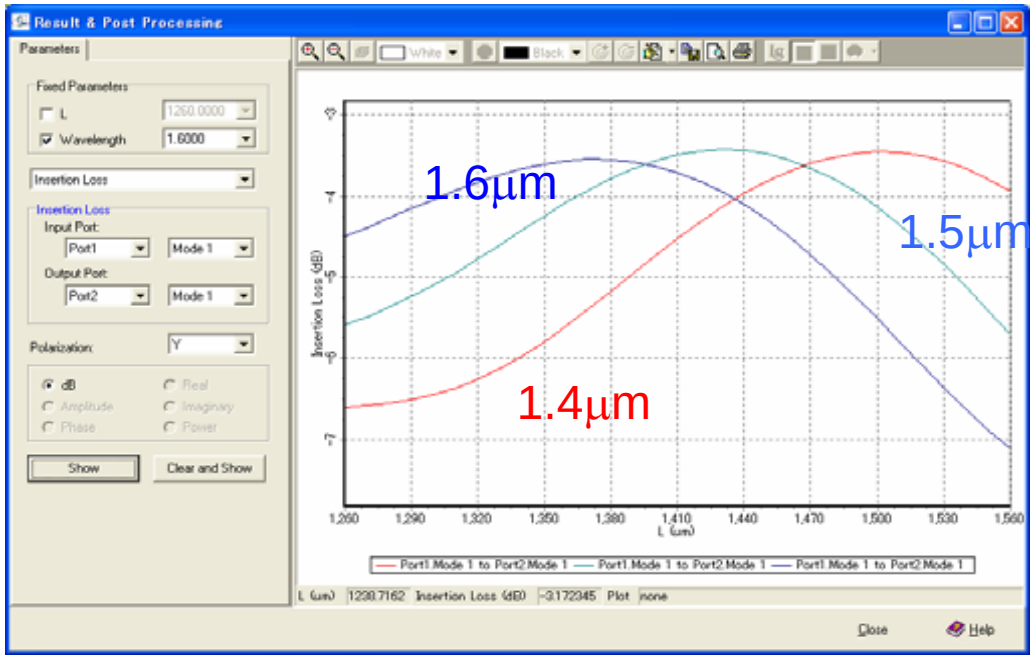
実習7．MMIの設計

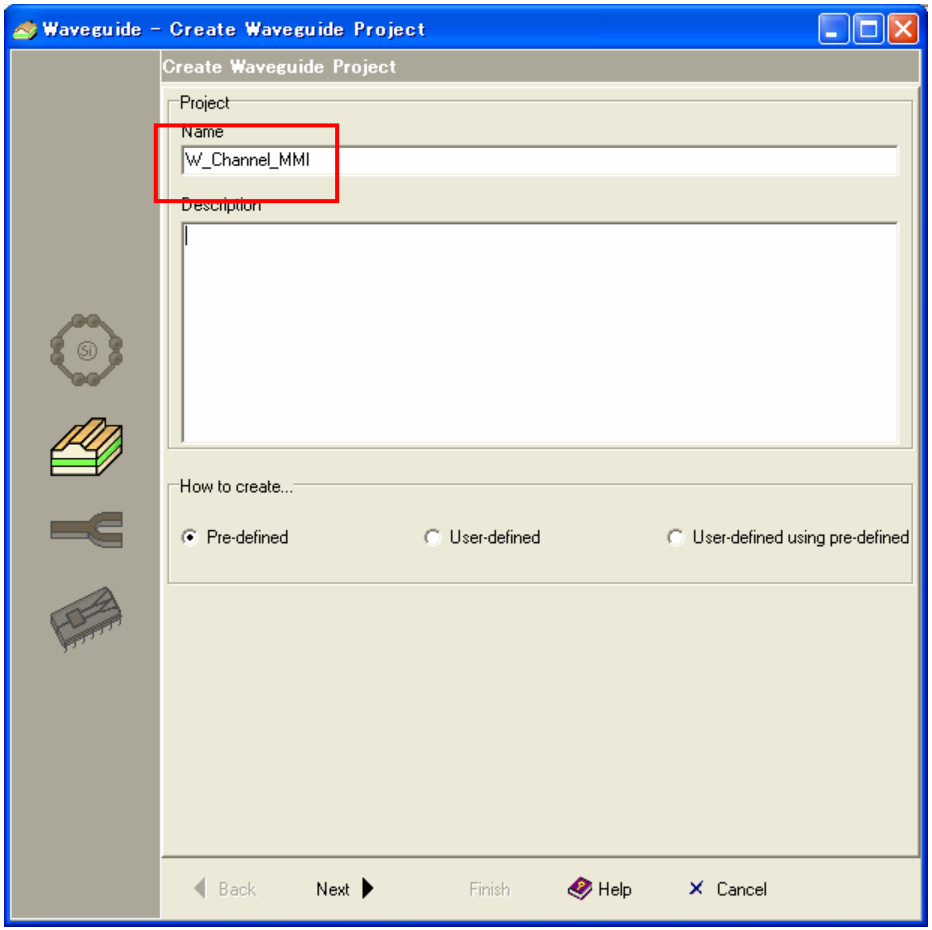
指定帯域でのパワー分岐

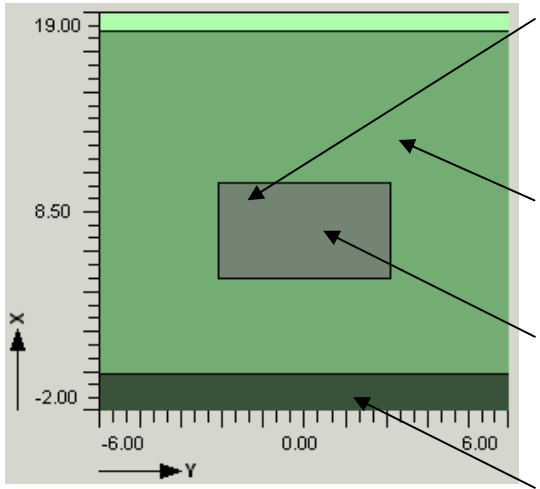


Noah Consulting Limited

MMIを構成する導波路 W_Channel_MMI

1.4μm ～ 1.6μm





チャンネル5μm□

波長 1.5μm

純粋シリカ
n=1.444618

6.3% GeO2 **のシリカ**
