

```

diary on          % begin recording

% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: YK-06F
% calculation by SJH, Ransom Consulting, Inc. 06-Feb-2020
% 100-year wave runup using TAW methodology
% including berm and weighted average with foreshore if necessary
%
% chk nld 20181015
%
% 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='infiles/YK-06Fsta_ele_include.csv'; % file with station, elevation, include
% third column is 0 for excluded points
imgname='logfiles/YK-06F-runup';
SWEL=9.0235; % 100-yr still water level including wave setup.
H0=5.4882; % significant wave height at toe of structure
Tp=9.7138; % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=0.96835; % this may get changed automatically below
gamma_rough=0.85;
gamma_beta=1;
gamma_perm=1;

setupAtToe=0.02834;
maxSetup=0.62428; % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for YK-06F'

plotTitle =

Iterative TAW for YK-06F

% END CONFIG
%-----

SWEL=SWEL+setupAtToe

SWEL =

          9.05184

SWEL_fore=SWEL+maxSetup

SWEL_fore =

          9.67612

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

L0 =

          399.019438762892

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

Ztoe =

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0.81954

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% 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 =
```

17.28414

```
% 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
% 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
```

```
toe_sta =
```

22.726185201595

```
if top_sta== -999
    dy=Z2-dep(end);
    top_sta=sta(end)+dy/S(end)
end
```

```
top_sta =
```

107.239672801636

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

```
top_sta =
```

107.239672801636

```
toe_sta
```

```
toe_sta =
```

22.726185201595

```
% 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
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```
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',de
    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')
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end

ans =

-!!- The User has selected a starting point that is 2.03 feet above the elevation of SWEL-1.5H0

ans =

-!!- This may be reasonable for some cases. However the user may want to consider:

ans =

-!!- 1) Selecting a starting point that is at or below 0.82 feet elevation, or

ans =

-!!- 2) Reducing the incident wave height to a depth limited condition.

% now iterate converge on a runup elevation
tol=0.001; % 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)

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        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)
    TAW_VALID=0;
else
    sprintf('!!! - - Iribaren 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
    % 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
    end
end

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        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 =
        0.81954
toe_sta =
        22.726185201595
top_sta =
        107.239672801636
Z2 =
        17.28414
H0 =
        5.4882
Tp =
        9.7138
T0 =
        8.83072727272727
R2 =
        16.4646
Z2 =
        25.51644
top_sta =
        191.414519427404
Lslope =
        168.688334225809
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 11
dh =
        1.70393
rdh_sum =
        0.0582905121957862
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 12
dh =
        2.17791
rdh_sum =
        0.152325771265479
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 13
dh =
        2.65189
rdh_sum =
        0.289565477260354
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 14
dh =
        3.12587
rdh_sum =
        0.476675438096609
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 15
dh =
        3.59985
rdh_sum =
        0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 1 -----!
berm_width =
    5
rB =
        0.0296404610487583
rdh_mean =
        0.143881016745364
gamma_berm =
        0.974624238623738
slope =
        0.150877581574815
Irb =
        1.28649107041569
gamma_berm =
        0.974624238623738
gamma_perm =
    1
gamma_beta =

