```
diary on         % begin recording

% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: CM-137
% calculation by SJH, Ransom Consulting, Inc. 20-Feb-2020
% 100-year wave runup using TAW methodology
% including berm and weighted average with foreshore if necessary
%
% chk nld 20200220
%
% This script assumes that the incident wave conditions provided
% as input in the configuration section below are the
% appropriate values located at the end of the foreshore
% or toe of the slope on which the run-up is being calculated
% the script does not attempt to apply a depth limit or any other
% transformation to the incident wave conditions other than
% conversion of the peak wave period to the spectral mean wave
% as recommended in the references below
%
% references:
%
% Van der Meer, J.W., 2002. Technical Report Wave Run-up and
% Wave Overtopping at Dikes. TAW Technical Advisory Committee on
% Flood Defence, The Netherlands.
%
% FEMA. 2007,  Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update
%
%
%

%-------------------------------------------------------------------------
% CONFIG
%-------------------------------------------------------------------------
fname='inpfiles/CM-137sta_ele_include.csv';   % file with station, elevation, include
                                      % third colunm is 0 for excluded points
imgname='logfiles/CM-137-runup';
SWEL=8.8077;  % 100-yr still water level including wave setup.
H0=4.9302;    % significant wave height at toe of structure
Tp=9.6953;    % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=0.94202;   % this may get changed automatically below
gamma_rough=0.8;
gamma_beta=1;
gamma_perm=1;

setupAtToe=0.0016634;
maxSetup=0.73897;   % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for CM-137'

plotTitle =

Iterative TAW for CM-137



% END CONFIG
%------------------------------

SWEL=SWEL+setupAtToe

SWEL =

                 8.8093634

SWEL_fore=SWEL+maxSetup

SWEL_fore =

                 9.5483334



% FIND WAVELENGTH USING DEEPWATER DISPERSION RELATION
% using English units
L0=32.15/(2*pi)*T0^2

L0 =

          397.501015444419


% Find Hb (Munk, 1949)
%Hb=H0/(3.3*(H0/L0)^(1/3))
%Db=-Hb/.78+SWEL;  % depth at breaking

% The toe elevation here is only used to determine the average
% structure slope, it is not used to depth limit the wave height.
% Any depth limiting or other modification of the wave height
```

```
% to make it consitent with TAW guidance should be performed
% prior to the input of the significant wave height given above.
Ztoe=SWEL-1.5*H0

Ztoe =

                 1.4140634


% read the transect
[sta,dep,inc] = textread(fname,'%n%n%n%*[^\n]','delimiter',',','headerlines',0);

% remove unselected points
k=find(inc==0);
sta(k)=[];
dep(k)=[];

sta_org=sta;  % used for plotting purposes
dep_org=dep;


% initial guess at maximum run-up elevation to estimate slope
Z2=SWEL+1.5*H0

Z2 =

               16.2046634


% determine station at the max runup and -1.5*H0 (i.e. the toe)
top_sta=-999;
toe_sta=-999;
for kk=1:length(sta)-1
    if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1)))    % here is the intersection of z2 with profile
       top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
    end
    if  ((Ztoe > dep(kk)) & (Ztoe <= dep(kk+1)))    % here is the intersection of Ztoe with profile
       toe_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Ztoe)
    end
end

toe_sta =

          40.7079960918417


top_sta =

          137.619585407725

% check to make sure we got them, if not extend the end slopes outward
S=diff(dep)./diff(sta);
if toe_sta==-999
   dy=dep(1)-Ztoe;
   toe_sta=sta(1)-dy/S(1)
end
if top_sta==-999
   dy=Z2-dep(end);
   top_sta=sta(end)+dy/S(end)
end

% just so the reader can tell the values aren't -999 anymore
top_sta

top_sta =

          137.619585407725

toe_sta

toe_sta =

          40.7079960918417




% check for case where the toe of slope is below SWL-1.5*H0
% in this case interpolate setup from the setupAtToe(really setup as first station), and the max setup
% also un-include points seaward of SWL-1.5*H0
if Ztoe > dep(1)
   dd=SWEL_fore-dep;
   k=find(dd<0,1); % k is index of first land point
   staAtSWL=interp1(dep(k-1:k),sta(k-1:k),SWEL_fore);
   dsta=staAtSWL-sta(1);
   dsetup=maxSetup-setupAtToe;
   dsetdsta=dsetup/dsta;