n=1.454052

シリコン, n=3.5

導波路

図1．導波路プロジェクトの作成

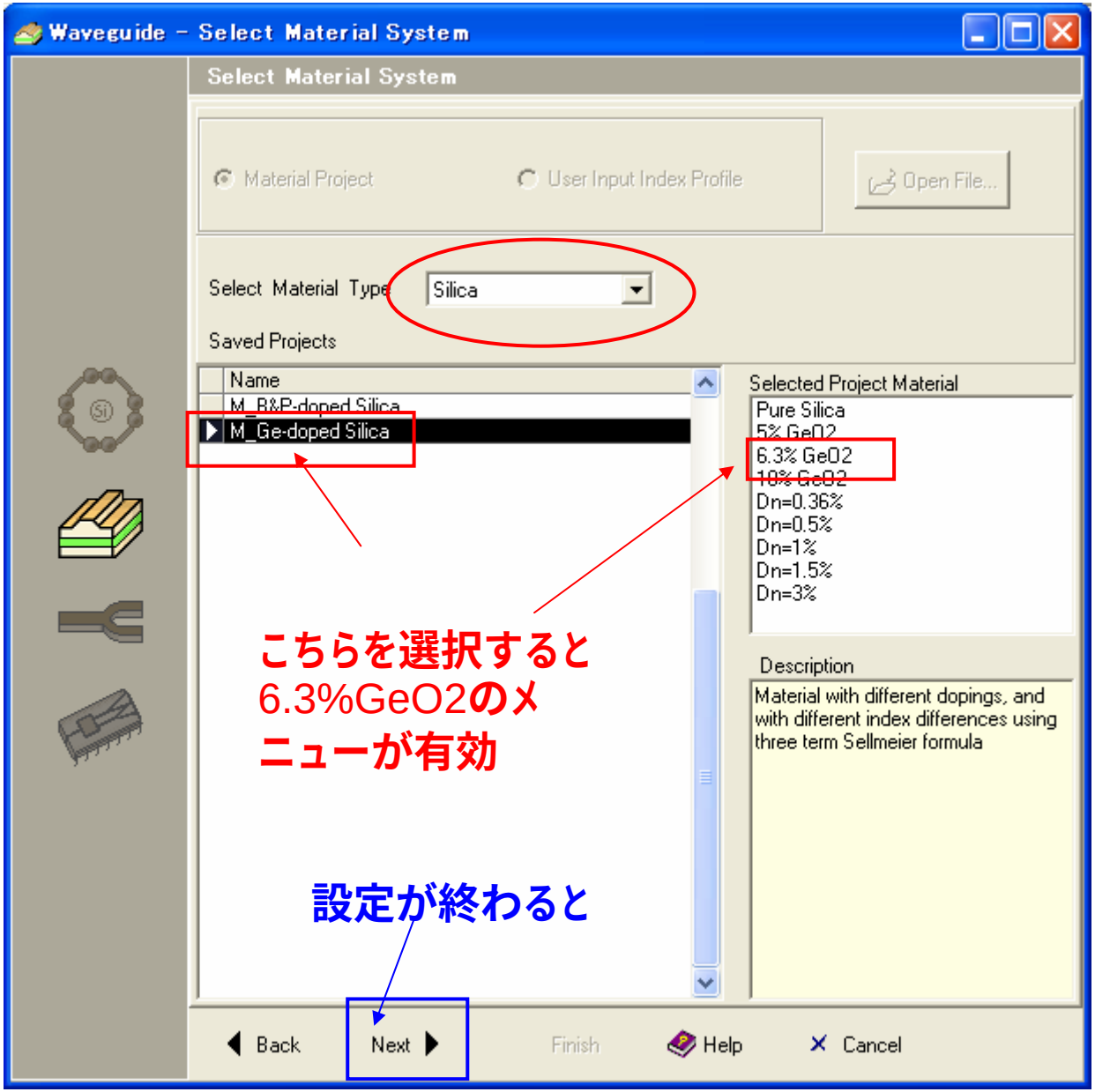

Waveguide – Select Material System
Select Material System
Material Project
User Input Index Profile
Open File...
Select Material Type
Silica
Saved Projects
Name
M_B&P-doped Silica
M_Ge-doped Silica
Selected Project Material
Pure Silica
5% GeO2
6.3% GeO2
10% GeO2
Dn=0.36%
Dn=0.5%
Dn=1%
Dn=1.5%
Dn=3%
Description
Material with different dopings, and with different index differences using three term Sellmeier formula
こちらを選択すると
6.3%GeO2のメ
ニューが有効
設定が終わると
Back
Next
Finish
Help
Cancel

