```
diary on          % begin recording

% FEMA appeal for The Town of Wells, York county, Maine
% TRANSECT ID: YK-76
% calculation by SJH, Ransom Consulting, Inc. 05-Mar-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/YK-76sta_ele_include.csv';   % file with station, elevation, include
                                 % third colunm is 0 for excluded points
imgname='logfiles/YK-76-runup';
SWEL=8.8908;  % 100-yr still water level including wave setup.
H0=4.5874;    % significant wave height at toe of structure
Tp=13.8735;    % peak period, 1/fma,
T0=Tp/1.1;

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

setupAtToe=1.055;
maxSetup=1.4316;   % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for YK-76'

plotTitle =

Iterative TAW for YK-76



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

SWEL=SWEL+setupAtToe

SWEL =

                  9.9458

SWEL_fore=SWEL+maxSetup

SWEL_fore =

                11.3774



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

L0 =

          813.931423408094


% 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 =

                    3.0647


% 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 =

                    16.8269


% 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 =

          104.854303700985

% 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

top_sta =

          195.19464415276


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

top_sta =

          195.19464415276

toe_sta

toe_sta =

          104.854303700985



% 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')
```

```matlab
    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 97.7 ft landward of toe of slope

ans =

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

ans =

-!!-   setup is adjusted to 1.10 feet

ans =

-!!-   SWEL is adjusted to 9.99 feet

k =

     1
     2
     3
     4
     5
     6
     7
     8
     9
    10
    11
    12
    13


```matlab
% 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 berm
        % 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 =
                3.0647
toe_sta =
        104.854303700985
top_sta =
        195.19464415276
Z2 =
                16.8269
H0 =
                4.5874
Tp =
                13.8735
T0 =
        12.6122727272727
R2 =
                13.7622
Z2 =
        23.7536831059892
top_sta =
        201.206245166779
Lslope =
        96.3519414657942
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 14
dh =
        5.89403360598923
rdh_sum =
        0.716315843427734
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 15
```

```
dh =
        5.83791060598923
rdh_sum =
        1.42392937190642
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 16
dh =
        5.78682760598923
rdh_sum =
        2.12355534105991
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 17
dh =
        5.73574410598923
rdh_sum =
        2.81513259666574
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 18
dh =
        5.68466060598923
rdh_sum =
        3.49860252491216
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 19
dh =
        5.63357760598923
rdh_sum =
        4.17390907262567
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 20
dh =
        5.58249410598923
rdh_sum =
        4.84099852444886
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 21
dh =
        5.53141060598923
rdh_sum =
        5.49981975870949
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 22
dh =
        5.48032760598923
rdh_sum =
        6.15032426506241
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 23
dh =
        5.42924410598923
rdh_sum =
        6.79246591489399
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 24
dh =
        5.37816060598923
rdh_sum =
         7.4262012194097
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 25
dh =
        5.32707760598923
rdh_sum =
        8.05148934464204
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 26
dh =
        5.27599410598923
rdh_sum =
        8.66829187571347
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 27
dh =
        5.22491060598923
rdh_sum =
        9.27657307643208
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 28
dh =
        5.17382760598923
rdh_sum =
        9.87629990162416
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 29
dh =
        5.12274410598923
rdh_sum =
        10.4674417559046
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 30
```

```
dh =
          5.07166060598923
rdh_sum =
          11.0499707540661
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 31
dh =
          5.02057710598923
rdh_sum =
          11.6238616460385
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 32
dh =
          4.96949360598923
rdh_sum =
          12.1890918246138
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 33
dh =
          4.91841060598923
rdh_sum =
           12.745641417418
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 34
dh =
          4.86732710598923
rdh_sum =
          13.2934930380095
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 35
dh =
          4.81624360598923
rdh_sum =
          13.8326320459975
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 36
dh =
          4.76516060598923
rdh_sum =
          14.3630465520945
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 37
dh =
          4.71407710598923
rdh_sum =
          14.8847271655221
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 38
dh =
          4.66299360598923
rdh_sum =
          15.3976672530117
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 39
dh =
          4.61191060598923
rdh_sum =
          15.9018629410937
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 40
dh =
          4.56082710598923
rdh_sum =
          16.3973128605056
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 41
dh =
          4.50974360598923
rdh_sum =
          16.8840184033626
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 42
dh =
          4.45866060598923
rdh_sum =
          17.3619837226764
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 43
dh =
          4.40757760598923
rdh_sum =
          17.8312155599119
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 44
dh =
          4.35649410598923
rdh_sum =
          18.2917232431884
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 45
```