   setup=setupAtToe+dsetdsta*(toe_sta-sta(1));
   sprintf('-!!- Location of SWEL-1.5*H0 is %4.1f ft landward of toe of slope',dsta)
   sprintf('-!!- Setup is interpolated between setup at toe of slope and max setup')
```

```
   sprintf('-!!-       setup is adjusted to %4.2f feet',setup)
   SWEL=SWEL-setupAtToe+setup;
   sprintf('-!!-       SWEL is adjusted to %4.2f feet',SWEL)
   k=find(dep < SWEL-1.5*H0)
   sta(k)=[];
   dep(k)=[];
else
   sprintf('-!!- The User has selected a starting point that is %4.2f feet above the elevation of SWEL-1.5H0\n',dep(1
   sprintf('-!!- This may be reasonable for some cases.  However the user may want to consider:\n')
   sprintf('-!!-   1) Selecting a starting point that is at or below %4.2f feet elevation, or\n', Ztoe)
   sprintf('-!!-   2) Reducing the incident wave height to a depth limited condition.\n')
end

ans =

-!!- Location of SWEL-1.5*H0 is 59.7 ft landward of toe of slope


ans =

-!!- Setup is interpolated between setup at toe of slope and max setup


ans =

-!!-       setup is adjusted to 0.06 feet


ans =

-!!-       SWEL is adjusted to 8.87 feet


k =

     1
     2
     3
     4
     5
     6



% now iterate converge on a runup elevation
tol=0.01;  % convergence criteria
R2del=999;
R2_new=3*H0; %initial guess
R2=R2_new;
iter=0;
R2_all=[];
topStaAll=[];
Berm_Segs=[];
TAW_ALWAYS_VALID=1;
while(abs(R2del) > tol && iter <= 25)
    iter=iter+1;
    sprintf ('!----------------- STARTING ITERATION %d -----------------!',iter)
    % elevation of toe of slope
    Ztoe
    % station of toe slope (relative to 0-NAVD88 shoreline
    toe_sta
    % station of top of slope/extent of 2% run-up
    top_sta
    % elevation of top of slope/extent of 2% run-up
    Z2
    % incident significant wave height
    H0
    % incident spectral peak wave period
    Tp
    % incident spectral mean wave period
    T0

    R2=R2_new
    Z2=R2+SWEL
    % determine slope for this iteration
    top_sta=-999;
    for kk=1:length(sta)-1
       if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1)))    % here is the intersection of z2 with profile
          top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
          break;
       end
    end
    if top_sta==-999
       dy=Z2-dep(end);
       top_sta=sta(end)+dy/S(end)
    end

    % get the length of the slope (not accounting for berm)
    Lslope=top_sta-toe_sta
```

```
% loop over profile segments to determine berm factor
% re-calculate influence of depth of berm based on this run-up elevation
% check for berm, berm width, berm height
berm_width=0;
rdh_sum=0;
Berm_Segs=[];
Berm_Heights=[];
for kk=1:length(sta)-1
   ddep=dep(kk+1)-dep(kk);
   dsta=sta(kk+1)-sta(kk);
   s=ddep/dsta;
   if  (s < 1/15)     % count it as a berm if slope is flatter than 1:15 (see TAW manual)
      sprintf ('Berm Factor Calculation: Iteration %d, Profile Segment: %d',iter,kk)
      berm_width=berm_width+dsta;   % tally the width of all berm segments
      % compute the rdh for this segment and weight it by the segment length
      dh=SWEL-(dep(kk)+dep(kk+1))/2
      if  dh < 0
          chi=R2;
      else
          chi=2* H0;
      end
      if (dh <= R2 & dh >=-2*H0)
         rdh=(0.5-0.5*cos(3.14159*dh/chi)) ;
      else
         rdh=1;
      end
      rdh_sum=rdh_sum + rdh * dsta
      Berm_Segs=[Berm_Segs, kk];
      Berm_Heights=[Berm_Heights, (dep(kk)+dep(kk+1))/2];
   end
   if dep(kk) >= Z2  % jump out of loop if we reached limit of run-up for this iteration
      break
   end
end
sprintf ('!------- End Berm Factor Calculation, Iter: %d ---------!',iter)
berm_width
rB=berm_width/Lslope
if (berm_width > 0)
   rdh_mean=rdh_sum/berm_width
else
   rdh_mean=1
end
gamma_berm=1- rB * (1-rdh_mean)
if gamma_berm > 1
   gamma_berm=1
end
if gamma_berm < 0.6
   gamma_berm =0.6
end
% Iribarren number
slope=(Z2-Ztoe)/(Lslope-berm_width)
Irb=(slope/(sqrt(H0/L0)))
% runup height
gamma_berm
gamma_perm
gamma_beta
gamma_rough
gamma=gamma_berm*gamma_perm*gamma_beta*gamma_rough

% check validity
TAW_VALID=1;
if (Irb*gamma_berm < 0.5 | Irb*gamma_berm > 10 )
   sprintf('!!! - - Iribaren number: %6.2f is outside the valid range (0.5-10), TAW NOT VALID - - !!!\n', Irb*gam
   TAW_VALID=0;
else
   sprintf('!!! - - Iribaren number: %6.2f is in the valid range (0.5-10), TAW RECOMMENDED - - !!!\n', Irb*gamma_