図2．材料選択

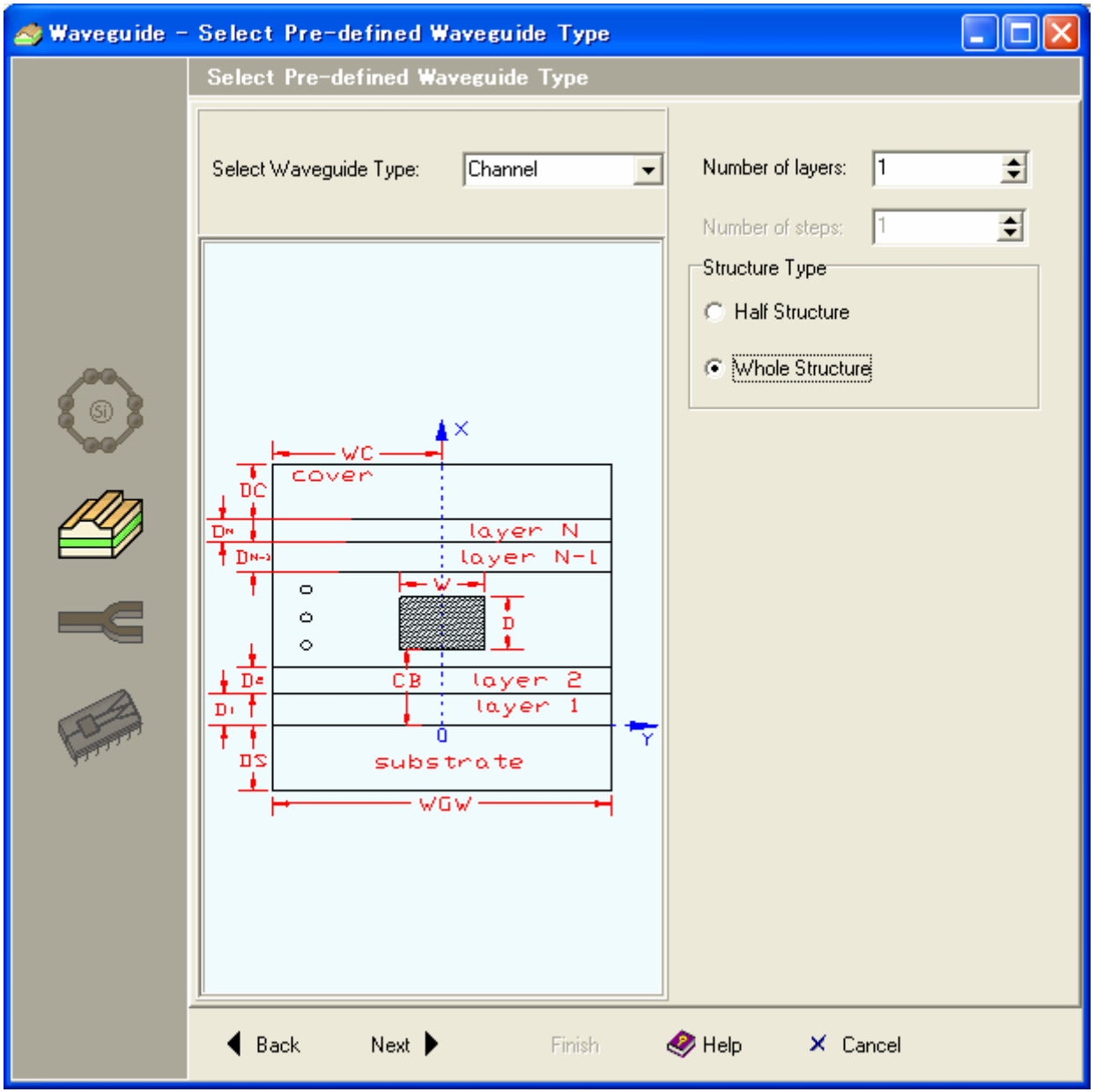

Waveguide - Select Pre-defined Waveguide Type
Select Pre-defined Waveguide Type
Select Waveguide Type:
Channel
Number of layers:
1
Number of steps:
1
Structure Type
Half Structure
Whole Structure
WC
cover
DC
layer N
layer N-1
W
D
CB
layer 2
layer 1
substrate
WGW
Back
Next
Finish
Help
Cancel

