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diary on          % begin recording

% FEMA appeal for The Town of Kennebunkport, York county, Maine
% TRANSECT ID: YK-99-2
% calculation by SJH, Ransom Consulting, Inc. 02-Apr-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-99-2sta_ele_include.csv'; % file with station, elevation, include
% third column is 0 for excluded points
imgname='logfiles/YK-99-2-runup';
SWEL=9.3261; % 100-yr still water level including wave setup.
H0=5.0379; % significant wave height at toe of structure
Tp=11.3516; % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=0.94117; % this may get changed automatically below
gamma_rough=1;
gamma_beta=1;
gamma_perm=1;

setupAtToe=-0.039442;
maxSetup=0.93903; % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for YK-99-2'

plotTitle =

Iterative TAW for YK-99-2

% END CONFIG
%-----

SWEL=SWEL+setupAtToe

SWEL =

          9.286658

SWEL_fore=SWEL+maxSetup

SWEL_fore =

          10.225688

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

L0 =

          544.916423199444

% 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

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

Ztoe =

    1.729808

% 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 =

    16.843508

% 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 =

    1626.06965548772

% 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 =

    1763.60050963102

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

top_sta =

    1763.60050963102

toe_sta

toe_sta =

    1626.06965548772

% 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')

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    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 40.4 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 9.39 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

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% 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('!!! - - Iribarren number: %6.2f is outside the valid range (0.5-10), TAW NOT VALID - - !!!\n', Irb*gamma_berm)
    TAW_VALID=0;
else
    sprintf('!!! - - Iribarren number: %6.2f is in the valid range (0.5-10), TAW RECOMMENDED - - !!!\n', Irb*gamma_berm)
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')
end

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% 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
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 =
    1.729808
toe_sta =
    1626.06965548772
top_sta =
    1763.60050963102
Z2 =
    16.843508
H0 =
    5.0379
Tp =
    11.3516
T0 =
    10.3196363636364
R2 =
    15.1137
Z2 =
    24.4989728103088
top_sta =
    1891.93808670951
Lslope =
    265.868431221787
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 37
dh =
    -1.54678418969124
rdh_sum =
    0.0256219611509224
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.0532395156699975
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 39

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dh =
    -1.66608768969124
rdh_sum =
    0.0829252725026096
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.114751539044794
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.148790312450615
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.185113212627531
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.223791526559033
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.264896179100873
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.308497722076877
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    0.354666345242235
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    0.403471800648496
ans =
!----- End Berm Factor Calculation, Iter: 1 -----!
berm_width =
    11
rB =
    0.0413738477691765
rdh_mean =
    0.0366792546044087
gamma_berm =
    0.960143714127113
slope =
    0.0893369363210579
Irb =
    0.929118766642681
gamma_berm =
    0.960143714127113
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.960143714127113
ans =
!!! - - Iribaren number: 0.89 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:11.2 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    7.95481866838369
R2del =
    7.1588813316163
Z2 =
    17.3400914786925
ans =
!----- STARTING ITERATION 2 -----!
Ztoe =
    1.729808

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toe_sta =
    1626.06965548772
top_sta =
    1771.92532361054
Z2 =
    17.3400914786925
H0 =
    5.0379
Tp =
    11.3516
T0 =
    10.3196363636364
R2 =
    7.95481866838369
Z2 =
    17.3400914786925
top_sta =
    1771.92532361054
Lslope =
    145.855668122821
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 37
dh =
    -1.54678418969124
rdh_sum =
    0.0904254034272675
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.187720127674867
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 39
dh =
    -1.66608768969124
rdh_sum =
    0.2921076011301
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.403807372624405
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.523034996951388
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.650001725062773
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.784914575223744
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.927976155925547
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    1.07938455344603
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    1.23933329430215
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    1.40801102230549
ans =
!----- End Berm Factor Calculation, Iter: 2 -----!
berm_width =
    11

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rB =
    0.07541702109744
rdh_mean =
    0.128001002027772
gamma_berm =
    0.934236433172982
slope =
    0.115755486558231
Irb =
    1.20387601514107
gamma_berm =
    0.934236433172982
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.934236433172982
ans =
!!! - - Iribaren number: 1.12 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:8.6 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    10.0290863585598
R2del =
    2.0742676901761
Z2 =
    19.4143591688686
ans =
!----- STARTING ITERATION 3 -----!
Ztoe =
    1.729808
toe_sta =
    1626.06965548772
top_sta =
    1806.69871701847
Z2 =
    19.4143591688686
H0 =
    5.0379
Tp =
    11.3516
T0 =
    10.3196363636364
R2 =
    10.0290863585598
Z2 =
    19.4143591688686
top_sta =
    1806.69871701847
Lslope =
    180.629061530746
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 37
dh =
    -1.54678418969124
rdh_sum =
    0.0575522845257002
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.119533397816781
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 39
dh =
    -1.66608768969124
rdh_sum =
    0.186096235692182
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.257392130759526
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.333570804650896
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.414780192346405

