Equivalent thickness calculation in Paratie Plus

A. Steel sheet wall

Consider the sheet wall designed in the example.

It's a tipe AZ28, it's inertia is 58938.8 cm^4/m.

Paratie Plus calculates an equivalent thickness considering a rectangular section having the same inertia.

It's possible to rea, in Paratie input file (.d):

** 6.1 LEFT WALL STRUCTURAL PROPERTIES*

**Calculate equivalent Steel Sheet Pile Ixx. X Wall Spacing*

** Ewall= 210000 Mpa, Stiffness Ixx= 58938.8 cm4/m x 1 m = 58938.8 cm4*

** Iequivalent= Ewall x Ixx x ConvEI / (Estandard x ConvEL x Wall Spacing) =>*

** Iequivalent= 210000 Mpa x 58938.8 cm4/m x 1 m = 58938.8 cm4 x 1E-08/ (210000 x 1 x 1)= 0.00059 (m^4/m)*

**Now calculate Equivalent Wall Thickness from Ixx/Length*

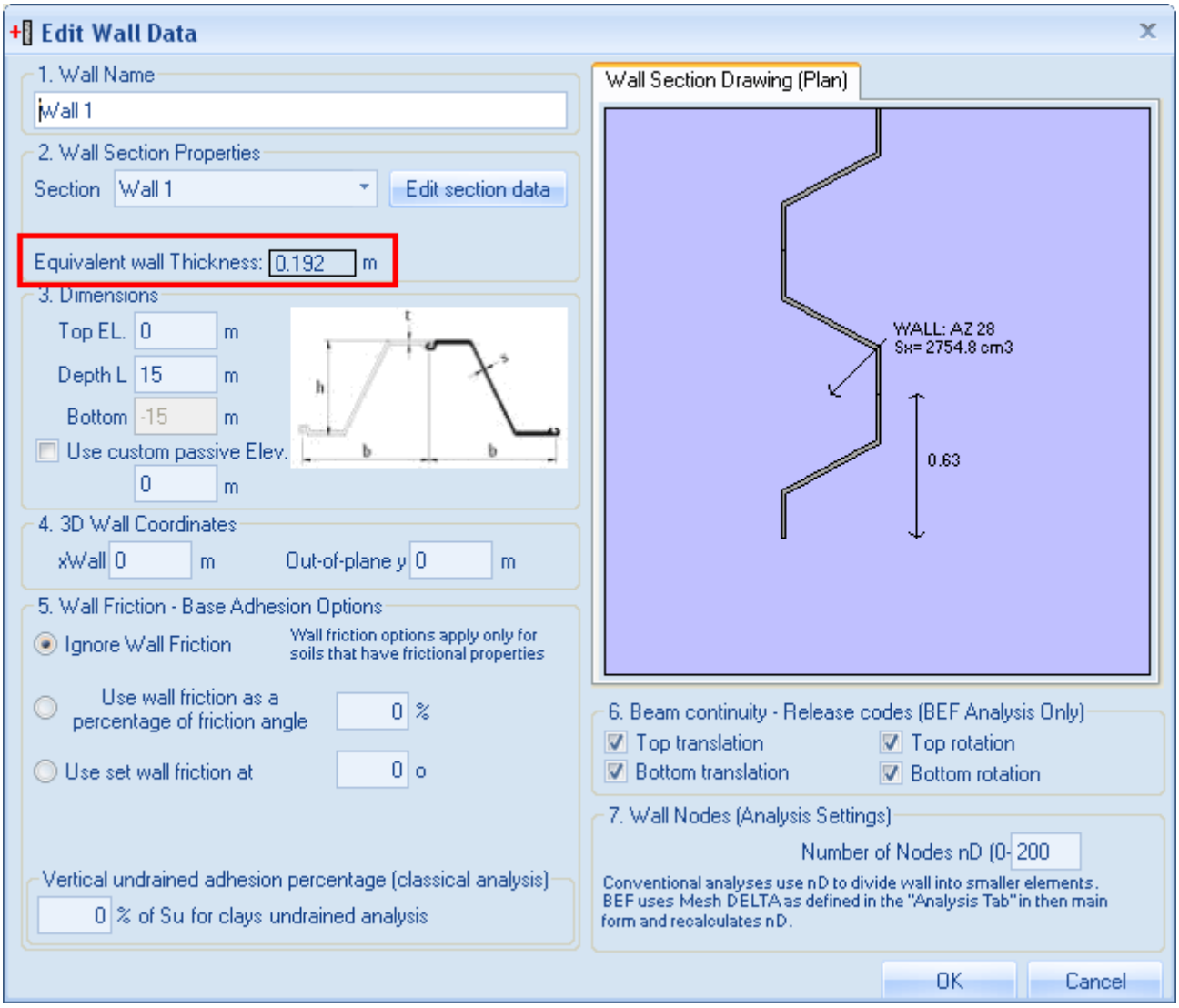
** Wall thick= (12 x Ixx/L)^(1/3) = (12 x 0.00059)^(1/3) = 0.19195 (m)*