```
dh =
          4.30541060598923
rdh_sum =
           18.743518855335
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 46
dh =
          4.25432760598923
rdh_sum =
          19.1866172297205
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 47
dh =
          4.20324410598923
rdh_sum =
          19.6210356904152
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 48
dh =
          4.15216060598923
rdh_sum =
          20.0467943023479
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 49
dh =
          4.10107710598923
rdh_sum =
           20.463915779962
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 50
dh =
          4.04284760598923
rdh_sum =
          20.8712229623013
ans =
!------- End Berm Factor Calculation, Iter: 1 ---------!
berm_width =
     37
rB =
          0.384008868291827
rdh_mean =
          0.564087107089225
gamma_berm =
          0.832605583319517
slope =
          0.348581404332203
Irb =
          4.64317249256902
gamma_berm =
          0.832605583319517
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
     1
gamma =
          0.832605583319517
ans =
!!! - - Iribaren number:   3.87 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:2.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          13.5877477004462
R2del =
          0.174452299553765
Z2 =
          23.5792308064355
ans =
!--------------- STARTING ITERATION 2 -----------------!
Ztoe =
                   3.0647
toe_sta =
          104.854303700985
top_sta =
          201.054841895615
Z2 =
          23.5792308064355
H0 =
                   4.5874
Tp =
                  13.8735
T0 =
          12.6122727272727
R2 =
          13.5877477004462
Z2 =
          23.5792308064355
top_sta =
          201.054841895615
```

```
Lslope =
          96.2005381946294
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 14
dh =
          5.89403360598923
rdh_sum =
         0.716315843427734
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 15
dh =
          5.83791060598923
rdh_sum =
          1.42392937190642
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 16
dh =
          5.78682760598923
rdh_sum =
          2.12355534105991
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 17
dh =
          5.73574410598923
rdh_sum =
          2.81513259666574
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 18
dh =
          5.68466060598923
rdh_sum =
          3.49860252491216
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 19
dh =
          5.63357760598923
rdh_sum =
          4.17390907262567
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Berm Factor Calculation: Iteration 2, Profile Segment: 20
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rdh_sum =
          6.15032426506241
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Berm Factor Calculation: Iteration 2, Profile Segment: 23
dh =
          5.42924410598923
rdh_sum =
          6.79246591489399
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 24
dh =
          5.37816060598923
rdh_sum =
           7.4262012194097
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 25
dh =
          5.32707760598923
rdh_sum =
          8.05148934464204
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 26
dh =
          5.27599410598923
rdh_sum =
          8.66829187571347
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```
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          12.1890918246138
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 33
dh =
          4.91841060598923
rdh_sum =
           12.745641417418
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 34
dh =
          4.86732710598923
rdh_sum =
          13.2934930380095
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 35
dh =
          4.81624360598923
rdh_sum =
          13.8326320459975
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 36
dh =
          4.76516060598923
rdh_sum =
          14.3630465520945
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 37
dh =
          4.71407710598923
rdh_sum =
          14.8847271655221
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 38
dh =
          4.66299360598923
rdh_sum =
          15.3976672530117
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 39
dh =
          4.61191060598923
rdh_sum =
          15.9018629410937
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 40
dh =
          4.56082710598923
rdh_sum =
          16.3973128605056
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 41
dh =
          4.50974360598923
rdh_sum =
          16.8840184033626
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 42
dh =
          4.45866060598923
rdh_sum =
          17.3619837226764
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 43
dh =
          4.40757760598923
```

```
rdh_sum =
          17.8312155599119
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 44
dh =
          4.35649410598923
rdh_sum =
          18.2917232431884
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 45
dh =
          4.30541060598923
rdh_sum =
           18.743518855335
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 46
dh =
          4.25432760598923
rdh_sum =
          19.1866172297205
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 47
dh =
          4.20324410598923
rdh_sum =
          19.6210356904152
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 48
dh =
          4.15216060598923
rdh_sum =
          20.0467943023479
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 49
dh =
          4.10107710598923
rdh_sum =
           20.463915779962
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 50
dh =
          4.04284760598923
rdh_sum =
          20.8712229623013
ans =
!------- End Berm Factor Calculation, Iter: 2 ---------!
berm_width =
    37
rB =
          0.384613232881743
rdh_mean =
          0.564087107089225
gamma_berm =
          0.832342133002754
slope =
          0.346526086283055
Irb =
          4.61579525410857
gamma_berm =
          0.832342133002754
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
     1
gamma =
          0.832342133002754
ans =
!!! - - Iribaren number:   3.84 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:2.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          13.5750527122701
R2del =
        0.0126949881761842
Z2 =
          23.5665358182593
ans =
!---------------- STARTING ITERATION 3 -----------------!
Ztoe =
                    3.0647
toe_sta =
          104.854303700985
top_sta =
          201.043824197698
Z2 =
          23.5665358182593
H0 =
                    4.5874
```

