

TecAt 6 - Tutorial - Grid 1

TecAt module Grid 1 is intended to make a quick calculation of several grids of some typical configurations in a 2-layer soil; note that the item Analysis is not available on TecAt LE (the Learning Edition).

1. Configuration

At the Menu bar, select Grid 1 / Configuration:

Camada	Resistividade [Ohm . m]	Espessura [m]
1	428,27	2,98
2	142,45	

Requisitos de Projeto		
Resistência de projeto	10	Ω
Custo máximo	5000	\$
Tempo máximo	80	h

Eletrodos padrão:		
Haste 1	aço cobreado 2.0 m x 5/8"	
Haste 2	aço cobreado 2.4 m x 5/8	
Haste 3	aço cobreado 3 m x 5/8	
Profundidade da cabeça [m]	0,5	
Cabos	cabo cobre 50 mm ²	
Profundidade dos cabos [m]	0,5	

Conexões padrão:		
em 'X'	solda	molde solda X 50x50 mm ²
em 'T'	solda	molde solda T 50x50 mm ²
cabo - haste	solda	molde solda CH 50 mm ² x 5/8
haste - haste	solda	Luva roscada 5/8
cabo - cabo	solda	molde solda CC 50x50 mm ²

Este módulo - Malhas 1 - do TecAt realiza cálculos rápidos de malhas típicas, em solos de duas camadas; para solos de 3 ou 4 camadas e flexibilidade no desenho da malha, utilize o módulo Malhas 2, disponível nas versões TecAt Pro e TecAt Plus.

If you already have done the Resistivity stratification, the values for resistivity and first layer thickness are already listed, otherwise you can enter them at this screen.

Note: module Grid 1 requires a 2-layer soil; if your field data only fit a 3- or 4-layer soil, you must use the module Grid 2.

You need to select one cable for the horizontal electrodes and three rod lengths for the vertical ones; chose also the connections default for each format - cable-cable, cable-rod, cables in "T", cables in "X" and rods union.

Finally, set the desired project resistance, budget and time to build, then click on the Update button.

2. Selecting a grid "family"

At Menu bar, tab Grid 1, choose the item corresponding with the desired grid family (same format and components, different sizes):

- Local: 1 to 3 rods, line or triangle, with and without cable
- Small: 4 to 16 rod, in square or line formation
- Building: rectangular ring with zero to 16 rods
- Tower: one or two parallel counterpoise, with or without rods
- Circular ring: similar do Building, but a circle instead of rectangle.

3. Local grid

At the Menu bar, select Grid 1, then Local:

Malha 1 - Pontual

Projatos

Resistividade

Malha 1

Configuração

Pontual

Pequena

Edifício

Torre

Circular

Relatórios

Materiais

Malhas de Terra

Espaçamento das Hastes "c"

igual ao comprimento h delas

especificar abaixo

espaçamento b = 2 m

Calcular !

Malhas muito pequenas, de uma a três hastes; o cabo de interligação entre as hastes será calculado como pertencente e não-pertencente à malha - neste caso, um cabo isolado ou instalado por cima do solo.

h

p₂

p₁

e

c

C

You can set the spacing between rods to be equal to their length - 2 meter rods will be spaced 2 meters, 3 meter rods will be spaced 3 meters - or you can set a fixed spacing for all configurations.

4. Report: Options Table (Local)

When you click on Calculate, TecAt does the math for 21 grids: for each rod length, grids with:

- one rod
- two rods, cable not considered
- two rods, cable considered
- three rods in line, no cable
- three rods in line, with cable
- three rods in triangle, no cable
- three rods in triangle, with cable