```

```

1
gamma_rough =
0.85
gamma =
0.828430602830178
ans =
!!! - - Iribaren number: 1.25 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:6.6 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
10.3529974157404
R2del =
6.11160258425958
Z2 =
19.4048374157404
ans =
!----- STARTING ITERATION 2 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
128.923695457469
Z2 =
19.4048374157404
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
10.3529974157404
Z2 =
19.4048374157404
top_sta =
128.923695457469
Lslope =
106.197510255874
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 2 -----!
berm_width =
5
rB =
0.0470820830728792
rdh_mean =
0.143881016745364
gamma_berm =
0.959692134910136
slope =
0.183653702237814
Irb =
1.56596391267428
gamma_berm =
0.959692134910136
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.85
gamma =
0.815738314673616
ans =
!!! - - Iribaren number: 1.50 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =

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!!! - - slope: 1:5.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
    12.4089720609493
R2del =
    2.0559746452089
Z2 =
    21.4608120609493
ans =
!----- STARTING ITERATION 3 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    149.945931093552
Z2 =
    21.4608120609493
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    12.4089720609493
Z2 =
    21.4608120609493
top_sta =
    149.945931093552
Lslope =
    127.219745891957
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 11
dh =
    1.70393
rdh_sum =
    0.0582905121957862
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 12
dh =
    2.17791
rdh_sum =
    0.152325771265479
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 13
dh =
    2.65189
rdh_sum =
    0.289565477260354
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 14
dh =
    3.12587
rdh_sum =
    0.476675438096609
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 15
dh =
    3.59985
rdh_sum =
    0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 3 -----!
berm_width =
    5
rB =
    0.039302075043023
rdh_mean =
    0.143881016745364
gamma_berm =
    0.96635274747437
slope =
    0.168886556835066
Irb =
    1.44004858119911
gamma_berm =
    0.96635274747437
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.85
gamma =
    0.821399835353214
ans =
!!! - - Iribaren number: 1.39 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 =
    11.4903947996176
R2del =
    0.918577261331743
Z2 =
    20.5422347996176
ans =

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!----- STARTING ITERATION 4 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    140.553525558462
Z2 =
    20.5422347996176
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    11.4903947996176
Z2 =
    20.5422347996176
top_sta =
    140.553525558462
Lslope =
    117.827340356867
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 11
dh =
    1.70393
rdh_sum =
    0.0582905121957862
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 12
dh =
    2.17791
rdh_sum =
    0.152325771265479
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 13
dh =
    2.65189
rdh_sum =
    0.289565477260354
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 14
dh =
    3.12587
rdh_sum =
    0.476675438096609
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 15
dh =
    3.59985
rdh_sum =
    0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 4 -----!
berm_width =
    5
rB =
    0.0424349729430906
rdh_mean =
    0.143881016745364
gamma_berm =
    0.963670614109523
slope =
    0.174804216223086
Irb =
    1.49050681283954
gamma_berm =
    0.963670614109523
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.85
gamma =
    0.819120021993095
ans =
!!! - - Iribaren number: 1.44 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 =
    11.8600003798249
R2del =
    0.369605580207363
Z2 =
    20.9118403798249
ans =
!----- STARTING ITERATION 5 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    144.332723720092
Z2 =

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20.9118403798249
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
11.8600003798249
Z2 =
20.9118403798249
top_sta =
144.332723720092
Lslope =
121.606538518497
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 5 -----!
berm_width =
5
rB =
0.041116210204762
rdh_mean =
0.143881016745364
gamma_berm =
0.964799631924215
slope =
0.17230852261889
Irb =
1.46922672932561
gamma_berm =
0.964799631924215
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.85
gamma =
0.820079687135583
ans =
!!! - - Iribaren number: 1.42 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 =
11.7043707848237
R2del =
0.155629595001265
Z2 =
20.7562107848237
ans =
!----- STARTING ITERATION 6 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
142.741419067727
Z2 =
20.7562107848237
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =

```

```

11.7043707848237
Z2 =
20.7562107848237
top_sta =
142.741419067727
Lslope =
120.015233866132
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 6 -----!
berm_width =
5
rB =
0.0416613778012308
rdh_mean =
0.143881016745364
gamma_berm =
0.964332903595823
slope =
0.173339392658439
Irb =
1.47801667072575
gamma_berm =
0.964332903595823
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.85
gamma =
0.81968296805645
ans =
!!! - - Iribaren number: 1.43 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 =
11.7686985703862
R2del =
0.0643277855624831
Z2 =
20.8205385703862
ans =
!----- STARTING ITERATION 7 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
143.399167386362
Z2 =
20.8205385703862
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
11.7686985703862
Z2 =
20.8205385703862
top_sta =
143.399167386362
Lslope =
120.672982184767
ans =