$I_{eq} = E_{muro} * Ixx / (E_{standard} * s) = 0.00059\ m^4/m$.

s = horizontal space between elements.

The equivalnt thickness is calculated as:

$s = \sqrt[3]{(12 * I_{eq})}$ and is worth, in this case, 19.2 cm.



B. IPE pails filled with concrete

Consider the wall designed in the example.

It's a wall made up with aligned IPE beams; the inertia for a IPE220 is worth 1943 cm^4.

Paratie Plus calculates an equivalent thickness considering a rectangular section having an equivalent inertia.

In the imput file of Paratie it's possible to read:

** 6.1 LEFT WALL STRUCTURAL PROPERTIES*

**Calculate equivalent Soldier Pile Ixx, with Steel Beam.*

** Ewall= 206000 MPa, Stiffness Ixx= 1943 cm4*

** Iequivalent= Ewall x Ixx x ConvEI / (Estandard x ConvEL x Wall Spacing) =>*

** Iequivalent= 206000 MPa x 1943 cm4 x 1E-08/ (206000 x 1 x 0.2)= 0.0001 (m^4/m)*

**Now calculate Equivalent Wall Thickness from Ixx/Length*

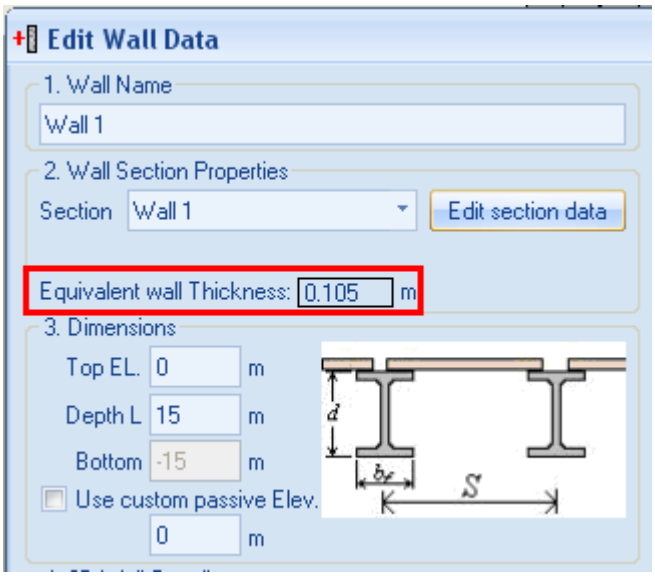
** Wall thick= (12 x Ixx/L)^(1/3) = (12 x 0.0001)^(1/3) = 0.10525 (m)*

$I_{eq} = E_{muro} * Ixx / (E_{standard} * s) = 0.0001\ m^4/m$.

s = 0,2 m beams horizontal space

The equivalent thickness is:

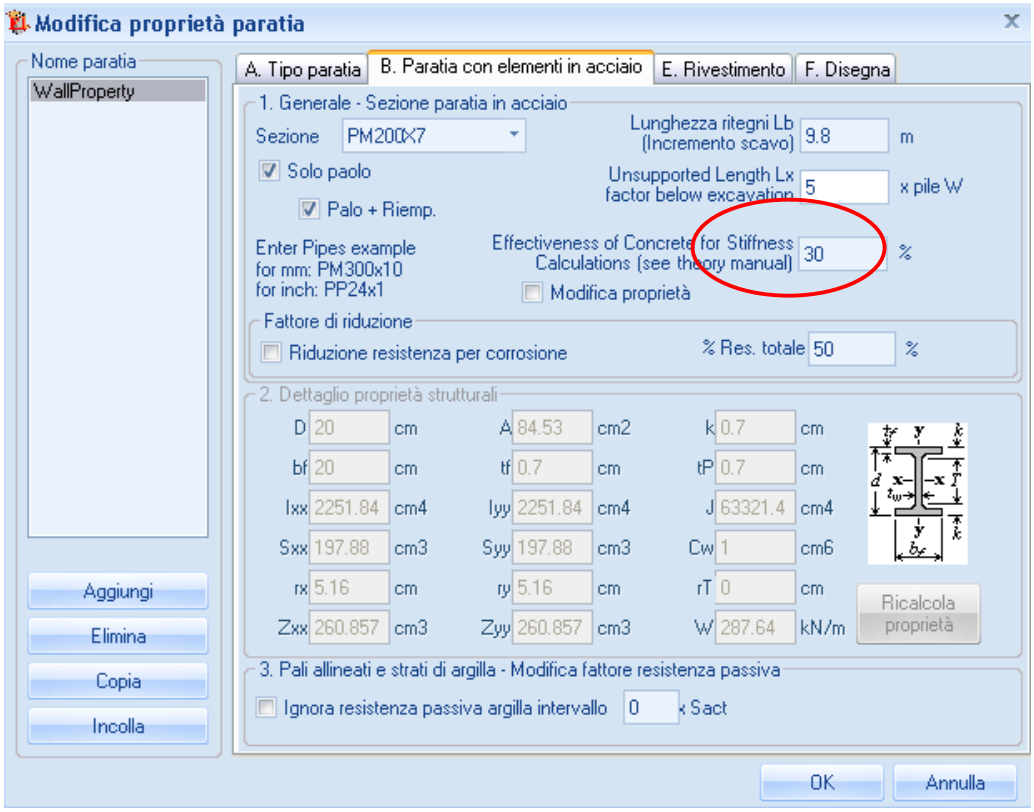
$s = \sqrt[3]{(12 * I_{eq})}$ and is worth, in this case, 10.52 cm.



C. Steel pipe filled with concrete

Consider a wall made up with pails, having diameter 200 mm, thickness 7 mm and horizontal spacing 0,3m.

In the window *Edit section data* it's possible to choose the effectiveness of concrete for section stiffness calculation. Assume 30% (see figure below).



Steel section inertia is worth:

$Ixx = /64 * (D^4 – (D – 2*tp)^4) = 1978,8\ cm^4$.

Concrete inertia is worth:

$I\_cls = /64 * D\_int^4 * 0,3 * (E\_cls / E\_steel) = 237\ cm^4$.

Having:

E_cls = 31000 kPa

E_steel = 200100 kPa

Ieq = Ixx + I_cls = 2252 cm^4/m.

Paratie Plus calculates an equivalent thickness considering a rectangular section having an equivalent inertia.

In the imput file of Paratie it's possible to read:

** 6.1 LEFT WALL STRUCTURAL PROPERTIES*

**Calculate equivalent Soldier Pile Ixx, with Steel Beam.*

** Ewall= 200100 MPa, Stiffness Ixx= 2251.85 cm4*

** Iequivalent= Ewall x Ixx x ConvEI / (Estandard x ConvEL x Wall Spacing) =>*

** Iequivalent= 200100 MPa x 2251.85 cm4 x 1E-08/ (200100 x 1 x 0.3)= 8E-05 (m^4/m)*

**Now calculate Equivalent Wall Thickness from Ixx/Length*

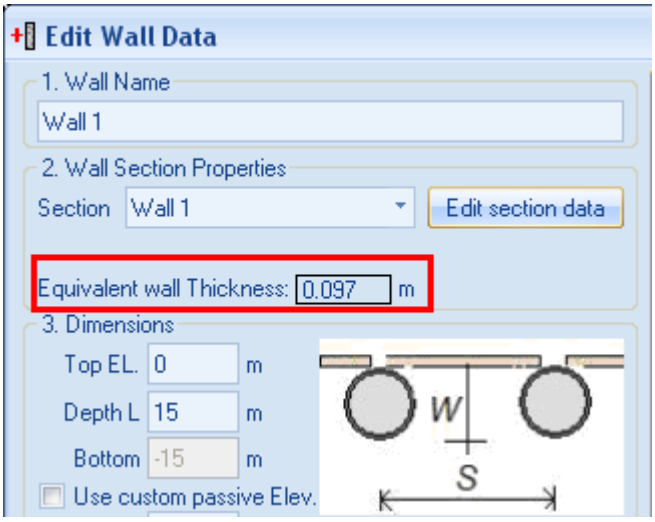
** Wall thick= (12 x Ixx/L)^(1/3) = (12 x 8E-05)^(1/3) = 0.09658 (m)*

