



1 of 7

## Technické výpočty se sw *Mathematica* - Swell, spol. s r.o.

[www.swell.cz](http://www.swell.cz)

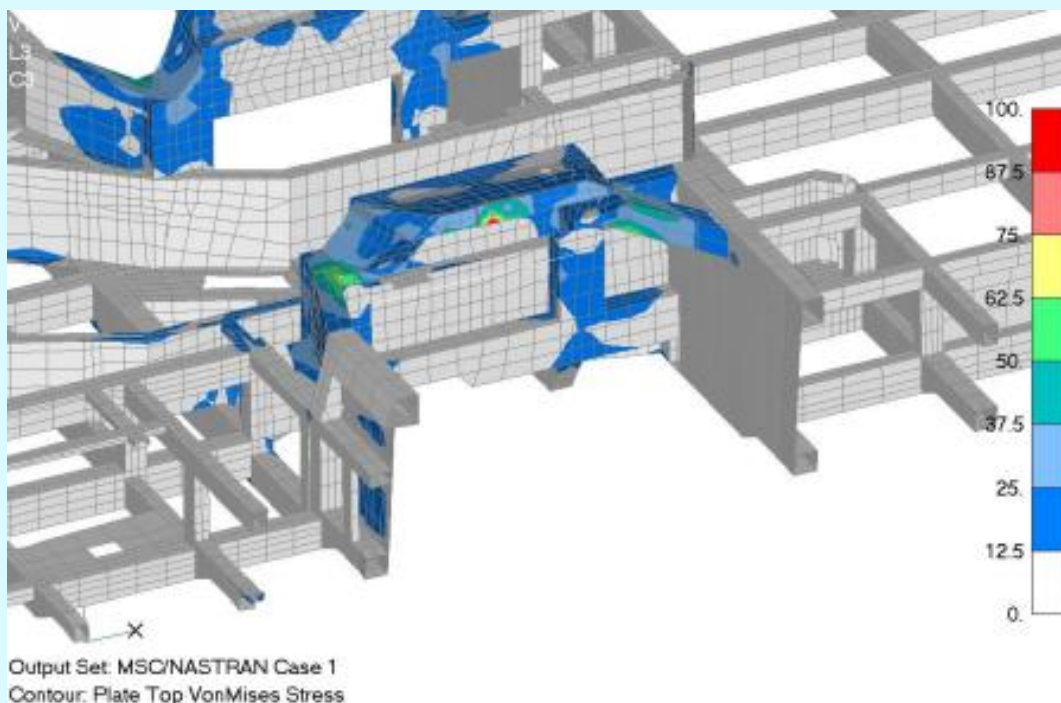


2 of 7

## Vyhodnocení tenzoru napětí

```
In[1]:= << Graphics`Graphics`
```

```
In[1]:= Show[Import["E:/prednaska_math_04/VM.tiff","TIFF"]];
```



```
In[3]:= arcTan2[x_,y_]:=Arg[x+y*I]
```

```

In[4]:= StressOutPlate[v_] := Module[{r, a, s1, s2, d, s},
  d = (v[[1]] - v[[2]])/2;
  s = (v[[1]] + v[[2]])/2;
  r = Sqrt[d^2 + v[[3]]^2];
  s1 = s + r;
  s2 = s - r;
  a = arcTan2[d, v[[3]]];
  Return[{s1, s2, 90*a/Pi, s, r, Sqrt[s1^2 + s2^2 - s1*s2]} // N] //;
  VectorQ[v]

In[5]:= MohrCirclesPlate[v_] := Module[{vyh = StressOutPlate[v]},
  Show[Graphics[{{Hue[0.7],Circle[{vyh[[4]], 0}, vyh[[5]]}},
  Point[{0, 0}], {Hue[0],Line[{v[[1]], v[[3]], {v[[2]], -v[[3]]}}]}],
  AspectRatio -> Automatic, Axes -> Automatic]//;VectorQ[v]

In[6]:= CutP[v_,fi_]:=Module[{s,cx,ncx,f=2*fi*Pi/180},
  s=(v[[1]]+v[[2]])/2;
  cx=(v[[1]]-v[[2]])/2+I*v[[3]];
  ncx=cx*(Cos[f]+I*Sin[f]);
  Return[{s+Re[ncx],s-Re[ncx],Im[ncx]}]//; VectorQ[v]

In[7]:= tn={40,20,20};

In[8]:= TableForm[StressOutPlate[tn],TableHeadings->{"MajorPrn Stress", "MinorPrn
  Stress", "PrnStress Angle", "Mean Stress", "MaxShear Stress", "VonMises
  Stress"},None}]

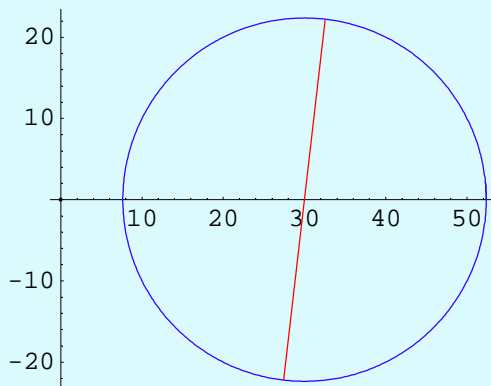
Out[8]//TableForm=
  MajorPrn Stress      52.3607
  MinorPrn Stress      7.63932
  PrnStress Angle     31.7175
  Mean Stress          30.
  MaxShear Stress     22.3607
  VonMises Stress     48.9898

In[10]:= CutP[tn,10]//N

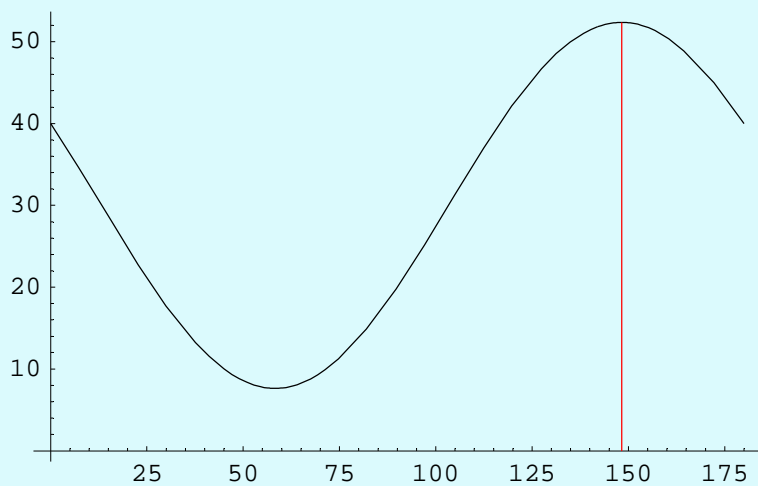
Out[10]= 832.5565, 27.4435, 22.2141<

In[11]:= MohrCirclesPlate[CutP[tn,10]];

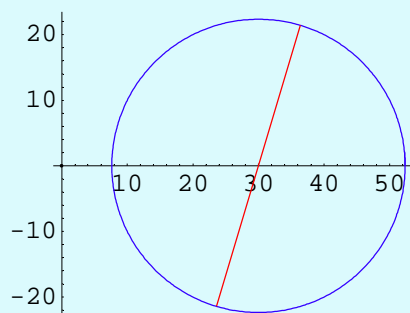
```



```
In[12]:= DisplayTogether[
  Plot[CutP[tn,fi][[1]], {fi,0,180}],
  ListPlot[{{180-StressOutPlate[tn][[3]],0}, {180-StressOutPlate[tn][[3]],
  StressOutPlate[tn][[1]]}},
  PlotJoined -> True, PlotStyle -> Hue[0]]];
```



```
In[13]:= Table[MohrCirclesPlate[CutP[tn,fi]],{fi,5,90,5}];
```