```

```

Berm Factor Calculation: Iteration 7, Profile Segment: 11
dh =
    1.70393
rdh_sum =
    0.0582905121957862
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 12
dh =
    2.17791
rdh_sum =
    0.152325771265479
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 13
dh =
    2.65189
rdh_sum =
    0.289565477260354
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 14
dh =
    3.12587
rdh_sum =
    0.476675438096609
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 15
dh =
    3.59985
rdh_sum =
    0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 7 -----!
berm_width =
    5
rB =
    0.0414342954775437
rdh_mean =
    0.143881016745364
gamma_berm =
    0.964527313083893
slope =
    0.172909854942947
Irb =
    1.47435412238942
gamma_berm =
    0.964527313083893
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.85
gamma =
    0.819848216121309
ans =
!!! - - Iribaren number: 1.42 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 =
    11.7419022420415
R2del =
    0.026796328344652
Z2 =
    20.7937422420415
ans =
!----- STARTING ITERATION 8 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    143.125176298993
Z2 =
    20.7937422420415
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    11.7419022420415
Z2 =
    20.7937422420415
top_sta =
    143.125176298993
Lslope =
    120.398991097398
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 11
dh =
    1.70393
rdh_sum =
    0.0582905121957862
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 12
dh =

```

```

2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 8 -----!
berm_width =
5
rB =
0.0415285871951799
rdh_mean =
0.143881016745364
gamma_berm =
0.964446588154461
slope =
0.17308818779172
Irb =
1.47587471686816
gamma_berm =
0.964446588154461
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.85
gamma =
0.819779599931292
ans =
!!! - - Iribaren number: 1.42 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 =
11.7530286694215
R2del =
0.0111264273799865
Z2 =
20.8048686694215
ans =
!----- STARTING ITERATION 9 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
143.238943450118
Z2 =
20.8048686694215
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
11.7530286694215
Z2 =
20.8048686694215
top_sta =
143.238943450118
Lslope =
120.512758248523
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 13
dh =
2.65189
rdh_sum =

```

```

0.289565477260354
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 9 -----!
berm_width =
5
rB =
0.0414893831380818
rdh_mean =
0.143881016745364
gamma_berm =
0.964480151491963
slope =
0.173014037344892
Irb =
1.47524245668268
gamma_berm =
0.964480151491963
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.85
gamma =
0.819808128768169
ans =
!!! - - Iribaren number: 1.42 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 =
11.748402545563
R2del =
0.00462612385846839
Z2 =
20.800242545563
ans =
!----- STARTING ITERATION 10 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
143.191641570175
Z2 =
20.800242545563
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
11.748402545563
Z2 =
20.800242545563
top_sta =
143.191641570175
Lslope =
120.46545636858
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =

```

```

Berm Factor Calculation: Iteration 10, Profile Segment: 15
dh =
    3.59985
rdh_sum =
    0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 10 -----!
berm_width =
    5
rB =
    0.0415056743295925
rdh_mean =
    0.143881016745364
gamma_berm =
    0.964466204293651
slope =
    0.173044849723559
Irb =
    1.47550518524447
gamma_berm =
    0.964466204293651
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.85
gamma =
    0.819796273649604
ans =
!!! - - Iribaren number: 1.42 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 =
    11.7503249174496
R2del =
    0.00192237188656819
Z2 =
    20.8021649174496
ans =
!----- STARTING ITERATION 11 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    143.211297724434
Z2 =
    20.8021649174496
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    11.7503249174496
Z2 =
    20.8021649174496
top_sta =
    143.211297724434
Lslope =
    120.485112522839
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 11
dh =
    1.70393
rdh_sum =
    0.0582905121957862
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 12
dh =
    2.17791
rdh_sum =
    0.152325771265479
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 13
dh =
    2.65189
rdh_sum =
    0.289565477260354
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 14
dh =
    3.12587
rdh_sum =
    0.476675438096609
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 15
dh =
    3.59985
rdh_sum =
    0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 11 -----!
berm_width =