```
Tp =
                    13.8735
T0 =
          12.6122727272727
R2 =
          13.5750527122701
Z2 =
          23.5665358182593
top_sta =
          201.043824197698
Lslope =
          96.1895204967132
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 14
dh =
          5.89403360598923
rdh_sum =
         0.716315843427734
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 15
dh =
          5.83791060598923
rdh_sum =
          1.42392937190642
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 16
dh =
          5.78682760598923
rdh_sum =
          2.12355534105991
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 17
dh =
          5.73574410598923
rdh_sum =
          2.81513259666574
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 18
dh =
          5.68466060598923
rdh_sum =
          3.49860252491216
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 19
dh =
          5.63357760598923
rdh_sum =
          4.17390907262567
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 20
dh =
          5.58249410598923
rdh_sum =
          4.84099852444886
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 21
dh =
          5.53141060598923
rdh_sum =
          5.49981975870949
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 22
dh =
          5.48032760598923
rdh_sum =
          6.15032426506241
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 23
dh =
          5.42924410598923
rdh_sum =
          6.79246591489399
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 24
dh =
          5.37816060598923
rdh_sum =
          7.4262012194097
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 25
dh =
          5.32707760598923
rdh_sum =
          8.05148934464204
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 26
dh =
          5.27599410598923
rdh_sum =
          8.66829187571347
```

```
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 27
dh =
        5.22491060598923
rdh_sum =
        9.27657307643208
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 28
dh =
        5.17382760598923
rdh_sum =
        9.87629990162416
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 29
dh =
        5.12274410598923
rdh_sum =
        10.4674417559046
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 30
dh =
        5.07166060598923
rdh_sum =
        11.0499707540661
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 31
dh =
        5.02057710598923
rdh_sum =
        11.6238616460385
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 32
dh =
        4.96949360598923
rdh_sum =
        12.1890918246138
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 33
dh =
        4.91841060598923
rdh_sum =
         12.745641417418
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 34
dh =
        4.86732710598923
rdh_sum =
        13.2934930380095
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 35
dh =
        4.81624360598923
rdh_sum =
        13.8326320459975
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 36
dh =
        4.76516060598923
rdh_sum =
        14.3630465520945
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 37
dh =
        4.71407710598923
rdh_sum =
        14.8847271655221
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 38
dh =
        4.66299360598923
rdh_sum =
        15.3976672530117
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 39
dh =
        4.61191060598923
rdh_sum =
        15.9018629410937
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 40
dh =
        4.56082710598923
rdh_sum =
        16.3973128605056
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 41
dh =
        4.50974360598923
rdh_sum =
        16.8840184033626
```

```
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 42
dh =
          4.45866060598923
rdh_sum =
          17.3619837226764
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 43
dh =
          4.40757760598923
rdh_sum =
          17.8312155599119
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 44
dh =
          4.35649410598923
rdh_sum =
          18.2917232431884
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 45
dh =
          4.30541060598923
rdh_sum =
           18.743518855335
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 46
dh =
          4.25432760598923
rdh_sum =
          19.1866172297205
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 47
dh =
          4.20324410598923
rdh_sum =
          19.6210356904152
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 48
dh =
          4.15216060598923
rdh_sum =
          20.0467943023479
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 49
dh =
          4.10107710598923
rdh_sum =
           20.463915779962
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 50
dh =
          4.04284760598923
rdh_sum =
          20.8712229623013
ans =
!------- End Berm Factor Calculation, Iter: 3 ---------!
berm_width =
    37
rB =
          0.384657287082165
rdh_mean =
          0.564087107089225
gamma_berm =
          0.832322929208803
slope =
          0.346376109253964
Irb =
           4.6137975307437
gamma_berm =
          0.832322929208803
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
     1
gamma =
          0.832322929208803
ans =
!!! - - Iribaren number:   3.84 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:2.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          13.5741239705276
R2del =
     0.000928741742468375
Z2 =
          23.5656070765168
% final 2% runup elevation
Z2=R2_new+SWEL
```

```
Z2 =
          23.5656070765168
diary off
-1.000000e+00
```