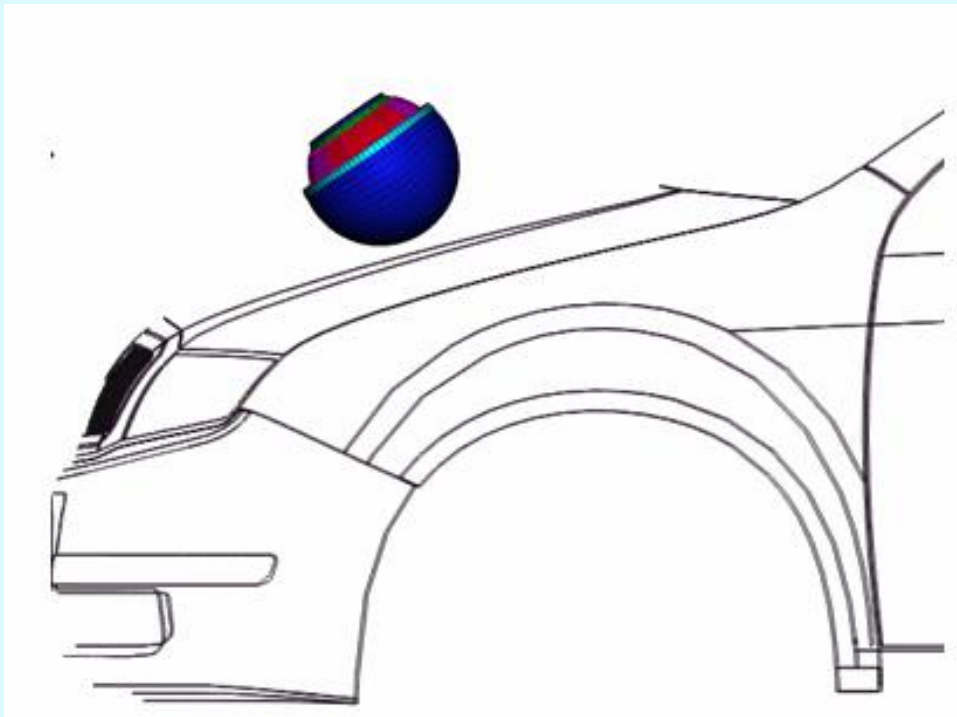


3 of 7

## Ochrana chodců - výpočet HIC

```
In[14]:= << Graphics`Graphics`
```

```
In[15]:= Show[Import["D:/prednaska_math_04/HIC.tiff","TIFF"]];
```



```
In[16]:= fceHIC@a_D :=  $\int_k^{t+h} \frac{a@xD \hat{a}x}{h} \frac{y}{2} \frac{h}{h}$ 
```

```
In[17]:= pt1 = D[fceHIC[a],t]
ph1 = D[fceHIC[a],h]
```

```
Out[17]=  $\frac{5}{2} H - a@tD + a@h + tDL \int_k^{h+t} \frac{a@xD \hat{a}x}{h} \frac{y}{2} \frac{3 \cdot 2}{h}$ 
```

```
Out[18]=  $\int_k^{h+t} \frac{a@xD \hat{a}x}{h} \frac{5 \cdot 2}{h} + \frac{5}{2} h \int_k^{h+t} \frac{a@xD \hat{a}x}{h} \frac{y}{2} \frac{3 \cdot 2}{h} \int_k^{h+t} \frac{a@h + tD}{h} - \int_k^{h+t} \frac{a@xD \hat{a}x}{h^2} \frac{y}{2}$ 
```

```
In[19]:= K@a_D :=  $\int_k^{t+h} \frac{a@xD \hat{a}x}{h} \frac{y}{2} \frac{h}{h}$ 
```

```
In[20]:= pt1/K[a]
ph1/(3K[a]/2)//Simplify
```

