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% C. Petersen, H. Werkle, Dynamik der Baukonstruktionen
% 2. Auflage, Springer Vieweg, Wiesbaden, 2018
%
% ML_13_2_Antwortspektrum_EC_8: Ermittlung eines Antwortspektrums nach EC_8
%
% Version 1.0, April 2018
% Softwareentwicklung:
% Andrei Firus, M.Eng (andrei.firus@gmail.com)

% Aufbau Eingabedatei: Eingabedatei nicht notwendig

% Ausgabedateien:
% Outputdatei_1: Eingaben- und Ergebnisübersicht

%----- EINGABEBLOCK -----
% Eingaben im Quellcode

% Art der Erdbebenanregung: a_erd=1 (horizontal) oder a_erd=2 (vertikal)
a_erd=1;

% Erdbenenzone (1 bis 3)
Zone=3;

% Bedeutungskategorie (1 bis 4)
bed_k=4;

% Untergrund: unt=1 für A-R
%               unt=2 für B-R
%               unt=3 für C-R
%               unt=4 für B-T
%               unt=5 für C-T
%               unt=6 für C-S
unt=6;

% Verstärkungsbeiwert der Spektralbeschleunigung
beta_0=2.5;

% Verhaltensbeiwert
q=1;

% obere Grenze der Eigenschwingzeiten [s]
Tmax=3;

% Eigenschwingzeit des Antwortsystems [s]
T_0=0.5;
%-----

%----- BERECHNUNGSBLOCK -----
% Bemessungswert der Bodenbeschleunigung [m/s^2]
if Zone==1
    agr=0.4;
elseif Zone==2
    agr=0.6;
elseif Zone==3
    agr=0.8;
end

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% Bedeutungsbeiwert [-]
if bed_k==1
    gammai=0.8;
elseif bed_k==2
    gammai=1.0;
elseif bed_k==3
    gammai=1.2;
elseif bed_k==4
    gammai=1.4;
end

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% Untergrundbeiwert [-]
if a_erd==1
    if unt==1
        S=1.00;
    elseif unt==2
        S=1.25;
    elseif unt==3
        S=1.50;
    elseif unt==4
        S=1.00;
    elseif unt==5
        S=1.25;
    elseif unt==6
        S=0.75;
    end
elseif a_erd==2
    S=1.20;
end

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% Kontrollperioden
if a_erd==1
    if unt==1
        T_B=0.05;
        T_C=0.20;
        T_D=2.00;
    elseif unt==2
        T_B=0.05;
        T_C=0.25;
        T_D=2.00;
    elseif unt==3
        T_B=0.05;
        T_C=0.30;
        T_D=2.00;
    elseif unt==4
        T_B=0.10;
        T_C=0.30;
        T_D=2.00;
    elseif unt==5
        T_B=0.10;
        T_C=0.40;
        T_D=2.00;
    elseif unt==6
        T_B=0.10;
        T_C=0.50;
        T_D=2.00;
    end
end

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elseif a_erd==2
    T_B=0.05;
    T_C=0.20;
    T_D=2.00;
end

% Berechnung des Antwortspektrums nach EUROCODE 8 - DIN EN 1998 (2010-12)

% Definition des Vektors der Eigenschwingzeiten
T=0:0.01:Tmax;

if a_erd==1
    ag=agr;
elseif a_erd==2
    ag=0.5*agr;
end

ita=1/q;

S_a=zeros(length(T),1);
for i=1:length(T)
    if T(i)<=T_B
        if a_erd==1
            S_a(i)=ag*gamma_i*S*(1+(T(i)/T_B)*(ita*beta_0-1));
        elseif a_erd==2
            S_a(i)=ag*gamma_i*(1+(T(i)/T_B)*(S*ita*beta_0-1));
        end
    elseif T(i)>T_B && T(i)<=T_C
        S_a(i)=ag*gamma_i*S*beta_0*ita;
    elseif T(i)>T_C && T(i)<=T_D
        S_a(i)=ag*gamma_i*S*ita*beta_0*T_C/T(i);
    else
        S_a(i)=ag*gamma_i*S*ita*beta_0*T_C*T_D/T(i)^2;
    end
end