```

```

5
rB =
0.0414989030205056
rdh_mean =
0.143881016745364
gamma_berm =
0.964472001339902
slope =
0.173032042666952
Irb =
1.47539598304364
gamma_berm =
0.964472001339902
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.85
gamma =
0.819801201138917
ans =
!!! - - Iribaren number: 1.42 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 =
11.7495258969969
R2del =
0.000799020452674881
Z2 =
20.8013658969969
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
20.8013658969969
diary off
diary on % begin recording
% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: YK-06F
% calculation by SJH, Ransom Consulting, Inc. 19-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='infiles/YK-06Fsta_ele_include.csv'; % file with station, elevation, include
% third column is 0 for excluded points
imgname='logfiles/YK-06F-runup';
SWEL=9.0235; % 100-yr still water level including wave setup.
H0=5.4882; % significant wave height at toe of structure
Tp=9.7138; % peak period, 1/fma,
T0=Tp/1.1;
gamma_berm=0.96447; % this may get changed automatically below
gamma_rough=0.6;
gamma_beta=1;
gamma_perm=1;
setupAtToe=0.02834;
maxSetup=0.62428; % only used in case of berm/shallow foreshore weighted average
plotTitle='Iterative TAW for YK-06F'
plotTitle =
Iterative TAW for YK-06F
% END CONFIG
%-----
SWEL=SWEL+setupAtToe
SWEL =
9.05184
SWEL_fore=SWEL+maxSetup
SWEL_fore =
9.67612
% FIND WAVELENGTH USING DEEPWATER DISPERSION RELATION
% using English units
L0=32.15/(2*pi)*T0^2
L0 =
399.019438762892

```

```

% 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 consistent with TAW guidance should be performed
% prior to the input of the significant wave height given above.
Ztoe=SWEL-1.5*H0
Ztoe =
    0.81954

% 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 =
    17.28414

% 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
% 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
toe_sta =
    22.726185201595
if top_sta== -999
    dy=Z2-dep(end);
    top_sta=sta(end)+dy/S(end)
end
top_sta =
    107.239672801636
% just so the reader can tell the values aren't -999 anymore
top_sta
top_sta =
    107.239672801636
toe_sta
toe_sta =
    22.726185201595
% 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',de
    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 =
--- The User has selected a starting point that is 2.03 feet above the elevation of SWEL-1.5H0
ans =
--- This may be reasonable for some cases. However the user may want to consider:
ans =
--- 1) Selecting a starting point that is at or below 0.82 feet elevation, or
ans =
--- 2) Reducing the incident wave height to a depth limited condition.
% 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*gamma_berm);
    TAW_VALID=0;
else
    sprintf('!!! - - Iribaren 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 beach')
    % 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 =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    107.239672801636
Z2 =
    17.28414
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    16.4646
Z2 =

```

```

25.51644
top_sta =
191.414519427404
Lslope =
168.688334225809
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 1 -----!
berm_width =
5
rB =
0.0296404610487583
rdh_mean =
0.143881016745364
gamma_berm =
0.974624238623738
slope =
0.150877581574815
Irb =
1.28649107041569
gamma_berm =
0.974624238623738
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.584774543174243
ans =
!!! - - Iribaren number: 1.25 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:6.6 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
7.30799817581677
R2del =
9.15660182418323
Z2 =
16.3598381758168
ans =
!----- STARTING ITERATION 2 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
97.7887339040572
Z2 =
16.3598381758168
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
7.30799817581677
Z2 =
16.3598381758168
top_sta =
97.7887339040572
Lslope =
75.0625487024622
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 11
dh =

```

```

1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 2 -----!
berm_width =
5
rB =
0.0666111141498715
rdh_mean =
0.143881016745364
gamma_berm =
0.942972960680553
slope =
0.221806064204322
Irb =
1.89127846552481
gamma_berm =
0.942972960680553
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.565783776408332
ans =
!!! - - Iribaren number: 1.78 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.5 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
10.3946330745517
R2del =
3.08663489873491
Z2 =
19.4464730745517
ans =
!----- STARTING ITERATION 3 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
129.349417940202
Z2 =
19.4464730745517
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
10.3946330745517
Z2 =
19.4464730745517
top_sta =
129.349417940202
Lslope =
106.623232738607
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 12
dh =
2.17791
rdh_sum =