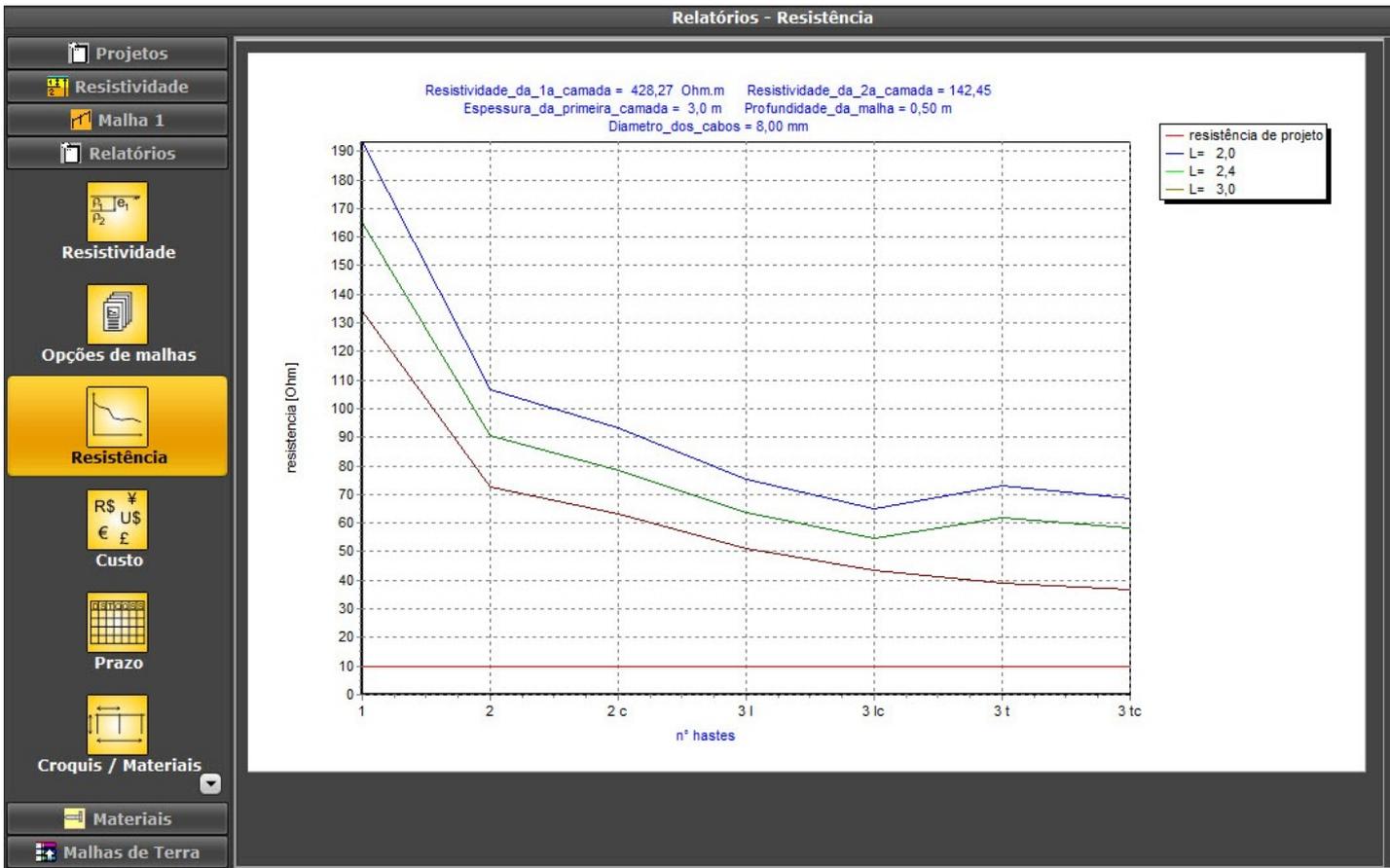
Relatórios - Resistência 1

Resultados de todas as configurações:

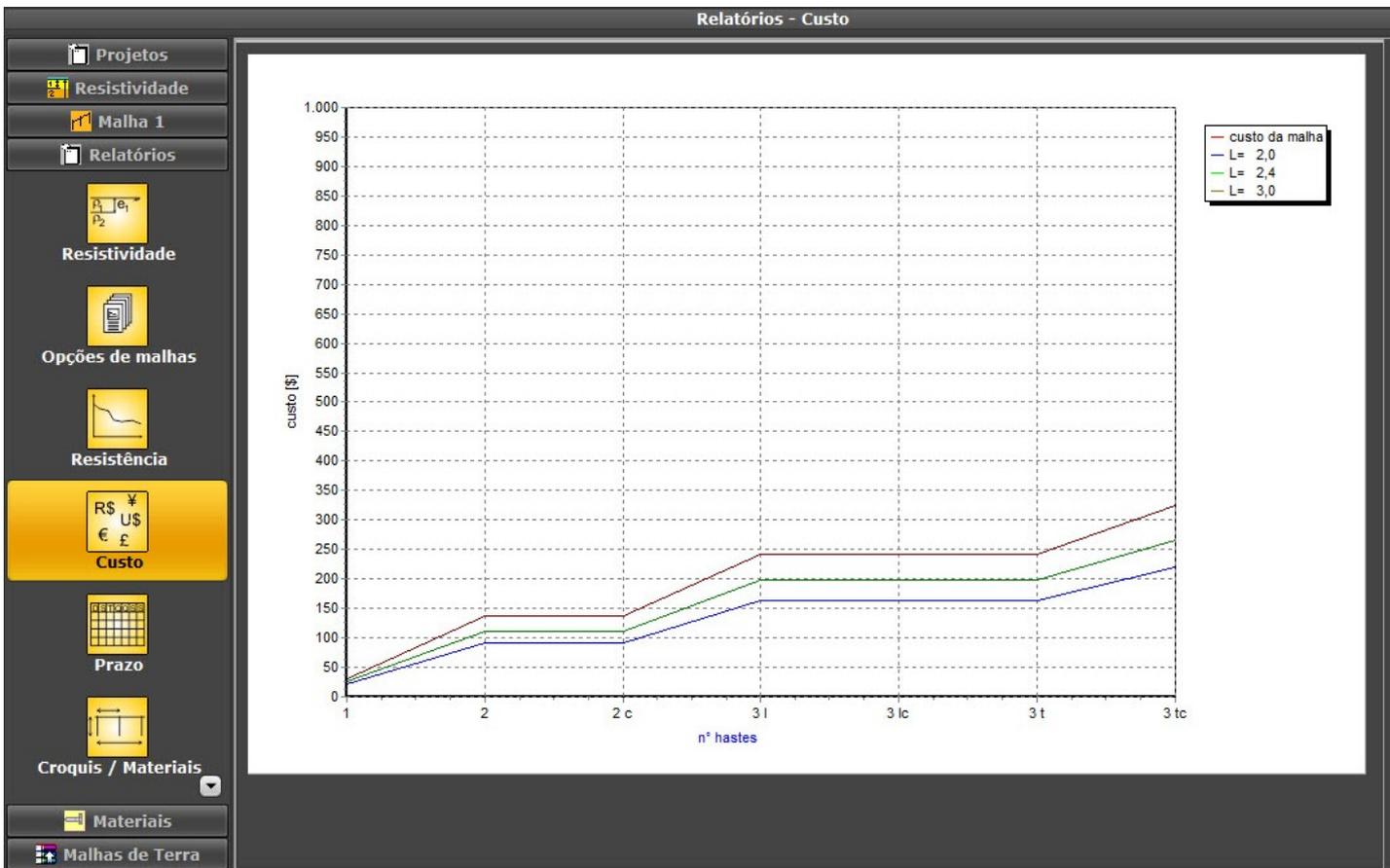
Configuração:	Parâmetro	Resist. [Ohm]	Custo [\$]	Tempo [h]
1 haste	haste 2 m	193,243	20,8	1
2 hastes sem cabo	haste 2 m	106,827	91,6	2
2 hastes com cabo	haste 2 m	93,2617	91,6	4
3 hastes em linha sem cabo	haste 2 m	75,5257	162,4	3
3 hastes em linha com cabo	haste 2 m	65,1777	162,4	7
3 hastes em triângulo sem cabo	haste 2 m	73,2737	162,4	7
3 hastes em triângulo com cabo	haste 2 m	68,6257	220,7	9,5
1 haste	haste 2,4 m	164,96	25,8	1
2 hastes sem cabo	haste 2,4 m	90,485	111,6	2
2 hastes com cabo	haste 2,4 m	78,614	111,6	4,4
3 hastes em linha sem cabo	haste 2,4 m	63,6692	197,4	3
3 hastes em linha com cabo	haste 2,4 m	54,5327	197,4	7,8
3 hastes em triângulo sem cabo	haste 2,4 m	62,0721	197,4	7,8
3 hastes em triângulo com cabo	haste 2,4 m	58,2525	265,7	10,7
1 haste	haste 3 m	133,852	30,8	1
2 hastes sem cabo	haste 3 m	72,7475	136,6	2
2 hastes com cabo	haste 3 m	62,9975	136,6	5
3 hastes em linha sem cabo	haste 3 m	50,9215	242,4	3
3 hastes em linha com cabo	haste 3 m	43,3102	242,4	9