図3．導波路構造選択

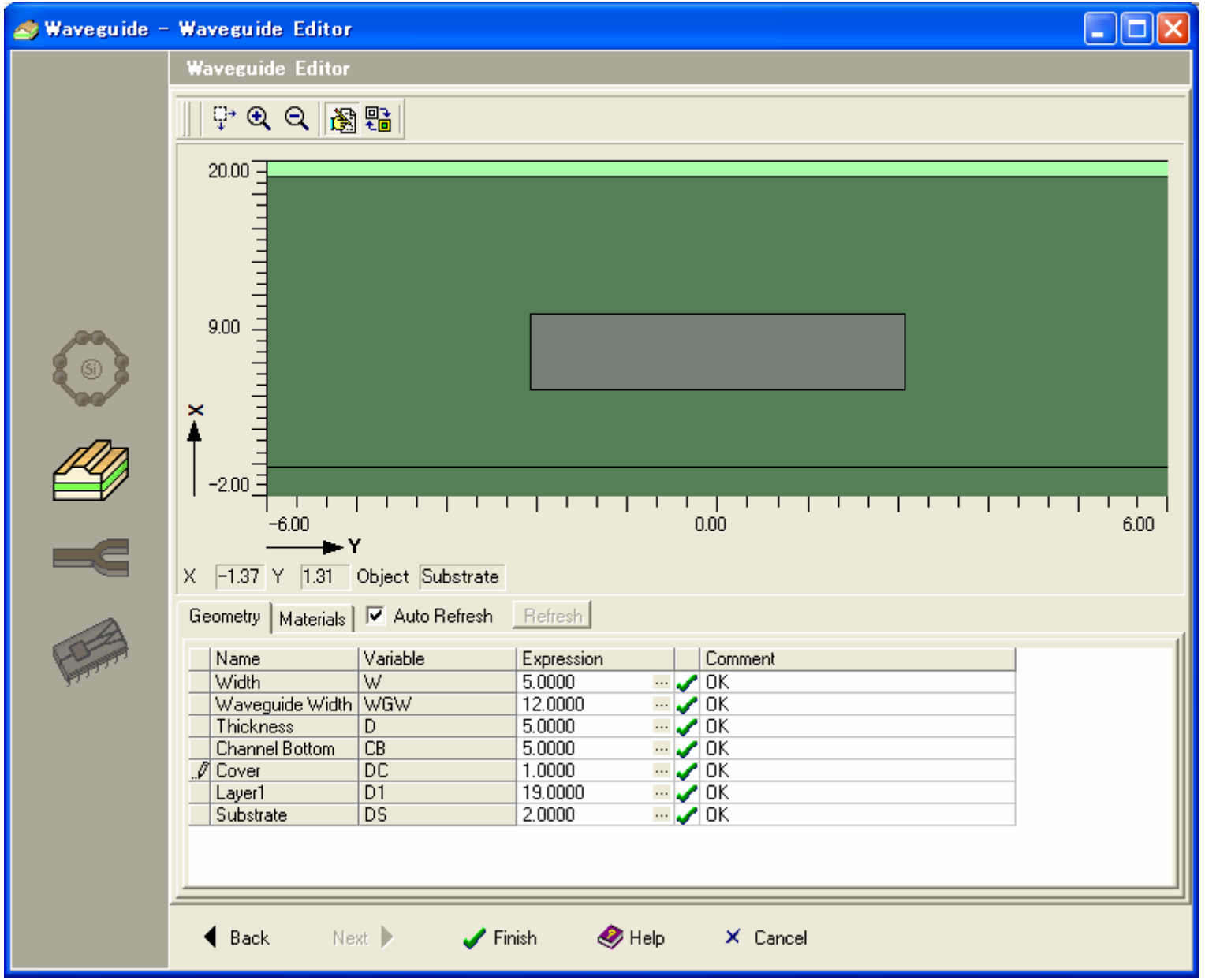


図4. 導波路構造定義 (寸法)