end
islope=1/slope;
if (slope < 1/8 | slope > 1)
   sprintf('!!! - - slope: 1:%3.1f V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!\n', islope)
   TAW_VALID=0;
else
   sprintf('!!! - - slope: 1:%3.1f V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!\n', islope)
end
if TAW_VALID == 0
   TAW_ALWAYS_VALID=0;
end

if (Irb*gamma_berm < 1.8)
   R2_new=gamma*H0*1.77*Irb
else
   R2_new=gamma*H0*(4.3-(1.6/sqrt(Irb)))
end


% check to see if we need to evaluate a shallow foreshore
if berm_width > 0.25 * L0;
   disp ('!   Berm_width is greater than 1/4 wave length')
   disp ('!   Runup will be weighted average with foreshore calculation assuming depth limited wave height on ber
```

```
       % do the foreshore calculation
       fore_H0=0.78*(SWEL_fore-min(Berm_Heights))
       % get upper slope
       fore_toe_sta=-999;
       fore_toe_dep=-999;
       for kk=length(dep)-1:-1:1
          ddep=dep(kk+1)-dep(kk);
          dsta=sta(kk+1)-sta(kk);
          s=ddep/dsta;
          if s < 1/15
             break
          end
          fore_toe_sta=sta(kk);
          fore_toe_dep=dep(kk);
          upper_slope=(Z2-fore_toe_dep)/(top_sta-fore_toe_sta)
       end
       fore_Irb=upper_slope/(sqrt(fore_H0/L0));
       fore_gamma=gamma_perm*gamma_beta*gamma_rough;
       if (fore_Irb < 1.8)
          fore_R2=fore_gamma*fore_H0*1.77*fore_Irb;
       else
          fore_R2=fore_gamma*fore_H0*(4.3-(1.6/sqrt(fore_Irb)));
       end
       if berm_width >= L0
          R2_new=fore_R2
          disp ('berm is wider than one wavelength, use full shallow foreshore solution');
       else
          w2=(berm_width-0.25*L0)/(0.75*L0)
          w1=1-w2
          R2_new=w2*fore_R2 + w1*R2_new
       end
    end % end berm width check

    % convergence criterion
    R2del=abs(R2-R2_new)
    R2_all(iter)=R2_new;

    % get the new top station (for plot purposes)
    Z2=R2_new+SWEL
    top_sta=-999;
    for kk=1:length(sta)-1
       if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1)))    % here is the intersection of z2 with profile
          top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
          break;
       end
    end
    if top_sta==-999
       dy=Z2-dep(end);
       top_sta=sta(end)+dy/S(end);
    end
    topStaAll(iter)=top_sta;
end
ans =
!----------------- STARTING ITERATION 1 -----------------!
Ztoe =
                1.4140634
toe_sta =
          40.7079960918417
top_sta =
          137.619585407725
Z2 =
               16.2046634
H0 =
                   4.9302
Tp =
                   9.6953
T0 =
          8.81390909090909
R2 =
                  14.7906
Z2 =
          23.6580921948499
top_sta =
          196.385252903886
Lslope =
          155.677256812044
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 15
dh =
          5.58809219484985
rdh_sum =
         0.604038036299631
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 16
dh =
          5.52509219484985
rdh_sum =
          1.19823932561153
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 73
```

```
dh =
         -4.37083280515015
rdh_sum =
          1.39867523922016
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 74
dh =
         -4.34068280515015
rdh_sum =
           1.5965536234778
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 77
dh =
         -4.55935780515015
rdh_sum =
          1.81325589487427
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 78
dh =
         -4.55905780515015
rdh_sum =
          2.02993191377365
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 79
dh =
         -4.55155780515015
rdh_sum =
           2.2459519944068
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 80
dh =
         -4.53685780515015
rdh_sum =
          2.46068852810624
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 81
dh =
         -4.52120780515015
rdh_sum =
          2.67406162129848
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 82
dh =
         -4.50460780515015
rdh_sum =
          2.88599197095693
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 83
dh =
         -4.51523280515015
rdh_sum =
          3.09884535198232
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 84
dh =
         -4.55308280515015
rdh_sum =
          3.31499874841325
ans =
!------- End Berm Factor Calculation, Iter: 1 ---------!