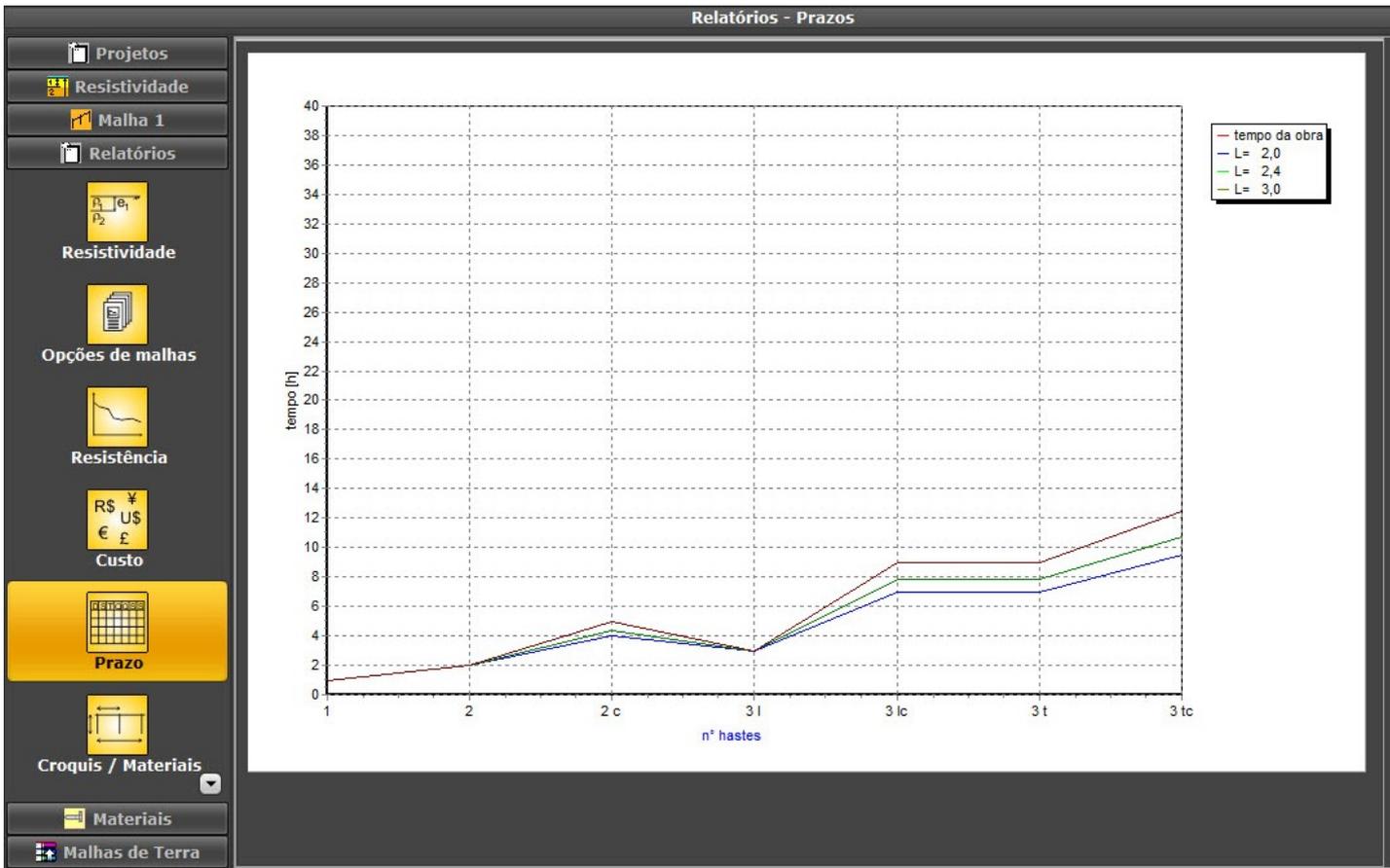
5. Chart reports

At the Resistances comparative chart, we can see the resistance for each of the 21 grids; the project resistance is plotted as a horizontal red line (if it doesn't show up it is because of the scale).



The Costs and Time comparative charts are analogous:





At the Menu bar, select Draft / Materials to choose one grid. Select the length and number of rods and click on Update to generate the draft and the table of materials of the chosen grid:

Relatórios - Esquema e Materiais

Selecione para gerar Lista de Materiais e Croquis: Configuração: haste 3 m Tamanho: 3 hastas em linha com cabo Atualizar