% Ermittlung des Wertes des Antwortspektrums für das Antwortsystem mit der
% Eigenschwingzeit T_0

if T_0<=T_B
    if a_erd==1
        S_a_T_0=ag*gamma_i*S*(1+(T_0/T_B)*(ita*beta_0-1));
    elseif a_erd==2
        S_a_T_0=ag*gamma_i*(1+(T_0/T_B)*(S*ita*beta_0-1));
    end
elseif T_0>T_B && T_0<=T_C
    S_a_T_0=ag*gamma_i*S*beta_0*ita;
elseif T_0>T_C && T_0<=T_D
    S_a_T_0=ag*gamma_i*S*ita*beta_0*T_C/T_0;
else
    S_a_T_0=ag*gamma_i*S*ita*beta_0*T_C*T_D/T_0^2;
end

%-----

%----- DARSTELLUNGSBLOCK -----
%Grafische Darstellung der Ergebnisse
name_fig1 = 'Antwortspektrum';

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fig1=figure('Name',name_fig1,'NumberTitle','off');
set(fig1,'Position',[500 350 700 500]);

plot(T,S_a,'r',T_0,S_a_T_0,'o','LineWidth', 1);
title('Antwortspektrum');
ylabel('Spektralbeschleunigung [m/s^2]');
xlabel('Eigenschwingzeit [s]');
legend('Antwortspektrum nach EUROCODE 8','Ausgabe')
grid on;
%-----

%----- AUSGABEBLOCK -----
% Ausgabe der Ergebnisse in eine Datei
fid = fopen('Outputdatei_1_Allgemein.txt', 'w');
fprintf(fid,...
        '%s\n','C. Petersen, H. Werkle, Dynamik der Baukonstruktionen');
fprintf(fid,...
        '%s\n','2. Auflage, Springer Vieweg, Wiesbaden, 2018');
fprintf(fid,...
        '%s\n','Softwareentwicklung: Andrei Firus (andrei.firus@gmail.com)');
fprintf(fid,'%s\n','Programm ML_13_2: Eingaben- und Ergebnisuebersicht');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,...
        '%s\n','-----');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,...
        '%s\n','EINGABEDATEN:');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Art der Erdbebenanregung:');
if a_erd==1
    Erdbebenart="Horizontal";
elseif a_erd==2
    Erdbebenart="Vertikal";
end
fprintf(fid,'%s\n',Erdbebenart);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Erdbebenzone:');
fprintf(fid,'%d\n',Zone);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Bedeutungskategorie:');
fprintf(fid,'%d\n',bed_k);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,'%s\n','Untergrund:');
if unt==1
    Untergrundart="A-R";
elseif unt==2
    Untergrundart="B-R";
elseif unt==3
    Untergrundart="C-R";
elseif unt==4
    Untergrundart="B-T";
elseif unt==5

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        Untergrundart="C-T";
elseif unt==6
        Untergrundart="C-S";
end
fprintf(fid, '%s\n', Untergrundart);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s %s\n', 'Verstärkungsbeiwert der Spektralbeschleunigung', ...
        '(beta_0):');
fprintf(fid, '%.3f\n', beta_0);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Verhaltensbeiwert:');
fprintf(fid, '%d\n', q);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Obere Grenze der Eigenschwingzeiten [s]:');
fprintf(fid, '%d\n', Tmax);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Eigenschwingzeit des Antwortsystems:');
fprintf(fid, '%.3f\n', T_0);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, ...
        '%s\n', '-----');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, ...
        '%s\n', 'ERGEBNISSE:');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Bemessungswert der Bodenbeschleunigung [m/s^2]:');
fprintf(fid, '%.3f\n', agr);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Bedeutungsbeiwert [-]:');
fprintf(fid, '%.3f\n', gamma_i);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Untergundbeiwert [-]:');
fprintf(fid, '%.3f\n', S);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Kontrollperioden:');
fprintf(fid, '%s \t %.3f\n', 'T_A:', 0);
fprintf(fid, '%s \t %.3f\n', 'T_B:', T_B);
fprintf(fid, '%s \t %.3f\n', 'T_C:', T_C);
fprintf(fid, '%s \t %.3f\n', 'T_D:', T_D);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Ergebnisse für das Antwortsystem:');
fprintf(fid, '%s \t %.3f\n', 'Eigenschwingzeit [s]:', T_0);
fprintf(fid, '%s \t %d\n', 'Spektralbeschleunigung [m/s^2]:', S_a_T_0);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Antwortspektrum:');
fprintf(fid, '%s \t %s\n', 'Eigenschwingzeit', 'Spektralwert [m/s^2]:');

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[illegible]