berm_width =
    12
rB =
        0.0770825504363049
rdh_mean =
         0.276249895701104
gamma_berm =
         0.944211496082099
slope =
         0.154819414626972
Irb =
          1.39015195114568
gamma_berm =
         0.944211496082099
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.8
gamma =
          0.75536919686568
ans =
!!! - - Iribaren number:   1.31 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:6.5 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          9.16345703929551
R2del =
          5.62714296070449
```

```
Z2 =
          18.0309492341454
ans =
!----------------- STARTING ITERATION 2 -----------------!
Ztoe =
                1.4140634
toe_sta =
          40.7079960918417
top_sta =
          147.218429306644
Z2 =
          18.0309492341454
H0 =
                    4.9302
Tp =
                    9.6953
T0 =
          8.81390909090909
R2 =
          9.16345703929551
Z2 =
          18.0309492341454
top_sta =
          147.218429306644
Lslope =
          106.510433214802
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 15
dh =
          5.58809219484985
rdh_sum =
         0.604038036299631
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 16
dh =
          5.52509219484985
rdh_sum =
          1.19823932561153
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 73
dh =
         -4.37083280515015
rdh_sum =
          1.66211852162778
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 74
dh =
         -4.34068280515015
rdh_sum =
          2.12084494582478
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 77
dh =
         -4.55935780515015
rdh_sum =
          2.61700954389453
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 78
dh =
         -4.55905780515015
rdh_sum =
          3.11312271765498
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 79
dh =
         -4.55155780515015
rdh_sum =
           3.6079502984605
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 80
dh =
         -4.53685780515015
rdh_sum =
          4.10025822416462
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 81
dh =
         -4.52120780515015
rdh_sum =
          4.58988387614565
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 82
dh =
         -4.50460780515015
rdh_sum =
          5.07666476078171
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 83
dh =
         -4.51523280515015
```

```
rdh_sum =
         5.56526642437265
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 84
dh =
        -4.55308280515015
rdh_sum =
          6.06035540658532
ans =
!------- End Berm Factor Calculation, Iter: 2 ---------!
berm_width =
    12
rB =
         0.112665019170463
rdh_mean =
         0.505029617215443
gamma_berm =
         0.944234152334766
slope =
         0.175820650365434
Irb =
           1.5787259029891
gamma_berm =
         0.944234152334766
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.8
gamma =
         0.755387321867813
ans =
!!! - - Iribaren number:   1.49 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.7 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
         10.4067286321687
R2del =
         1.24327159287315
Z2 =
         19.2742208270185
ans =
!----------------- STARTING ITERATION 3 -----------------!
Ztoe =
                1.4140634
toe_sta =
         40.7079960918417
top_sta =
         158.081440166173
Z2 =
         19.2742208270185
H0 =
                   4.9302
Tp =
                   9.6953
T0 =
         8.81390909090909
R2 =
         10.4067286321687
Z2 =
         19.2742208270185
top_sta =
         158.081440166173
Lslope =
         117.373444074331
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 15
dh =
         5.58809219484985
rdh_sum =
        0.604038036299631
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 16
dh =
         5.52509219484985
rdh_sum =
         1.19823932561153
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 73
dh =
        -4.37083280515015
rdh_sum =
           1.5738948334539
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 74
dh =
        -4.34068280515015
rdh_sum =
          1.94514767402656
```

```
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 77
dh =
         -4.55935780515015
rdh_sum =
          2.34855165884679
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 78
dh =
         -4.55905780515015
rdh_sum =
          2.75191121503677
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 79
dh =
         -4.55155780515015
rdh_sum =
          3.15416031402383
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 80
dh =
         -4.53685780515015
rdh_sum =
          3.55423437572973
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 81
dh =
         -4.52120780515015
rdh_sum =
          3.95199500020828
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 82
dh =
         -4.50460780515015
rdh_sum =
           4.3473042503047
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 83
dh =
         -4.51523280515015
rdh_sum =
          4.74418222871299
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 84
dh =
         -4.55308280515015
rdh_sum =
          5.14665708026423
ans =
!------- End Berm Factor Calculation, Iter: 3 ---------!