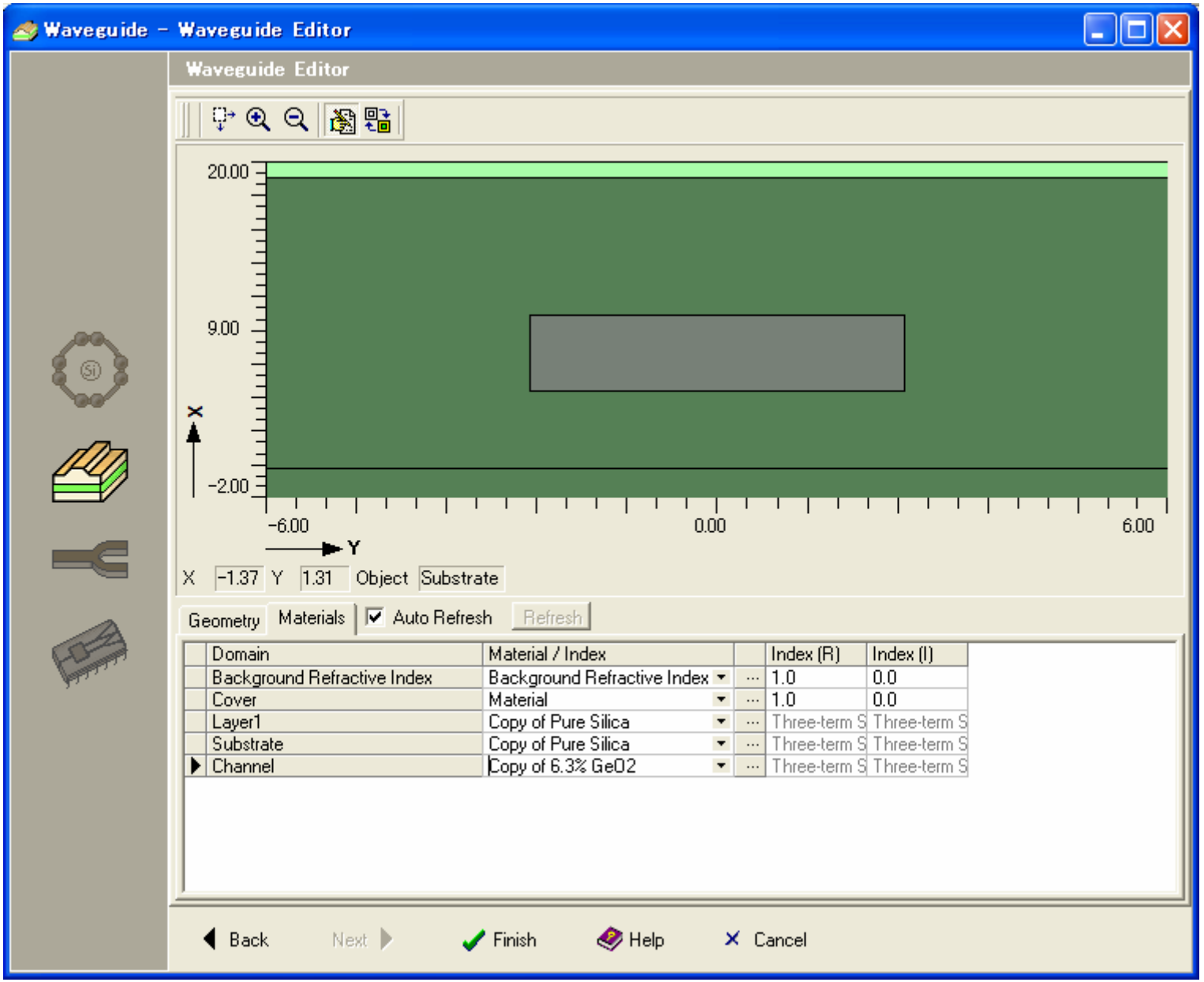

Waveguide – Waveguide Editor
Waveguide Editor
20.00
9.00
-2.00
-6.00
0.00
6.00
X
Y
X -1.37 Y 1.31 Object Substrate
Geometry
Materials
Auto Refresh
Refresh
Domain
Material / Index
Index (R)
Index (I)
Background Refractive Index
Background Refractive Index
1.0
0.0
Cover
Material
1.0
0.0
Layer1
Copy of Pure Silica
Substrate
Copy of Pure Silica
Channel
Copy of 6.3% GeO2
Back
Next
Finish
Help
Cancel

