Principal stress in 4-point bending

Principal stress in terms of normal and shear stress:

```
> sig[p1]:= (sigma/2) + sqrt( (sigma/2)^2 + tau^2 );
```

$$sig_{p1} := \frac{1}{2}\sigma + \frac{1}{2}\sqrt{\sigma^2 + 4\,\tau^2}$$

Normal and shear stress in beam bending:

```
> sigma:=M(x)*y/Iz;
```

$$\sigma := \frac{\mathrm{M}(x)\,y}{Iz}$$

```
> tau:=V(x)*Q/(Iz*b);
```

$$\tau := \frac{\mathrm{V}(x)\,Q}{Iz\,b}$$

Define singularity function

```
> sfn:= proc(x,a,n) (x-a)^n * Heaviside(x-a) end;
```

Shear and bending moment functions (developed manually):

```
> V:=(x)-> -P*sfn(x,0,0)+P*sfn(x,a,0)+P*sfn(x,2*a,0)-P*sfn(x,3*a,0);
> M:=(x)-> P*sfn(x,0,1)-P*sfn(x,a,1)-P*sfn(x,2*a,1);
```

Q parameter:

```
> Q:=(b/2)*( (h^2/4) - y^2);
```

$$Q := \frac{1}{2}\,b\left(\frac{1}{4}\,h^2 - y^2\right)$$

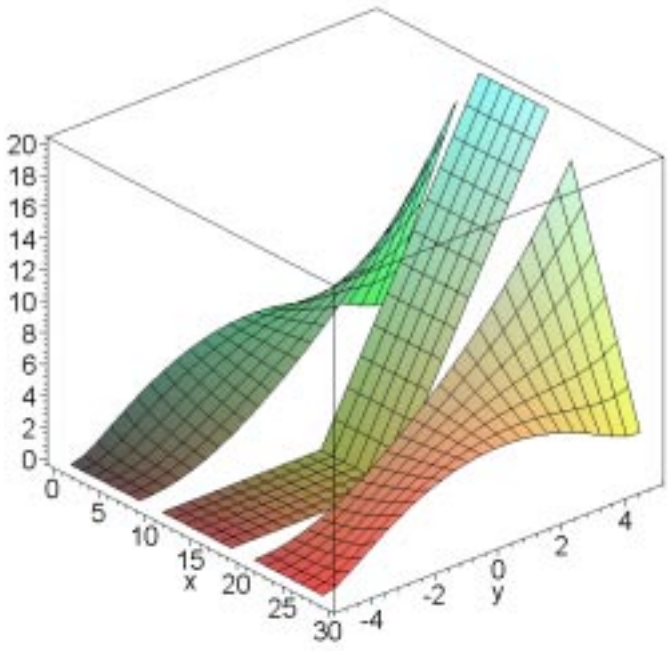
Moment of inertia for rectangular cross-section

```
> Iz:=b*h^3/12;
```

$$Iz := \frac{1}{12}\,b\,h^3$$

Define numerical parameters, make 3D plot

```
> P:=100;a:=10;h:=10;b:=3;
> plot3d(sig[p1],x=0..3*a,y=-h/2..h/2);
```


20
18
16
14
12
10
8
6
4
2
0
0
5
10
15
x
20
25
30
-4
-2
0
y
2
4

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