Croquis | Materiais

Diagram labels: p_1 , p_2 , e , ρ_1 , ρ_2 , h , b , c

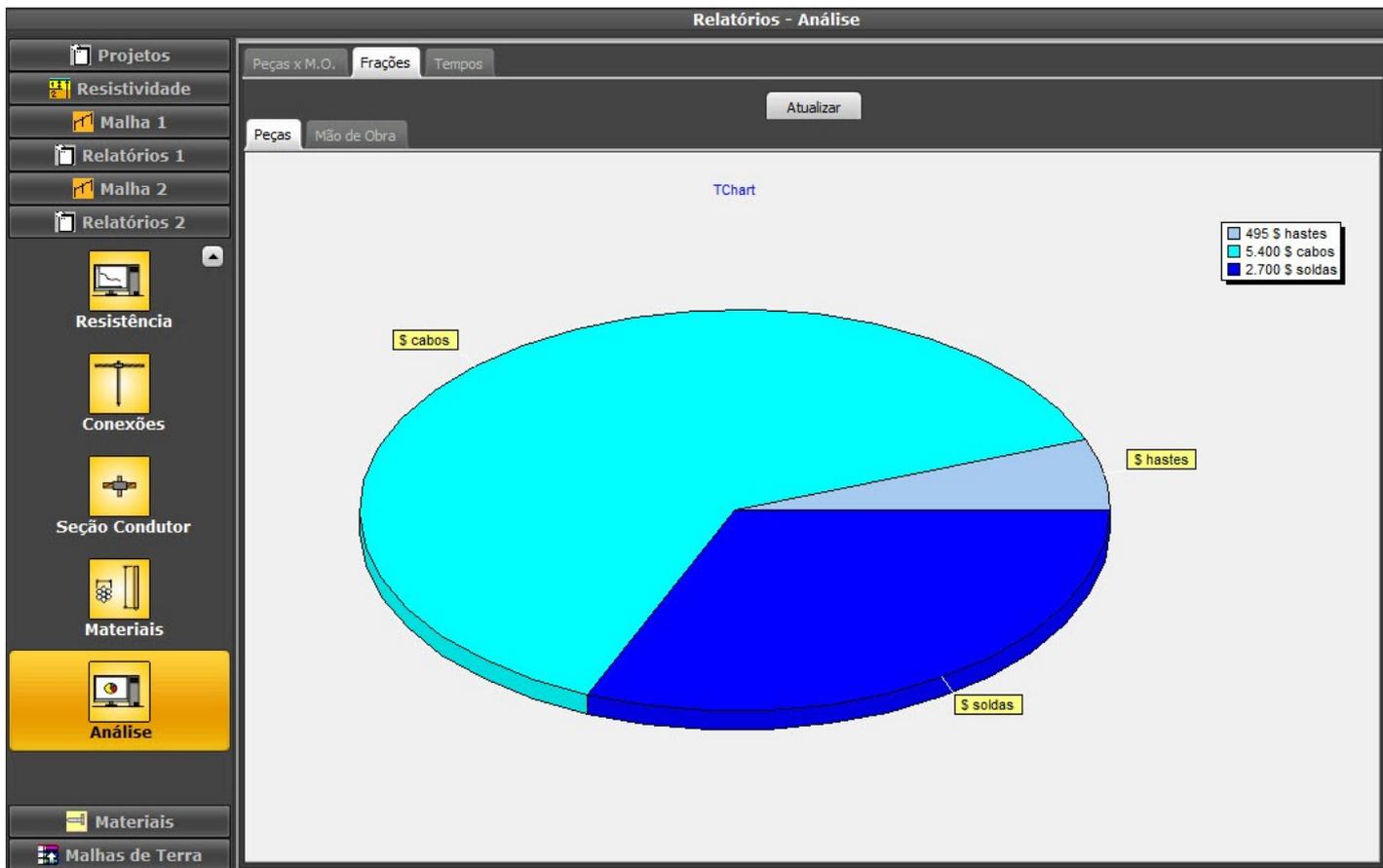
Lista de Materiais:

- 1 haste
- 2 hastas sem cabo
- 2 hastas com cabo
- 3 hastas em linha sem cabo
- 3 hastas em linha com cabo**
- 3 hastas em triângulo sem cabo
- 3 hastas em triângulo com cabo

$e = 2,9800$

Malha selecionada:

parâmetro	valor
P1 =	0,5000
P2 =	0,5000
b =	3,0000
h =	3,0000
c =	6,0000



7. Small grid

With our example data, even 3 rods with 3 meters length are not enough to reach the project resistance; then, we need to recalculate with a bigger area and/or more rods. With the same soil stratification, let's try grids with bigger dimensions - select Grid 1 / Small:

Projeto: Malha 1 - Pequena

Resistividade

Malha 1

Configuração

Pontual

Pequena

Edifício

Torre

Relatórios 1

Malha 2

Relatórios 2

Materiais

Malhas de Terra

Espaçamento das Hastes "b"