$I_{eq} = E_{muro} * Ixx / (E_{standard} * s) = 8e\text{-}5\ m^4/m.$

s = 0,3 m pails horiziontal space

The equivalent thickness is:

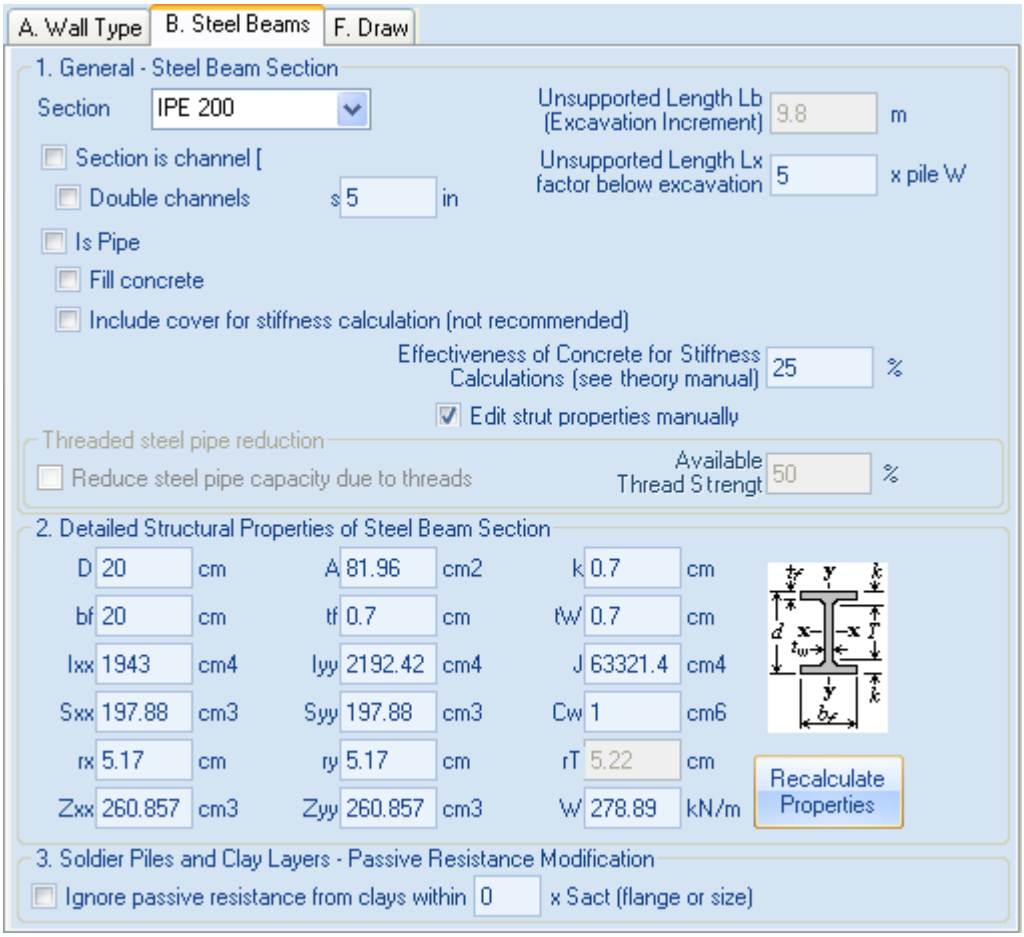
$s = \sqrt[3]{(12 * I_{eq})}$ and is worth, in this case, 9,66 cm.



D. Tangent pile wall

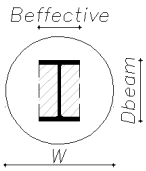
Consider a wall made up with tangent piles, with IPE200 profiles put into concrete pails having i D = 25 mm and S= 25 mm.

In the window *Edit section data* it's possible to choose the effectiveness of concrete for section stiffness calculation. Assume 25% (see figure below).



An IPE200 profile inertia is worth 1943 cm^4.

Also the concrete (incuded into the pipe) contribute must be considered:



$I\_cls = ((b - tw) * T^3) / 12 * (E\_cls/E\_steel) * 0,25$

Having:

b = 10 cm

tw = 0,6 cm

T = B – 2*tf

B = 20 cm

tf = 0,8 cm

Finally:

Ieq = I_cls + I_ipe

Continue as the examples above.