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ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.50116651267763
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.592874176973738
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.690045738640926
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    0.792821890951963
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    0.901341276410312
ans =
!----- End Berm Factor Calculation, Iter: 3 -----!
berm_width =
    11
rB =
    0.0608982846214235
rdh_mean =
    0.0819401160373011
gamma_berm =
    0.944091727886929
slope =
    0.104254253423805
Irb =
    1.08426130721864
gamma_berm =
    0.944091727886929
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.944091727886929
ans =
!!! - - Iribaren number: 1.02 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:9.6 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    9.12790184453968
R2del =
    0.901184514020114
Z2 =
    18.5131746548484
ans =
!----- STARTING ITERATION 4 -----!
Ztoe =
    1.729808
toe_sta =
    1626.06965548772
top_sta =
    1791.59109914081
Z2 =
    18.5131746548484
H0 =
    5.0379
Tp =
    11.3516
T0 =
    10.3196363636364
R2 =
    9.12790184453968
Z2 =
    18.5131746548484
top_sta =
    1791.59109914081
Lslope =
    165.521443653089
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 37

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dh =
    -1.54678418969124
rdh_sum =
    0.0691950822850872
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.143690982738681
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 39
dh =
    -1.66608768969124
rdh_sum =
    0.223667002294197
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.309300175757282
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.400765203122065
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.498234228568711
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.601876913821702
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.711860318485847
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.828348829632762
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    0.951504149064295
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    1.081485056849
ans =
!----- End Berm Factor Calculation, Iter: 4 -----!
berm_width =
    11
rB =
    0.0664566460829966
rdh_mean =
    0.0983168233499088
gamma_berm =
    0.940077160250373
slope =
    0.108615129771427
Irb =
    1.12961513532645
gamma_berm =
    0.940077160250373
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.940077160250373
ans =
!!! - - Iribaren number: 1.06 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

```

```

ans =
!!! - - slope: 1:9.2 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    9.46927682989579
R2del =
    0.34137498535611
Z2 =
    18.8545496402046
ans =
!----- STARTING ITERATION 5 -----!
Ztoe =
    1.729808
toe_sta =
    1626.06965548772
top_sta =
    1797.31397026378
Z2 =
    18.8545496402046
H0 =
    5.0379
Tp =
    11.3516
T0 =
    10.3196363636364
R2 =
    9.46927682989579
Z2 =
    18.8545496402046
top_sta =
    1797.31397026378
Lslope =
    171.244314776056
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 37
dh =
    -1.54678418969124
rdh_sum =
    0.064404034091573
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.133751062296208
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 39
dh =
    -1.66608768969124
rdh_sum =
    0.208209707506491
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.287946631389085
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.373126474698892
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.463911655250388
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.560462440484243
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.6629368397638
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.771490542491301
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 46
dh =
    -2.08364918969124

```

```

rdh_sum =
    0.886276910010338
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    1.0074467581845
ans =
!----- End Berm Factor Calculation, Iter: 5 -----!
berm_width =
    11
rB =
    0.0642357091643316
rdh_mean =
    0.0915860689258636
gamma_berm =
    0.941647386922695
slope =
    0.106866453665683
Irb =
    1.11142861748139
gamma_berm =
    0.941647386922695
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.941647386922695
ans =
!!! - Iribaren number: 1.05 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - slope: 1:9.4 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    9.33238591641954
R2del =
    0.136890913476247
Z2 =
    18.7176587267283
ans =
!----- STARTING ITERATION 6 -----!
Ztoe =
    1.729808
toe_sta =
    1626.06965548772
top_sta =
    1795.01910658209
Z2 =
    18.7176587267283
H0 =
    5.0379
Tp =
    11.3516
T0 =
    10.3196363636364
R2 =
    9.33238591641954
Z2 =
    18.7176587267283
top_sta =
    1795.01910658209
Lslope =
    168.94945109437
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 37
dh =
    -1.54678418969124
rdh_sum =
    0.0662641152074591
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.137610313555862
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 39
dh =
    -1.66608768969124
rdh_sum =
    0.214211394848707
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.296238081884604

```