```

```

0.152325771265479
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 3 -----!
berm_width =
5
rB =
0.0468940949507487
rdh_mean =
0.143881016745364
gamma_berm =
0.959853075110119
slope =
0.183294041850288
Irb =
1.56289718883032
gamma_berm =
0.959853075110119
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.575911845066071
ans =
!!! - - Iribaren number: 1.50 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.5 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
8.74358662000387
R2del =
1.65104645454781
Z2 =
17.7954266200039
ans =
!----- STARTING ITERATION 4 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
112.467552351778
Z2 =
17.7954266200039
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
8.74358662000387
Z2 =
17.7954266200039
top_sta =
112.467552351778
Lslope =
89.7413671501831
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =

```

```

Berm Factor Calculation: Iteration 4, Profile Segment: 14
dh =
    3.12587
rdh_sum =
    0.476675438096609
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 15
dh =
    3.59985
rdh_sum =
    0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 4 -----!
berm_width =
    5
rB =
    0.0557156655707334
rdh_mean =
    0.143881016745364
gamma_berm =
    0.952300761040228
slope =
    0.200325852542812
Irb =
    1.70812268979766
gamma_berm =
    0.952300761040228
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.6
gamma =
    0.571380456624137
ans =
!!! - - Iribaren number: 1.63 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.0 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
    9.48085794146406
R2del =
    0.737271321460193
Z2 =
    18.5326979414641
ans =
!----- STARTING ITERATION 5 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    120.006113920901
Z2 =
    18.5326979414641
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    9.48085794146406
Z2 =
    18.5326979414641
top_sta =
    120.006113920901
Lslope =
    97.2799287193058
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 11
dh =
    1.70393
rdh_sum =
    0.0582905121957862
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 12
dh =
    2.17791
rdh_sum =
    0.152325771265479
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 13
dh =
    2.65189
rdh_sum =
    0.289565477260354
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 14
dh =
    3.12587
rdh_sum =
    0.476675438096609
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 15
dh =

```

```

3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 5 -----!
berm_width =
5
rB =
0.0513980639770732
rdh_mean =
0.143881016745364
gamma_berm =
0.955997141726691
slope =
0.191950277674611
Irb =
1.63670649817349
gamma_berm =
0.955997141726691
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.573598285036015
ans =
!!! - - Iribaren number: 1.56 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.2 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
9.1197271855973
R2del =
0.361130755866759
Z2 =
18.1715671855973
ans =
!----- STARTING ITERATION 6 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
116.313570404881
Z2 =
18.1715671855973
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
9.1197271855973
Z2 =
18.1715671855973
top_sta =
116.313570404881
Lslope =
93.5873852032857
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 6 -----!
berm_width =
5
rB =

```

```

0.053426003826683
rdh_mean =
0.143881016745364
gamma_berm =
0.954260983924542
slope =
0.195874696445535
Irb =
1.6701689228271
gamma_berm =
0.954260983924542
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.572556590354725
ans =
!!! - - Iribaren number: 1.59 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
9.28927911205426
R2del =
0.169551926456956
Z2 =
18.3411191120543
ans =
!----- STARTING ITERATION 7 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
118.047230184604
Z2 =
18.3411191120543
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
9.28927911205426
Z2 =
18.3411191120543
top_sta =
118.047230184604
Lslope =
95.3210449830092
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 7 -----!
berm_width =
5
rB =
0.0524543137445801
rdh_mean =
0.143881016745364
gamma_berm =
0.95509286624967
slope =
0.193992209848218
Irb =