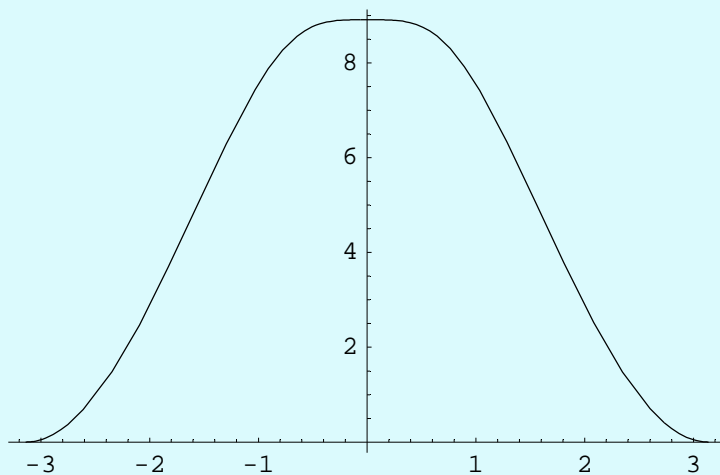
```
Out[20]=  $\frac{5}{2} H - a@tD + a@h + tDL$ 
```

```
Out[21]=  $\frac{5}{3} a@h + tD - \int_k^{h+t} \frac{a@xD \hat{a}x}{h}$ 
```

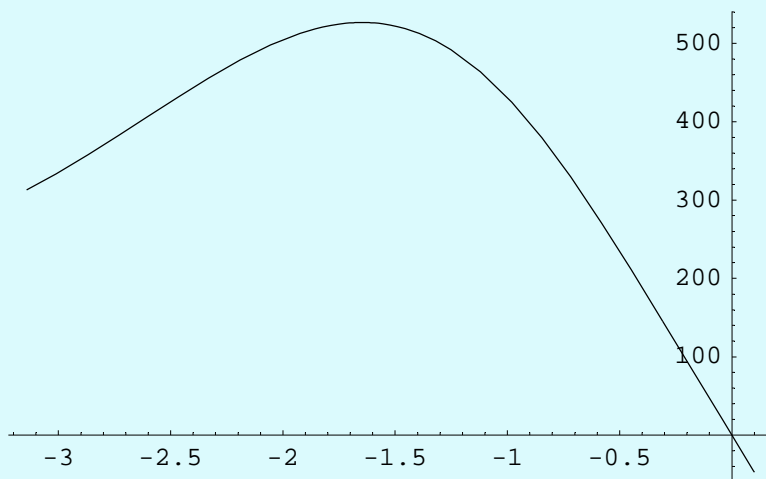
```
In[22]:= fceHIC@a_, t_, h_D :=  $\int_k^{t+h} \frac{a@xD \hat{a}x}{h} \frac{y}{2} \frac{2.5}{h} h$ 
g@x_D := fceHIC@f, x, - 2 xD
```

```
In[24]:= shapeF[x_]:=10*Cos[x/2]^2-1*((1+Cos[x])/2)^10  
par=0.0;
```

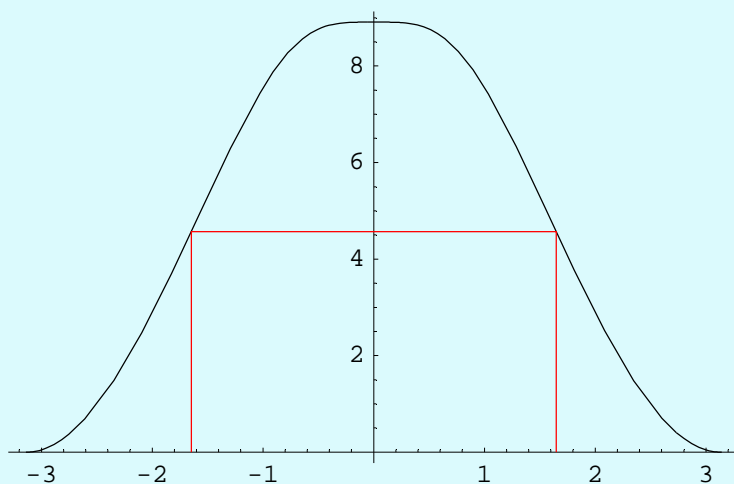
```
In[26]:= v=Integrate[shapeF[z],{z,-Pi,Pi}];  
f[x_]:=30*shapeF[x]/v  
graf1=Plot[f[t],{t,-Pi,Pi}];
```



```
In[29]:= g[t];  
graf=Plot[g[t],{t,-Pi,0.1}];  
m=FindMaximum[g[t],{t,-0.5}];  
tx=t/.m[[2]];
```



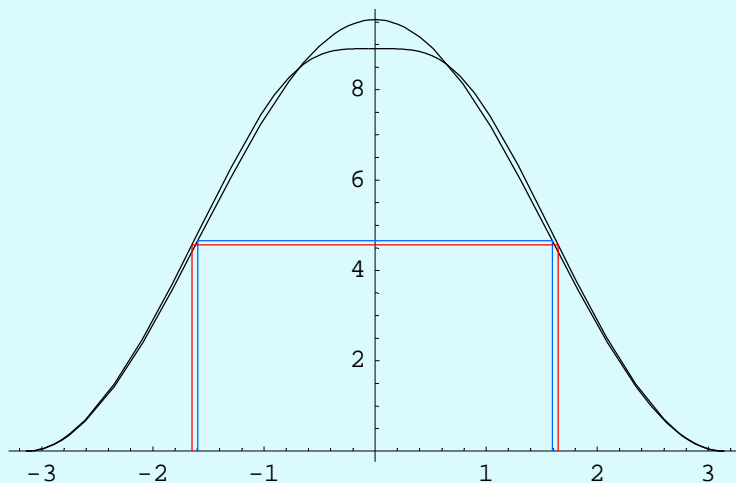
```
In[33]:= graf3=DisplayTogether[graf1,ListPlot[{{tx,0},{tx,f[tx]},{-tx,f[tx]},{-tx,0}},Plot  
Joined -> True, PlotStyle -> Hue[par]]];
```