igual ao comprimento h delas

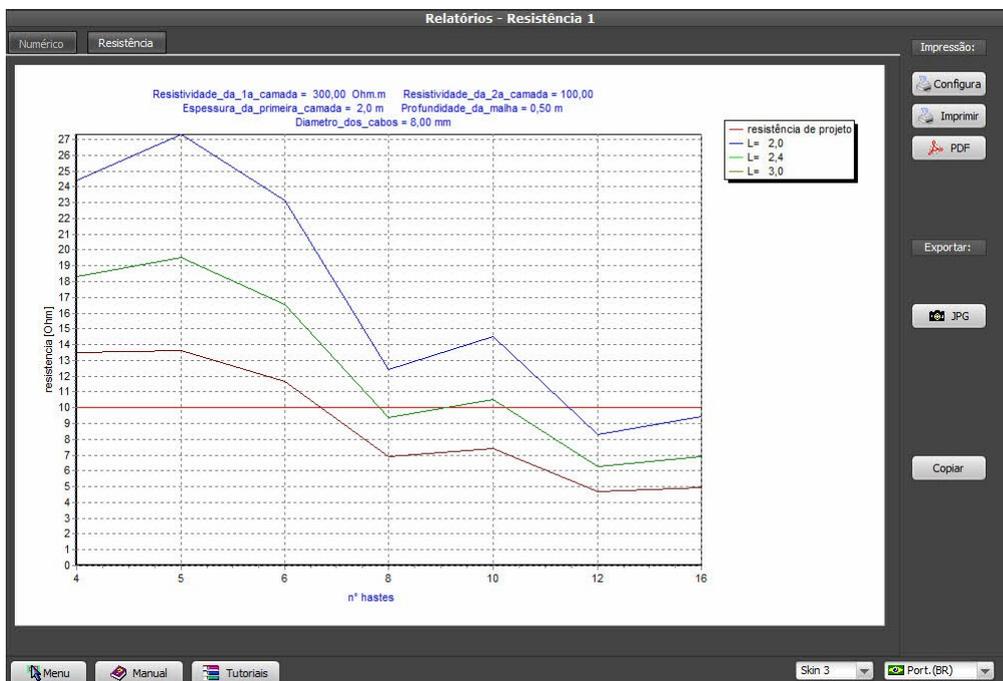
especificar abaixo

espaçamento b = m

Calcular

Malhas para sistemas pequenos, de 4 a 16 hastes, dispostas em quadrado (4, 8 e 12 hastes) ou em linha (5, 6, 10 e 16);

Let the spacing = length and click at Calculate:



Now we got some grid with resistance below the project specification! The choose between 8 rods of 3 meter length in square formation (a 6 meter square) or 10 rods in line (27 meters line) will be done according with costs and availability of space.

8. Building

Another available family of grids is the "Building", where we have a rectangular ring with zero to 16 rods:

Malha 1 - Edifício / Telecom

Resistividade

Malha 1

Configuração

Pontual

Pequena

Edifício

Torre

Comprimento c [m]:

Largura d [m]:

Configuração

A) anel com 0 a 16 hastes

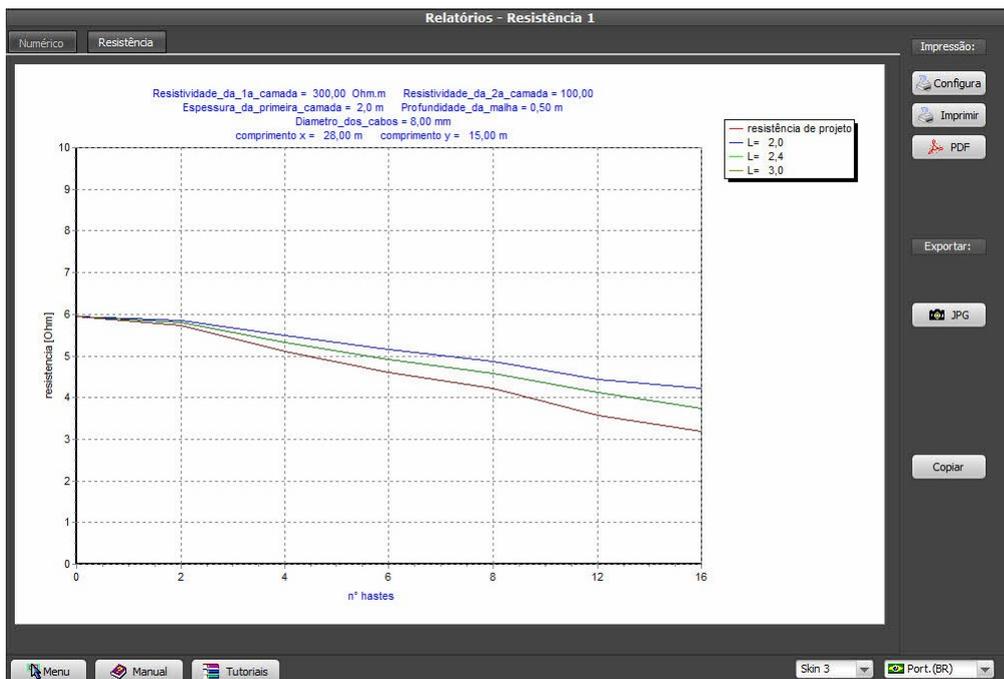
B) somente hastes

Configuração de malha usual para edifícios e outras construções retangulares;
 A opção "somente hastes" é utilizada quando não há condições de instalar um cabo ao redor da edificação; neste caso, as hastes devem estar interligadas por um condutor próximo ao solo, para poder considerar que fazem parte de uma única malha.

Note: it's called "Building" because is the logical grid for grounding the low voltage and lightning protection systems of most buildings, but, of course, it can be used anywhere.