```



```

1.6541174844865
gamma_berm =
0.95509286624967
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.573055719749802
ans =
!!! - - Iribaren number: 1.58 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.2 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
9.20802309211259
R2del =
0.081256019941673
Z2 =
18.2598630921126
ans =
!----- STARTING ITERATION 8 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
117.216391534894
Z2 =
18.2598630921126
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
9.20802309211259
Z2 =
18.2598630921126
top_sta =
117.216391534894
Lslope =
94.4902063332988
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 11
dh =
1.70393
rdh_sum =
0.0582905121957862
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 12
dh =
2.17791
rdh_sum =
0.152325771265479
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 13
dh =
2.65189
rdh_sum =
0.289565477260354
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 14
dh =
3.12587
rdh_sum =
0.476675438096609
ans =
Berm Factor Calculation: Iteration 8, Profile Segment: 15
dh =
3.59985
rdh_sum =
0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 8 -----!
berm_width =
5
rB =
0.0529155369008648
rdh_mean =
0.143881016745364
gamma_berm =
0.954698004350058
slope =
0.194885270765357
Irb =
1.66173236592379
gamma_berm =
0.954698004350058
gamma_perm =
1
gamma_beta =
1
gamma_rough =

```

```

0.6
gamma = 0.572818802610035
ans =
!!! - - Iribaren number: 1.59 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new = 9.24658869280951
R2del = 0.0385656006969288
Z2 = 18.2984286928095
ans =
!----- STARTING ITERATION 9 -----!
Ztoe = 0.81954
toe_sta = 22.726185201595
top_sta = 117.610722830364
Z2 = 18.2984286928095
H0 = 5.4882
Tp = 9.7138
T0 = 8.83072727272727
R2 = 9.24658869280951
Z2 = 18.2984286928095
top_sta = 117.610722830364
Lslope = 94.8845376287685
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 11
dh = 1.70393
rdh_sum = 0.0582905121957862
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 12
dh = 2.17791
rdh_sum = 0.152325771265479
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 13
dh = 2.65189
rdh_sum = 0.289565477260354
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 14
dh = 3.12587
rdh_sum = 0.476675438096609
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 15
dh = 3.59985
rdh_sum = 0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 9 -----!
berm_width = 5
rB = 0.0526956248610525
rdh_mean = 0.143881016745364
gamma_berm = 0.954886275221988
slope = 0.194459349226437
Irb = 1.65810065171682
gamma_berm = 0.954886275221988
gamma_perm = 1
gamma_beta = 1
gamma_rough = 0.6
gamma = 0.572931765133193
ans =
!!! - - Iribaren number: 1.58 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =

```

```

          9.22819976863614
R2del =
          0.0183889241733777
Z2 =
          18.2800397686361
ans =
!----- STARTING ITERATION 10 -----!
Ztoe =
          0.81954
toe_sta =
          22.726185201595
top_sta =
          117.42269702082
Z2 =
          18.2800397686361
H0 =
          5.4882
Tp =
          9.7138
T0 =
          8.83072727272727
R2 =
          9.22819976863614
Z2 =
          18.2800397686361
top_sta =
          117.42269702082
Lslope =
          94.6965118192247
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 11
dh =
          1.70393
rdh_sum =
          0.0582905121957862
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 12
dh =
          2.17791
rdh_sum =
          0.152325771265479
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 13
dh =
          2.65189
rdh_sum =
          0.289565477260354
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 14
dh =
          3.12587
rdh_sum =
          0.476675438096609
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 15
dh =
          3.59985
rdh_sum =
          0.719405083726818
ans =
!----- End Berm Factor Calculation, Iter: 10 -----!
berm_width =
          5
rB =
          0.0528002552992129
rdh_mean =
          0.143881016745364
gamma_berm =
          0.954796699117653
slope =
          0.194661970844822
Irb =
          1.65982834976185
gamma_berm =
          0.954796699117653
gamma_perm =
          1
gamma_beta =
          1
gamma_rough =
          0.6
gamma =
          0.572878019470592
ans =
!!! - - Iribaren number: 1.58 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          9.23694873213893
R2del =
          0.00874896350279109
Z2 =
          18.2887887321389
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =

```

18.2887887321389

diary off

-1.000000e+00