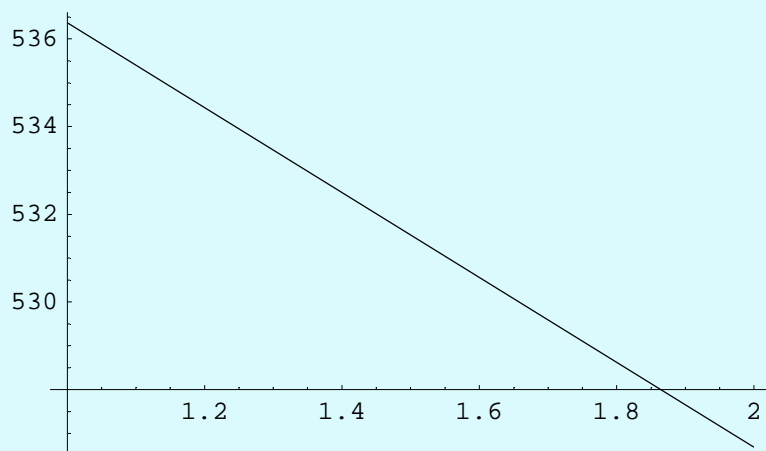
```
In[47]:= seznam = 8<;
```

```
In[70]:= AppendTo@seznam, 8f@tD, g@tD, m, graf, graf3<D;
```

```
In[71]:= L=Length[seznam];  
Show[seznam[[Range[L],5]]];  
seznam[[Range[L],3,1]]  
ListPlot[seznam[[Range[L],3,1]],PlotJoined@True];
```



```
Out[73]= 8536.369, 526.687<
```

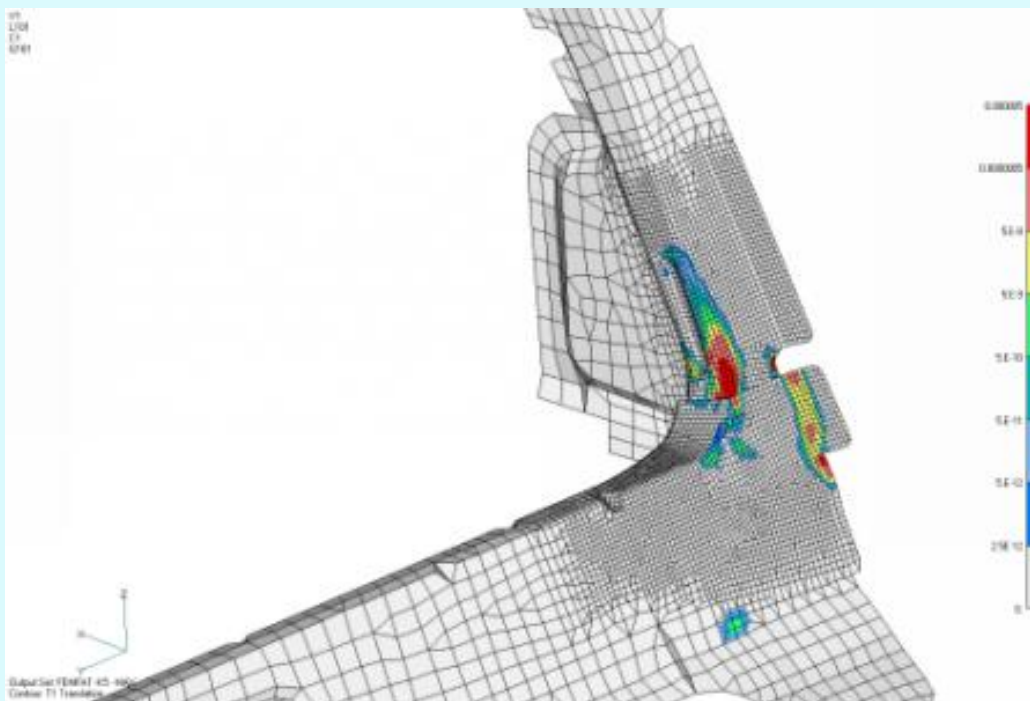


4 of 7

## Životnost - Haighův diagram

```
In[34]:= << Graphics`Graphics`
```

```
In[35]:= Show[Import["D:/prednaska_math_04/ziv.tiff","TIFF"]];
```



Vliv středního napětí

```
In[36]:= c={{-500,500},{0,0},{500,500}};
```

```
In[37]:= matHD[UTS_,YS_,YSP_,YSA_]:=Module[{k=2*YSA/YSP-1,p=YSP/2,q=YS/2,x1,x2},
  x1=(YS-YSA)/(1-k);x2=-(YS-YSA)/(1+k);

  Return[{{UTS,0},{x1,YS-x1},{p,p},{0,YSA},{x2,YS+x2},{-UTS+YS+x2,YS+x2},{-UTS,0}}]
]
```

```
In[38]:= HD[mat1_]:=DisplayTogether[
```

```
ListPlot[c,PlotJoined->True,AspectRatio->0.5,AxesLabel->{!\(s\_m\),!\(s\_a\)}],
  Epilog -> {Text["R = 0", {460, 400}, {0, -1}], Text["R = -1", {50, 400},
{0, -1}],
  Text["R = -\u03a8", {-460, 400}, {0, -1}],
  TextStyle->{FontFamily->"Times",FontSize->11}],
  ListPlot[mat1,PlotJoined->True, PlotStyle -> Hue[0.6]],
  ListPlot[mat1,PlotJoined->False, PlotStyle -> {Hue[0], PointSize[.015]}]]
```

