	18.305745	67.212190
269	119.720611	19.199561	69.114606	114.303631	18.330841	67.193343
270	119.713378	19.225851	69.095941	114.296726	18.355941	67.174678
271	119.706614	19.252144	69.077455	114.290267	18.381045	67.156191
272	119.700306	19.278439	69.059142	114.284244	18.406151	67.137879
273	119.694442	19.304736	69.041001	114.278646	18.431257	67.119737
274	119.689012	19.331033	69.023026	114.273462	18.456364	67.101763
275	119.684005	19.357329	69.005215	114.268681	18.481471	67.083952
276	119.679409	19.383623	68.987565	114.264294	18.506575	67.066302
277	119.675215	19.409915	68.970072	114.260289	18.531678	67.048808
278	119.671411	19.436203	68.952732	114.256657	18.556776	67.031469
279	119.667987	19.462487	68.935543	114.253388	18.581871	67.014279
280	119.664934	19.488765	68.918500	114.250473	18.606960	66.997237
281	119.662241	19.515037	68.901602	114.247902	18.632043	66.980339
282	119.659898	19.541301	68.884845	114.245665	18.657119	66.963582
283	119.657897	19.567558	68.868226	114.243754	18.682188	66.946963
284	119.656227	19.593806	68.851742	114.242160	18.707248	66.930479
285	119.654880	19.620044	68.835390	114.240874	18.732299	66.914127
286	119.653846	19.646272	68.819168	114.239887	18.757340	66.897905
287	119.653117	19.672488	68.803072	114.239191	18.782370	66.881809
288	119.652684	19.698693	68.787101	114.238778	18.807389	66.865837
289	119.652539	19.724884	68.771250	114.238639	18.832396	66.849987
290	119.652673	19.751063	68.755518	114.238767	18.857389	66.834255
291	119.653078	19.777227	68.739903	114.239154	18.882370	66.818639
292	119.653747	19.803376	68.724401	114.239792	18.907336	66.803137
293	119.654671	19.829510	68.709010	114.240675	18.932287	66.787746
294	119.655843	19.855627	68.693728	114.241793	18.957223	66.772464
295	119.657255	19.881728	68.678552	114.243141	18.982143	66.757289
296	119.658900	19.907811	68.663481	114.244712	19.007046	66.742217
297	119.660771	19.933876	68.648511	114.246498	19.031931	66.727248
298	119.662860	19.959923	68.633642	114.248493	19.056799	66.712378
299	119.665162	19.985950	68.618870	114.250691	19.081649	66.697607
300	119.667668	20.011957	68.604194	114.253084	19.106479	66.682930
301	119.670374	20.037944	68.589611	114.255667	19.131290	66.668347
302	119.673271	20.063910	68.575119	114.258433	19.156082	66.653856
303	119.676355	20.089855	68.560717	114.261377	19.180852	66.639454
304	119.679618	20.115777	68.546403	114.264493	19.205602	66.625140
305	119.683055	20.141677	68.532174	114.267774	19.230330	66.610911
306	119.686659	20.167555	68.518030	114.271215	19.255036	66.596766
307	119.690426	20.193408	68.503967	114.274812	19.279720	66.582704
308	119.694349	20.219238	68.489985	114.278557	19.304381	66.568722
309	119.698423	20.245044	68.476082	114.282447	19.329019	66.554818

310	119.702642	20.270824	68.462255	114.286475	19.353633	66.540992
311	119.707002	20.296580	68.448504	114.290638	19.378223	66.527240
312	119.711497	20.322310	68.434826	114.294929	19.402789	66.513563
313	119.716122	20.348013	68.421221	114.299345	19.427330	66.499958
314	119.720872	20.373691	68.407687	114.303880	19.451846	66.486423
315	119.725742	20.399341	68.394221	114.308530	19.476336	66.472958
316	119.730729	20.424965	68.380823	114.313291	19.500800	66.459560
317	119.735826	20.450561	68.367492	114.318158	19.525238	66.446228
318	119.741030	20.476129	68.354225	114.323126	19.549649	66.432962
319	119.746336	20.501669	68.341022	114.328192	19.574033	66.419759
320	119.751740	20.527181	68.327881	114.333352	19.598390	66.406618
321	119.757238	20.552663	68.314801	114.338601	19.622720	66.393537
322	119.762826	20.578117	68.301780	114.343936	19.647022	66.380517
323	119.768500	20.603541	68.288818	114.349353	19.671296	66.367555
324	119.774255	20.628935	68.275913	114.354848	19.695541	66.354650
325	119.780089	20.654300	68.263064	114.360418	19.719758	66.341801
326	119.785997	20.679634	68.250270	114.366059	19.743946	66.329007
327	119.791976	20.704938	68.237530	114.371767	19.768105	66.316266
328	119.798022	20.730211	68.224842	114.377539	19.792234	66.303579
329	119.804132	20.755453	68.212206	114.383373	19.816334	66.290942
330	119.810303	20.780664	68.199620	114.389264	19.840404	66.278356
331	119.816530	20.805843	68.187083	114.395210	19.864444	66.265820
332	119.822812	20.830991	68.174595	114.401208	19.888454	66.253332
333	119.829145	20.856107	68.162155	114.407254	19.912434	66.240891
334	119.835526	20.881190	68.149761	114.413346	19.936382	66.228497
335	119.841951	20.906242	68.137412	114.419481	19.960301	66.216149
336	119.848419	20.931261	68.125108	114.425656	19.984188	66.203845
337	119.854926	20.956248	68.112848	114.431869	20.008044	66.191585
338	119.861469	20.981201	68.100631	114.438116	20.031868	66.179368
339	119.868047	21.006122	68.088456	114.444396	20.055661	66.167192
340	119.874655	21.031010	68.076322	114.450705	20.079423	66.155058
341	119.881292	21.055864	68.064228	114.457042	20.103153	66.142965
342	119.887955	21.080685	68.052174	114.463404	20.126851	66.130911

6 V_s criteria for evaluating Liquefaction Resistance

In [ ]:
```
Vs1 = Vs*(100/sigV)**0.25
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