```

ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.383858957341145
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.477240254431518
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.57654592984021
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.681937551425475
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.793574233071974
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    0.911612624840858
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    1.03620668818343
ans =
!----- End Berm Factor Calculation, Iter: 6 -----!
berm_width =
    11
rB =
    0.0651082316559627
rdh_mean =
    0.0942006080166755
gamma_berm =
    0.94102500335292
slope =
    0.10755245180674
Irb =
    1.11856311048043
gamma_berm =
    0.94102500335292
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.94102500335292
ans =
!!! - - Iribaren number: 1.05 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:9.3 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    9.38608460262104
R2del =
    0.0536986862014981
Z2 =
    18.7713574129298
ans =
!----- STARTING ITERATION 7 -----!
Ztoe =
    1.729808
toe_sta =
    1626.06965548772
top_sta =
    1795.91932093226
Z2 =
    18.7713574129298
H0 =
    5.0379
Tp =
    11.3516

```

```

T0 =
    10.3196363636364
R2 =
    9.38608460262104
Z2 =
    18.7713574129298
top_sta =
    1795.91932093226
Lslope =
    169.849665444532
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 37
dh =
    -1.54678418969124
rdh_sum =
    0.065525042965719
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 38
dh =
    -1.60643618969124
rdh_sum =
    0.136076929715519
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 39
dh =
    -1.66608768969124
rdh_sum =
    0.211826805172205
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 40
dh =
    -1.72573918969124
rdh_sum =
    0.292943783651279
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 41
dh =
    -1.78539118969124
rdh_sum =
    0.379594887117465
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 42
dh =
    -1.84504268969124
rdh_sum =
    0.471944838755677
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 43
dh =
    -1.90469418969124
rdh_sum =
    0.57015613576958
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 44
dh =
    -1.96434568969124
rdh_sum =
    0.674388938917062
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.784801008667059
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    0.90154769605345
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    1.0247817208195
ans =
!----- End Berm Factor Calculation, Iter: 7 -----!
berm_width =
    11
rB =
    0.0647631537643051
rdh_mean =
    0.0931619746199547
gamma_berm =
    0.941270309522993
slope =
    0.107280990269888
Irb =
    1.1157398660454

```

```

gamma_berm =
0.941270309522993
gamma_perm =
1
gamma_beta =
1
gamma_rough =
1
gamma =
0.941270309522993
ans =
!!! - - Iribaren number: 1.05 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:9.3 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
9.36483478604849
R2del =
0.021249816572551
Z2 =
18.7501075963573
ans =
!----- STARTING ITERATION 8 -----!
Ztoe =
1.729808
toe_sta =
1626.06965548772
top_sta =
1795.56308521831
Z2 =
18.7501075963573
H0 =
5.0379
Tp =
11.3516
T0 =
10.3196363636364
R2 =
9.36483478604849
Z2 =
18.7501075963573
top_sta =
1795.56308521831
Lslope =
169.493429730587
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 37
dh =
-1.54678418969124
rdh_sum =
0.0658160375402676
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 38
dh =
-1.60643618969124
rdh_sum =
0.136680672223293
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 39
dh =
-1.66608768969124
rdh_sum =
0.212765701294397
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 40
dh =
-1.72573918969124
rdh_sum =
0.294240873185609
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 41
dh =
-1.78539118969124
rdh_sum =
0.381273825233258
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 42
dh =
-1.84504268969124
rdh_sum =
0.474029876102721
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 43
dh =
-1.90469418969124
rdh_sum =
0.572672098642466
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 44
dh =
-1.96434568969124

```

```

rdh_sum =
    0.677361208699018
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 45
dh =
    -2.02399718969124
rdh_sum =
    0.788255500761444
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 46
dh =
    -2.08364918969124
rdh_sum =
    0.905510838539324
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 47
dh =
    -2.14330068969124
rdh_sum =
    1.02928043195394
ans =
!----- End Berm Factor Calculation, Iter: 8 -----!
berm_width =
    11
rB =
    0.0648992708300535
rdh_mean =
    0.0935709483594489
gamma_berm =
    0.941173415489351
slope =
    0.107388045203445
Irb =
    1.11685325488461
gamma_berm =
    0.941173415489351
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    1
gamma =
    0.941173415489351
ans =
!!! - - Iribaren number: 1.05 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:9.3 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
    9.37321491298903
R2del =
    0.00838012694054058
Z2 =
    18.7584877232978
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
    18.7584877232978
diary off
-1.000000e+00

```