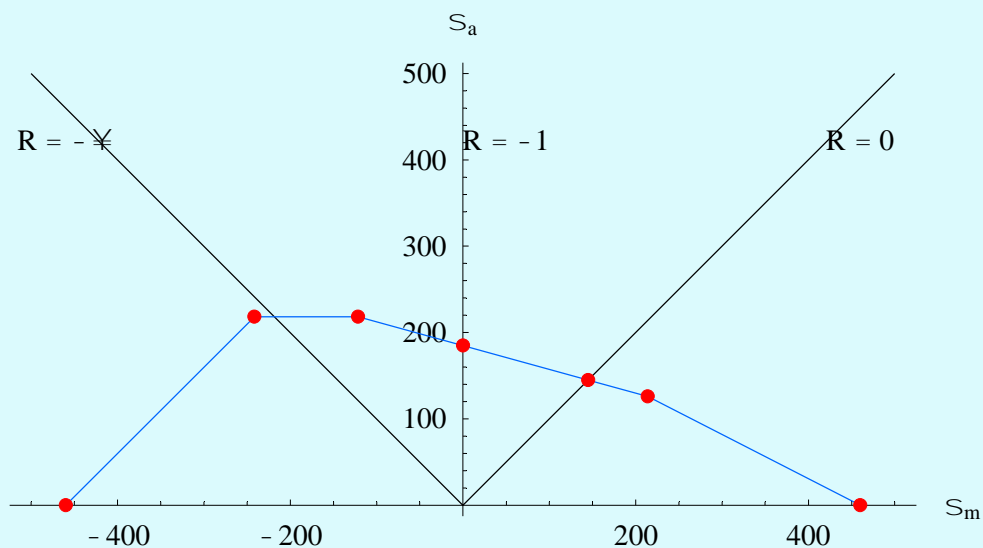
Materiál: jemnozrnná ocel QStE340

```
In[39]:= MezPevnosti = 460;
  MezKluzu = 340;
  MezUnavyPuls = 290;
  MezUnavyAlt = 185;
```

```
In[43]:= mat1=matHD[MezPevnosti, MezKluzu, MezUnavyPuls, MezUnavyAlt]/N
```

```
Out[43]= 88460., 0.<, 8214.048, 125.952<, 8145., 145.<, 80., 185.<,
  8- 121.486, 218.514<, 8- 241.486, 218.514<, 8- 460., 0.<<
```

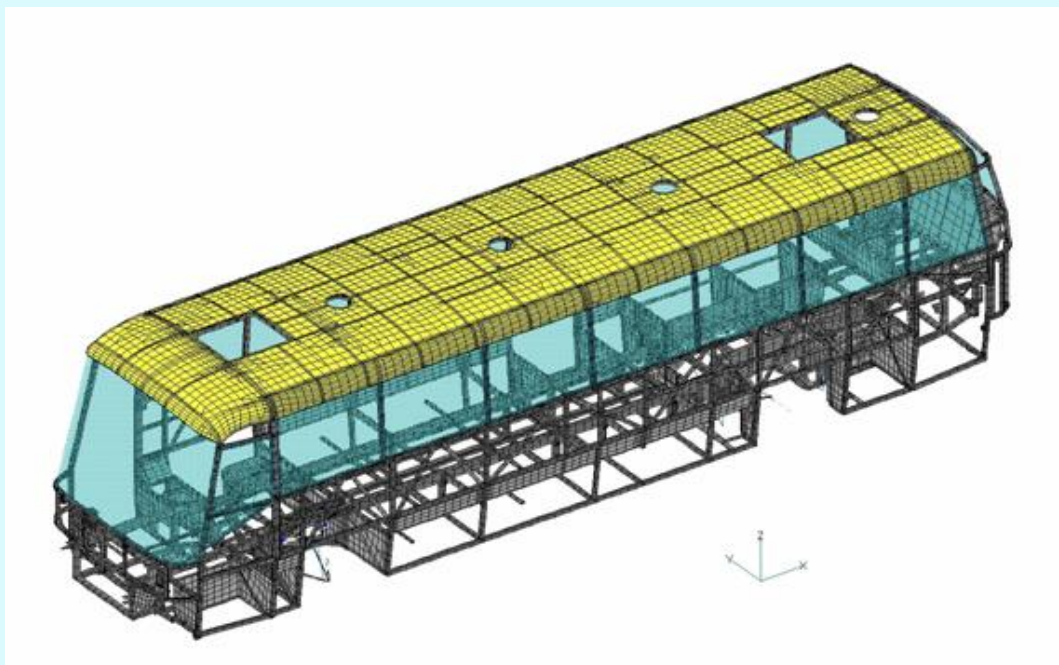
```
In[44]:= HD[mat1];
```



5 of 7

## Převrácení autobusu SOR C10.5 - EHK č. 66.00

```
In[45]:= Show[Import["D:/prednaska_math_04/SOR.tiff", "TIFF"]];
```



```
In[46]:= Remove[aT,bT,v,b,g,M,m,s,Ep,Ek,Ixx]
```

```
In[47]:= bTmax = Sqrt[aT^2 + bT^2];
a = ArcSin[aT/bTmax];
bTmin = aT Cos[a] - bT Sin[a];
```

```
In[50]:= Ep = M g H bTmax - bTmin L // Simplify
```

```
Out[50]= g M (Sqrt[aT^2 + bT^2] + bT/bTmax - aT/bTmax) L
```

```
In[51]:= Ek = 1/2 Ixx w^2
```

```
Out[51]= Ixx w^2 / 2
```

```
In[52]:= W = w // Solve[Ep == Ek, w] // FullSimplify
```

```
Out[52]= Sqrt[(M g L (Sqrt[aT^2 + bT^2] + bT/bTmax - aT/bTmax)) / Ixx]
```

```
In[53]:= FullSimplify@
```

```
HW /. {a -> 2.240 m, b -> 2.700 m, aT -> 1.120 m,
bT -> 1.310 m, v -> 0.8 m, M -> 13700 kg, g -> 9.81 m s^-2, Ixx -> 53040 kg m^2},
s >
0 &&
m >
0 D
```

```
Out[53]= 2.29791 / s
```