berm_width =
    12
rB =
         0.102237776991536
rdh_mean =
         0.428888090022019
gamma_berm =
         0.941610787910461
slope =
         0.169493913612806
Irb =
          1.52191697200171
gamma_berm =
         0.941610787910461
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.8
gamma =
         0.753288630328369
ans =
!!! - - Iribaren number:   1.43 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          10.0043799329634
R2del =
         0.402348699205216
Z2 =
          18.8718721278133
ans =
!----------------- STARTING ITERATION 4 -----------------!
Ztoe =
                1.4140634
toe_sta =
          40.7079960918417
top_sta =
          154.565942575913
```

```
Z2 =
          18.8718721278133
H0 =
                    4.9302
Tp =
                    9.6953
T0 =
          8.81390909090909
R2 =
          10.0043799329634
Z2 =
          18.8718721278133
top_sta =
          154.565942575913
Lslope =
          113.857946484072
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 15
dh =
          5.58809219484985
rdh_sum =
         0.604038036299631
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 16
dh =
          5.52509219484985
rdh_sum =
          1.19823932561153
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 73
dh =
         -4.37083280515015
rdh_sum =
          1.59975696570555
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 74
dh =
         -4.34068280515015
rdh_sum =
          1.99663794932747
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 77
dh =
         -4.55935780515015
rdh_sum =
          2.42733176043071
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 78
dh =
         -4.55905780515015
rdh_sum =
          2.85797892332342
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 79
dh =
         -4.55155780515015
rdh_sum =
          3.28746008206554
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 80
dh =
         -4.53685780515015
rdh_sum =
          3.71465701332937
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 81
dh =
         -4.52120780515015
rdh_sum =
          4.13942380306943
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 82
dh =
         -4.50460780515015
rdh_sum =
          4.56161492180336
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 83
dh =
         -4.51523280515015
rdh_sum =
          4.98545438600081
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 84
dh =
         -4.55308280515015
rdh_sum =
          5.41517260078245
ans =
!------- End Berm Factor Calculation, Iter: 4 ---------!
```

```
berm_width =
    12
rB =
         0.105394488224665
rdh_mean =
         0.451264383398538
gamma_berm =
         0.942166290517643
slope =
         0.171393684345907
Irb =
          1.53897536224117
gamma_berm =
         0.942166290517643
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.753733032414114
ans =
!!! - - Iribaren number:   1.45 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          10.1224821494486
R2del =
         0.118102216485209
Z2 =
          18.9899743442985
ans =
!----------------- STARTING ITERATION 5 -----------------!
Ztoe =
                1.4140634
toe_sta =
          40.7079960918417
top_sta =
          155.597853598064
Z2 =
          18.9899743442985
H0 =
                    4.9302
Tp =
                    9.6953
T0 =
          8.81390909090909
R2 =
          10.1224821494486
Z2 =
          18.9899743442985
top_sta =
          155.597853598064
Lslope =
          114.889857506223
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 15
dh =
          5.58809219484985
rdh_sum =
         0.604038036299631
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 16
dh =
          5.52509219484985
rdh_sum =
          1.19823932561153
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 73
dh =
        -4.37083280515015
rdh_sum =
          1.59191987625591
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 74
dh =
        -4.34068280515015
rdh_sum =
          1.98103350282899
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 77
dh =
        -4.55935780515015
rdh_sum =
          2.40346573417151
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 78
dh =
         -4.55905780515015
```

```
rdh_sum =
         2.82585197581539
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 79
dh =
        -4.55155780515015
rdh_sum =
         3.24708869470019
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 80
dh =
        -4.53685780515015
rdh_sum =
         3.66607359266593
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 81
dh =
        -4.52120780515015
rdh_sum =
         4.08266299822666
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 82
dh =
        -4.50460780515015
rdh_sum =
         4.49671364992218
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 83
dh =
        -4.51523280515015
rdh_sum =
         4.91238899848386
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 84
dh =
        -4.55308280515015
rdh_sum =
         5.33385941930112
ans =
!------- End Berm Factor Calculation, Iter: 5 ---------!
berm_width =
    12
rB =
        0.104447862156588
rdh_mean =
         0.44448828494176
gamma_berm =
        0.941977988959227
slope =
        0.170822580284315
Irb =
          1.5338473140087
gamma_berm =
        0.941977988959227
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.8
gamma =
        0.753582391167382
ans =
!!! - - Iribaren number:   1.44 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
         10.0867364993734
R2del =
       0.0357456500752331
Z2 =
         18.9542286942233
ans =
!----------------- STARTING ITERATION 6 -----------------!