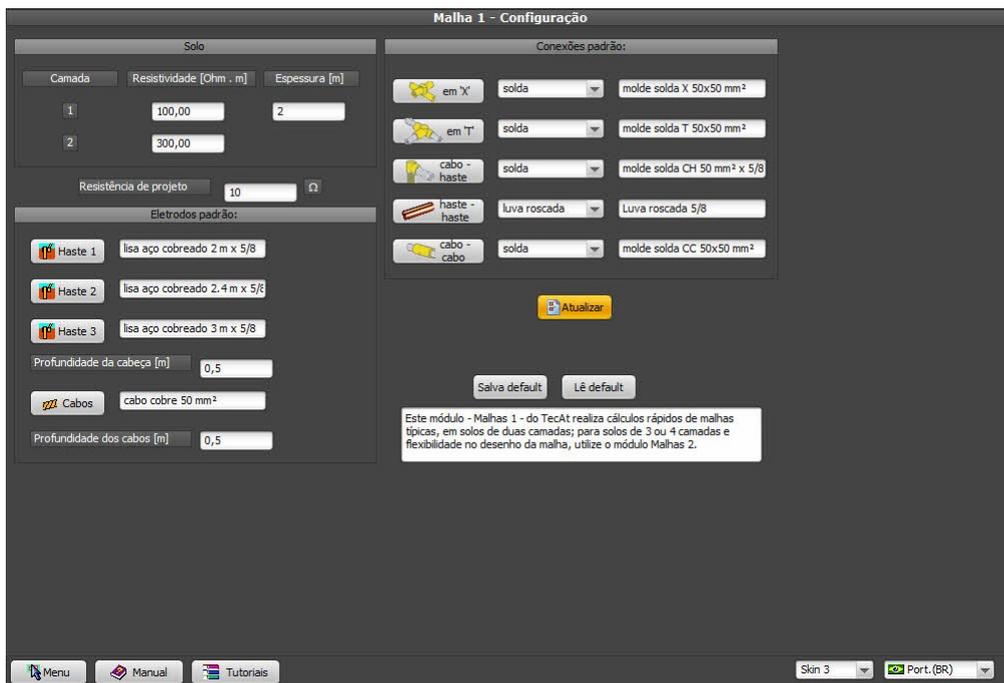
The data needed are the width and length of the rectangle. If there's no way to break the floor to install the cable at the soil, we still can calculate the grid with only the rods (configuration B)..

Keeping the soil of our example and option A (cable buried plus rods), we have:

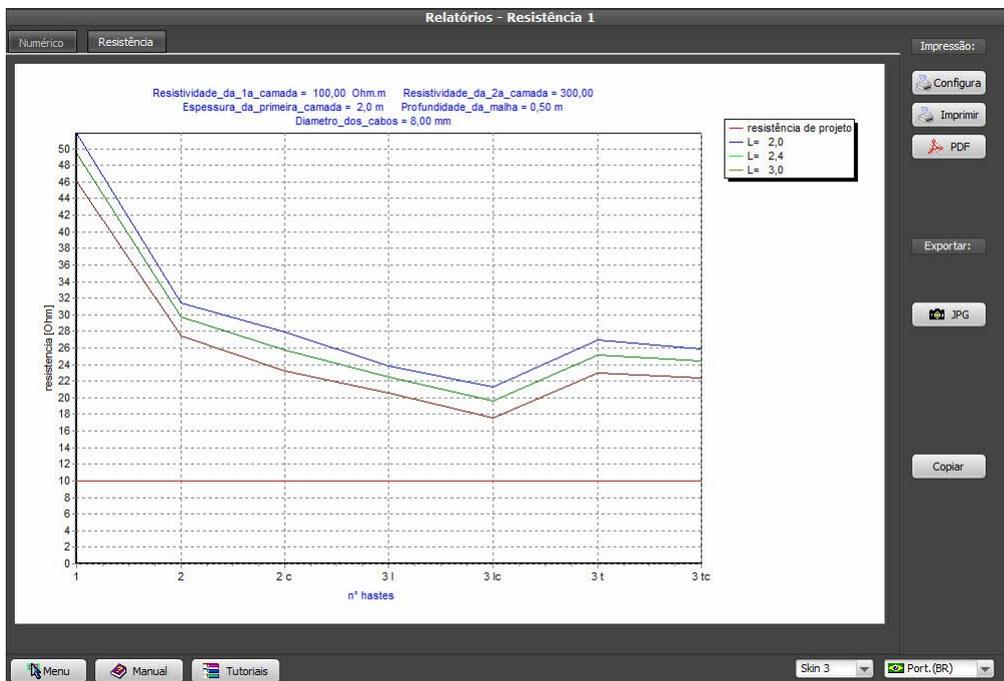


9. Influence of stratification

On the examples above, we used a soil with resistivity 300 Ohm.m at the first layer (with 2 meter depth) and 100 Ohm.m for the second layer; just to show the importance of the stratification, lets invert those values and recalculate:

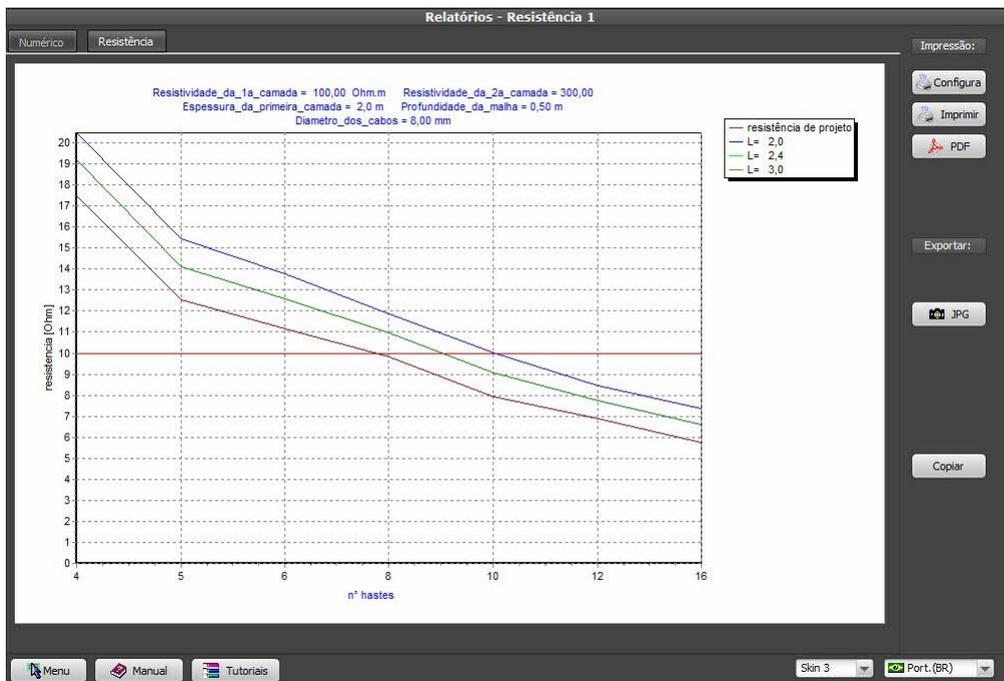


On the original example, a 2 meter rod buried at 0.5 meter depth had 3/4 of its length at the 300 Ohm.m soil and only half meter at the 100 Ohm.m; now we have the opposite, so we expect a better result - using Local model we get:

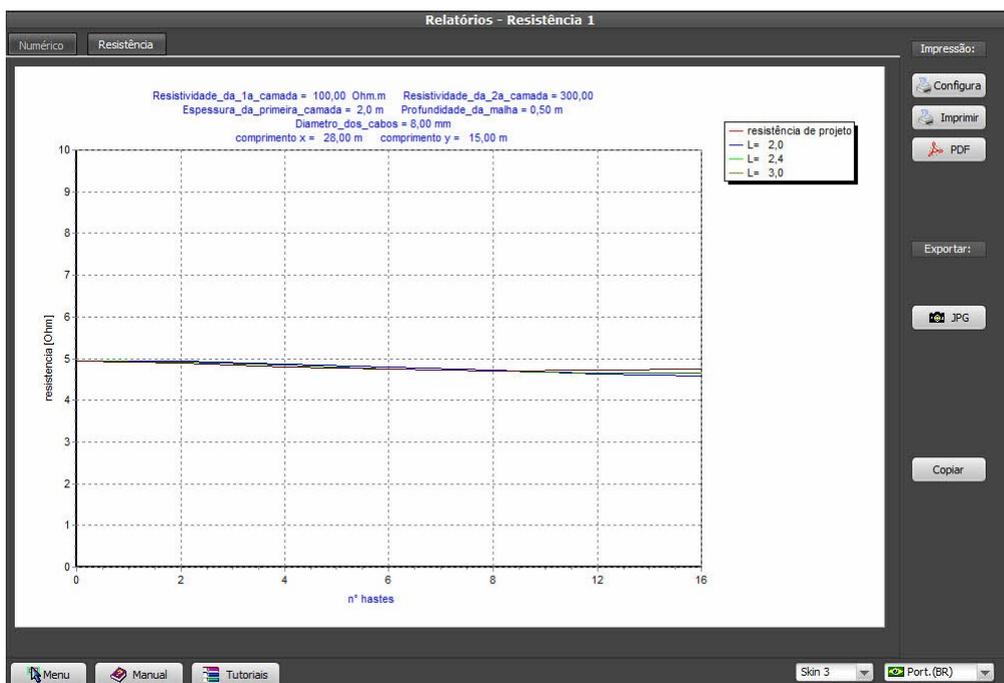


The same 2 meter rod that had over 130 Ohm resistance on the first soil, now presents 50 Ohm

Using the Small model, we have:



and, for Building:



As we can see:

- on a soil with greater resistivity on the second layer, the rods have smaller influence on big grids
- we must always run the stratification, as using an average number for the resistivity (as in manual methods of grid calculation) of the terrain will give a potentially huge error.