C

A

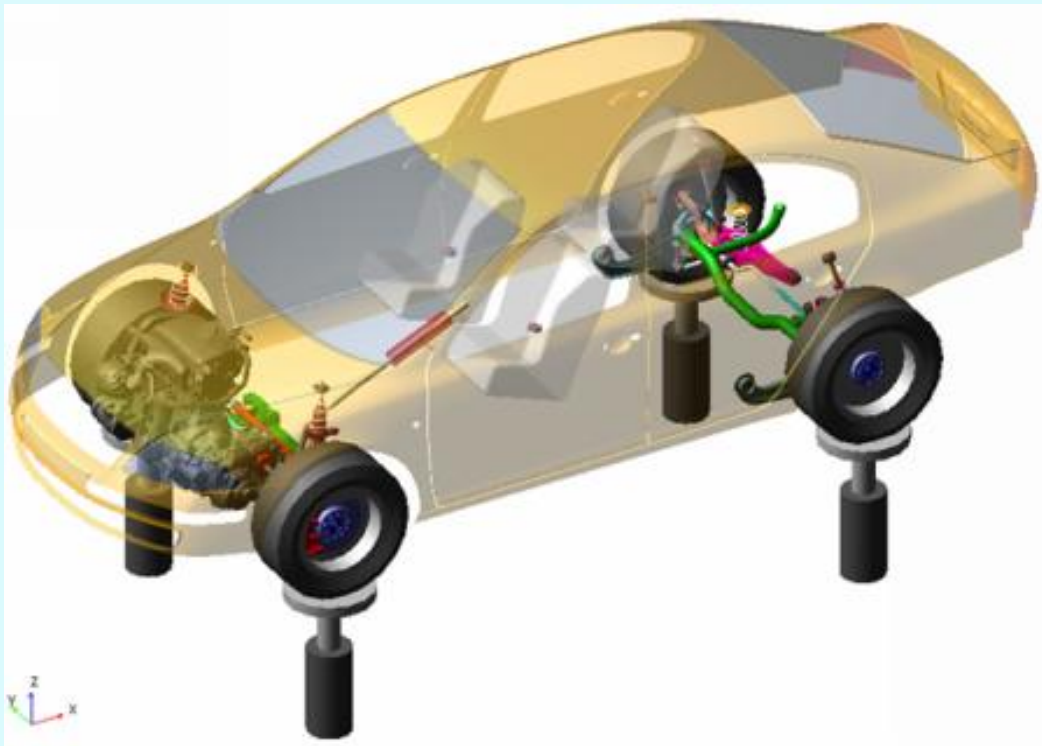
i

6 of 7

## Porovnání signálů - spektrální výkonová hustota

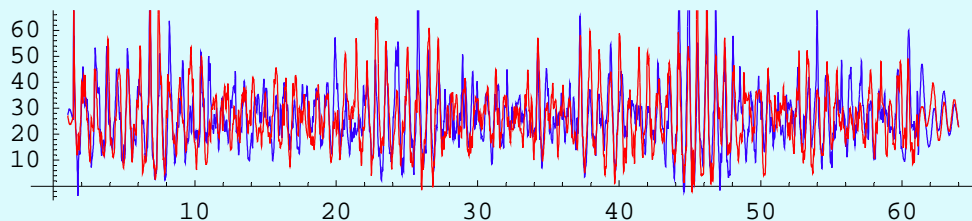
```
In[68]:= << Graphics`Graphics`
```

```
In[69]:= Show[Import["D:/prednaska_math_04/carA5.tiff","TIFF"]];
```



```
In[70]:= data=Import["D:/prednaska_math_04/MSA.tab","CSV"];
```

```
In[71]:= DisplayTogether[
  ListPlot[data[[All,{1,2}]],PlotJoined->True, PlotStyle -> Hue[0.7]],
  ListPlot[data[[All,{1,3}]],PlotJoined->True, PlotStyle -> Hue[0]],
  AspectRatio->0.2];
```



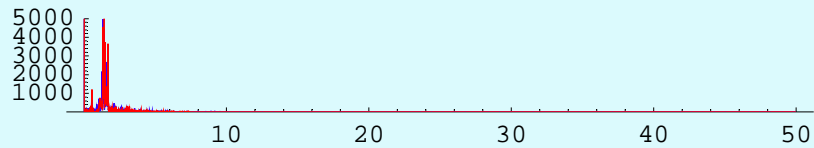
```
In[72]:= f=(Length[data]-1)/(Last[data[[All,1]]]-First[data[[All,1]])]
```

```
Out[72]= 100.
```