Ztoe =
              1.4140634
toe_sta =
         40.7079960918417
top_sta =
          155.28552812777
Z2 =
         18.9542286942233
H0 =
                  4.9302
Tp =
                  9.6953
T0 =
         8.81390909090909
R2 =
         10.0867364993734
```

```
Z2 =
          18.9542286942233
top_sta =
           155.28552812777
Lslope =
          114.577532035928
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 15
dh =
          5.58809219484985
rdh_sum =
         0.604038036299631
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 16
dh =
          5.52509219484985
rdh_sum =
          1.19823932561153
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 73
dh =
         -4.37083280515015
rdh_sum =
          1.59426976536326
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 74
dh =
         -4.34068280515015
rdh_sum =
          1.98571226365423
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 77
dh =
         -4.55935780515015
rdh_sum =
          2.41062241812904
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 78
dh =
         -4.55905780515015
rdh_sum =
          2.83548638415188
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 79
dh =
         -4.55155780515015
rdh_sum =
          3.25919585311649
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 80
dh =
         -4.53685780515015
rdh_sum =
           3.6806437212517
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 81
dh =
         -4.52120780515015
rdh_sum =
           4.0996856414664
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 82
dh =
         -4.50460780515015
rdh_sum =
          4.51617766922246
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 83
dh =
         -4.51523280515015
rdh_sum =
          4.93430152891594
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 84
dh =
         -4.55308280515015
rdh_sum =
          5.35824571210359
ans =
!------- End Berm Factor Calculation, Iter: 6 ---------!
berm_width =
    12
rB =
         0.104732575285678
rdh_mean =
         0.446520476008633
gamma_berm =
         0.942032664084493
slope =
          0.17099422208832
```

```
Irb =
          1.53538851728292
gamma_berm =
         0.942032664084493
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.753626131267594
ans =
!!! - - Iribaren number:   1.45 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          10.0974576610312
R2del =
        0.0107211616577576
Z2 =
           18.964949855881
ans =
!----------------- STARTING ITERATION 7 -----------------!
Ztoe =
                1.4140634
toe_sta =
          40.7079960918417
top_sta =
          155.379203633735
Z2 =
           18.964949855881
H0 =
                    4.9302
Tp =
                    9.6953
T0 =
          8.81390909090909
R2 =
          10.0974576610312
Z2 =
           18.964949855881
top_sta =
          155.379203633735
Lslope =
          114.671207541894
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 15
dh =
          5.58809219484985
rdh_sum =
         0.604038036299631
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 16
dh =
          5.52509219484985
rdh_sum =
          1.19823932561153
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 73
dh =
         -4.37083280515015
rdh_sum =
          1.59356296338389
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 74
dh =
         -4.34068280515015
rdh_sum =
          1.98430497158032
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 77
dh =
         -4.55935780515015
rdh_sum =
           2.4084698814978
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 78
dh =
         -4.55905780515015
rdh_sum =
          2.83258866262759
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 79
dh =
         -4.55155780515015
rdh_sum =
             3.25555443996
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 80
```

```
dh =
         -4.53685780515015
rdh_sum =
          3.67626155241782
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 81
dh =
         -4.52120780515015
rdh_sum =
          4.09456585583299
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 82
dh =
         -4.50460780515015
rdh_sum =
          4.51032361085259
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 83
dh =
         -4.51523280515015
rdh_sum =
          4.92771105568266
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 84
dh =
         -4.55308280515015
rdh_sum =
          5.35091124335129
ans =
!------- End Berm Factor Calculation, Iter: 7 ---------!
berm_width =
    12
rB =
         0.104647018700104
rdh_mean =
         0.445909270279274
gamma_berm =
         0.942016057045361
slope =
          0.17094263207842
Irb =
          1.53492528111131
gamma_berm =
         0.942016057045361
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.753612845636289
ans =
!!! - - Iribaren number:   1.45 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          10.0942332420792
R2del =
       0.00322441895198722
Z2 =
           18.961725436929
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
           18.961725436929
diary off
-1.000000e+00
```