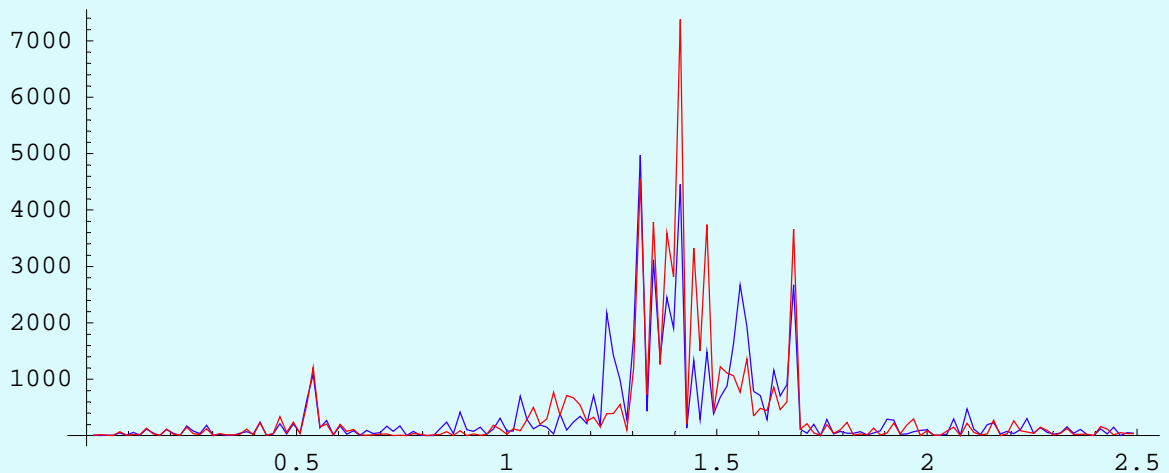
```
In[73]:= Spectrum[data_,f_]:=Module[{fft,fx},
  fx = f/2 * Table[i, {i, 0, 1, 2/(Length[data]-1)}];
  fft = Take[(Abs[Fourier[data]]^2)/(2Pi),Length[fx]];
  Return[Transpose[{fx,fft}]]]
```

```
In[74]:= tk=Round[Length[data]/40];
```

```
In[75]:= DisplayTogether[
  ListPlot[Spectrum[data[[All,2]],f], PlotJoined -> True, PlotStyle ->
  Hue[0.7]],
  ListPlot[Spectrum[data[[All,3]],f], PlotJoined->True, PlotStyle -> Hue[0]],
  AspectRatio->0.125,PlotRange->{0,5000}];
```



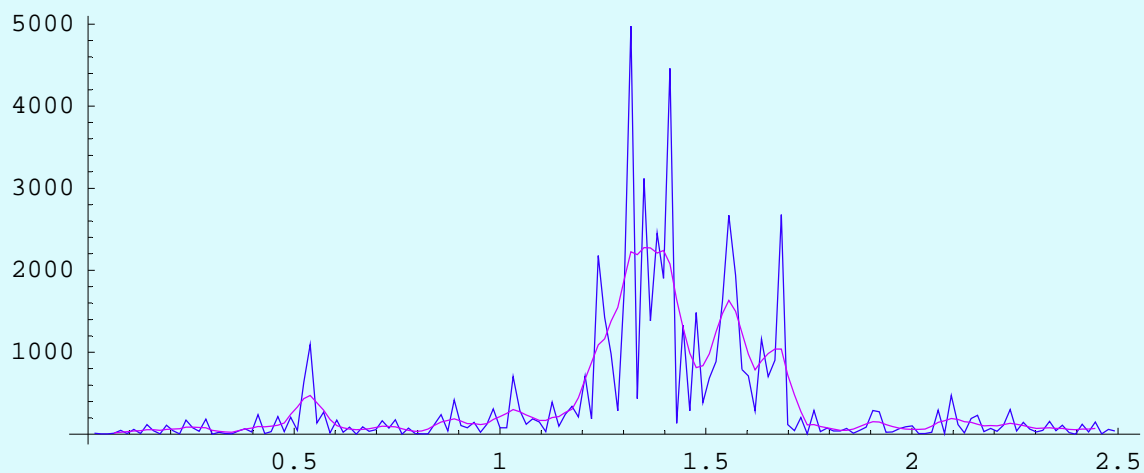
```
In[76]:= DisplayTogether[
  ListPlot[Spectrum[data[[All,2]],f][[Range[2,tk]]], PlotJoined -> True,
  PlotStyle -> Hue[0.7]],
  ListPlot[Spectrum[data[[All,3]],f][[Range[2,tk]]], PlotJoined->True,
  PlotStyle -> Hue[0]],
  AspectRatio->0.4,PlotRange->All];
```



```
In[77]:= Smooth[data_,filtr_]:= Module[{M = Length[filtr], fil = filtr/Apply[Plus,
  filtr], ou},
  ou = Table[Take[data, {i, i+M-1}].fil, {i, 1, Length[data]-M+1}];
  Return[ou]]
```

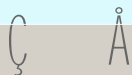
```
In[104]:=
  filtr = {1,2,3,4,3,2,1}; M = (Length[filtr]-1)/2;
  sd = Transpose[{Spectrum[data[[All,2]],f][[Range[2+M,tk-M],1]],
  Smooth[Spectrum[data[[All,2]],f][[Range[2,tk],2]],filtr]}}];
```

```
In[106]:=
DisplayTogether[
  ListPlot[Spectrum[data[[All,2]],f][[Range[2,tk]]], PlotJoined -> True,
  PlotStyle -> Hue[0.7]],
  ListPlot[sd, PlotJoined->True, PlotStyle -> Hue[0.8]],
  AspectRatio->0.4,PlotRange->All];
```



```
In[56]:= Export["E:/prednaska_math/MSA.tab",data,"CSV"]
```

```
Out[56]= E:•prednaska_math•MSA.tab
```

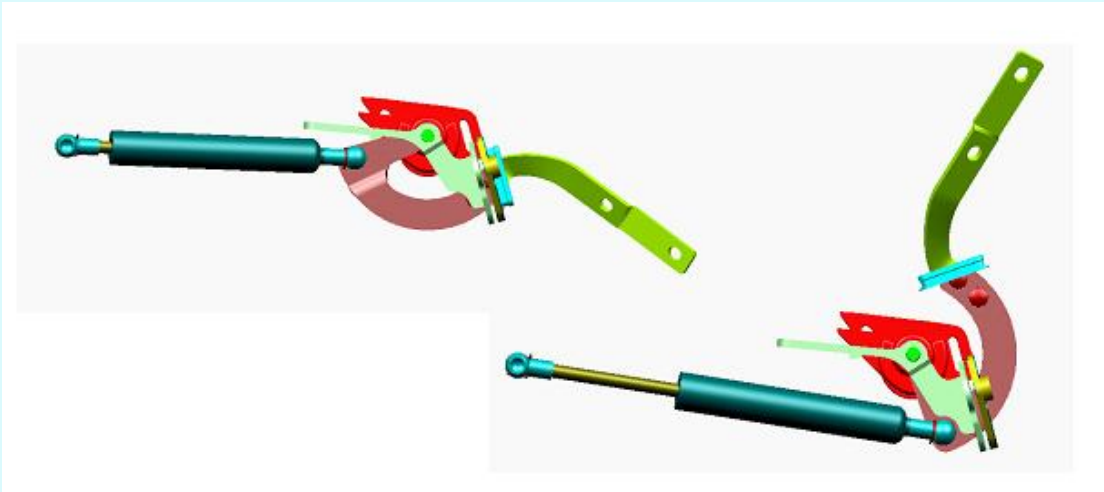


7 of 7

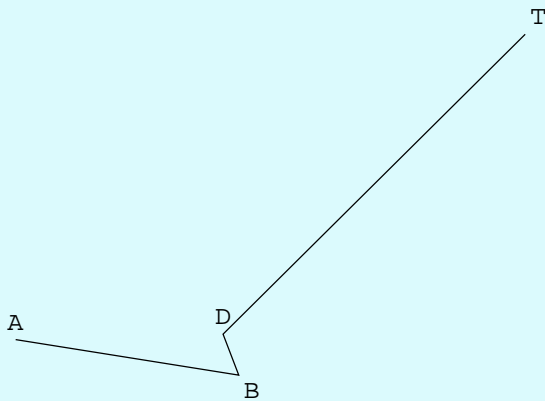
## Otevírání pátých dveří

```
In[107]:=
<< Graphics`Graphics`
```

```
In[108]:=
Show[Import["D:/prednaska_math_04/5dvere.tiff","TIFF"]];
```



```
In[135]:=
Table@Show@
Graphics@Point@{882600, 1600<, 83600, 600<<, AspectRatio@1D,
Graphics@Line@{8A0, B@fim*180*Pi*10*Abs@iDD, D0, T@fim*180*Pi*10*Abs@iDD<DD,
Epilog@{8Text@"A", A0, 80, -1<D,
Text@"B", B@fim*180*Pi*10*Abs@iDD, 8-1, 1<D,
Text@"D", D0, 80, -1<D, Text@"T", T@fim*180*Pi*10*Abs@iDD, 8-1, -1<D<D,
8i, -10, 10<D;
```



```

In[109]:=
A0={2634.6,1102.7};
D0={2925.6,1110.7};
B0={2866.7,1093.0};
T0={3314,656};
R1=L[B0,D0];
R2=L[T0,D0];
fi1=ArcTan[(D0-B0)[[2]]/(D0-B0)[[1]]]+Pi;
fi2=ArcTan[(D0-T0)[[2]]/(D0-T0)[[1]]];
fim=94.25;
G=22*9.81/2;

In[119]:=
B[fi_]:=D0+R1*{Cos[fi+fi1],Sin[fi+fi1]}
T[fi_]:=D0+R2*{Cos[fi+fi2],Sin[fi+fi2]}

In[121]:=
RM1[fi_]:=R1*RM[A0,D0,B[fi]]
RM2[fi_]:= (T[fi]-D0)[[1]]
MB[fi_]:=Fp[L[A0,B[fi]]]*RM1[fi]/1000
MT[fi_]:=G*RM2[fi]/1000
MD[fi_]:=MT[fi]-MB[fi]

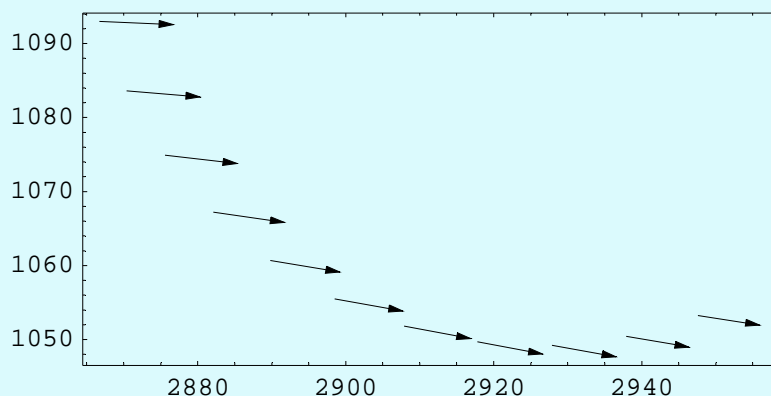
In[126]:=
L@a_, b_D := Sqrt@Apply@Plus, Ha - bL^2DD
RM@a_, b_, c_D := Module@8v1 = a - c, v2 = b - c, fi<,
  fi = Sin@ArcCos@Hv1.v2L * L@a, cD * L@b, cDDD; Return@fiDD

In[128]:=
Fp@x_D :=
Module@8F, l = L@a0, B@0DD, p = L@a0, B@fim * 180 * PiDD, h = 1510 - 40, d = 1200 + 40<,
  F = h + l * Hh - dL * Hp - 1L + x * Hd - hL * Hp - 1L; Return@FDD

In[129]:=
vFp@fi_D := Fp@L@a0, B@fiDDD * HB@fiD - A0L * L@a0, B@fiDD

In[130]:=
<< Graphics`PlotField`
vectors = Table@8B@uD, vFp@uD<, 8u, 0, fim * Pi * 180, fim * Pi * 1800<D;
ListPlotVectorField@vectors, ScaleFactor @ 10, Frame @ TrueD;

```



```
In[133]:=
```

```
DisplayTogether@
```

```
Plot@MT@fi • 180 * PiD, 8fi, 0, fim<, PlotRange @ 80, 90<D,  
Plot@MB@fi • 180 * PiD, 8fi, 0, fim<, PlotRange @ 80, 90<DD;  
Plot@MD@fi • 180 * PiD, 8fi, 0, fim<, PlotRange @ 8- 25, 15<D;
```