図5．導波路屈折率設定

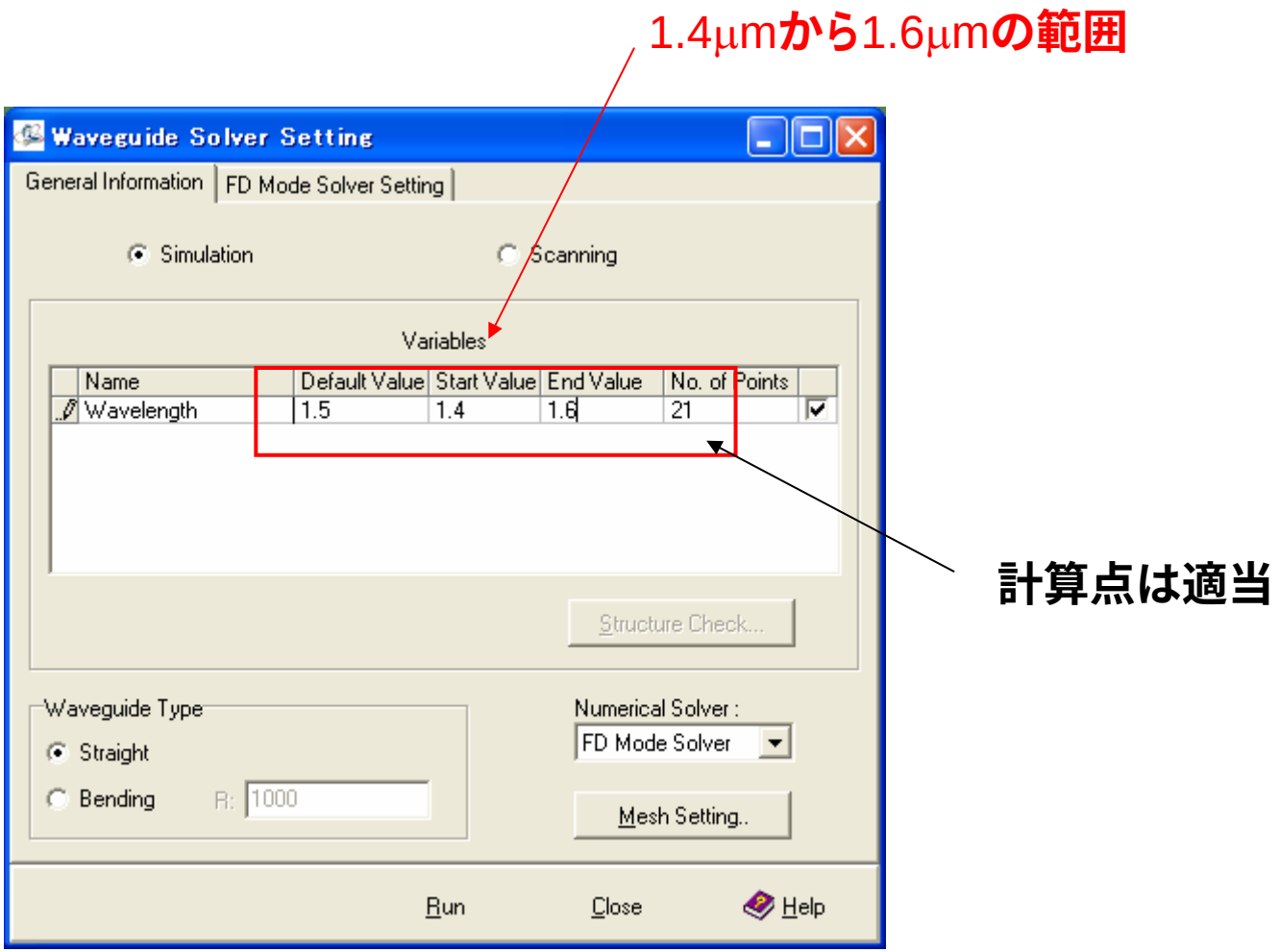

1.4μmから1.6μmの範囲
Waveguide Solver Setting
General Information
FD Mode Solver Setting
Simulation
Scanning
Variables
Name
Default Value
Start Value
End Value
No. of Points
Wavelength
1.5
1.4
1.6
21
Structure Check...
計算点は適当
Waveguide Type
Straight
Bending
R:
1000
Numerical Solver :
FD Mode Solver
Mesh Setting..
Run
Close
Help

図6．波長範囲の設定

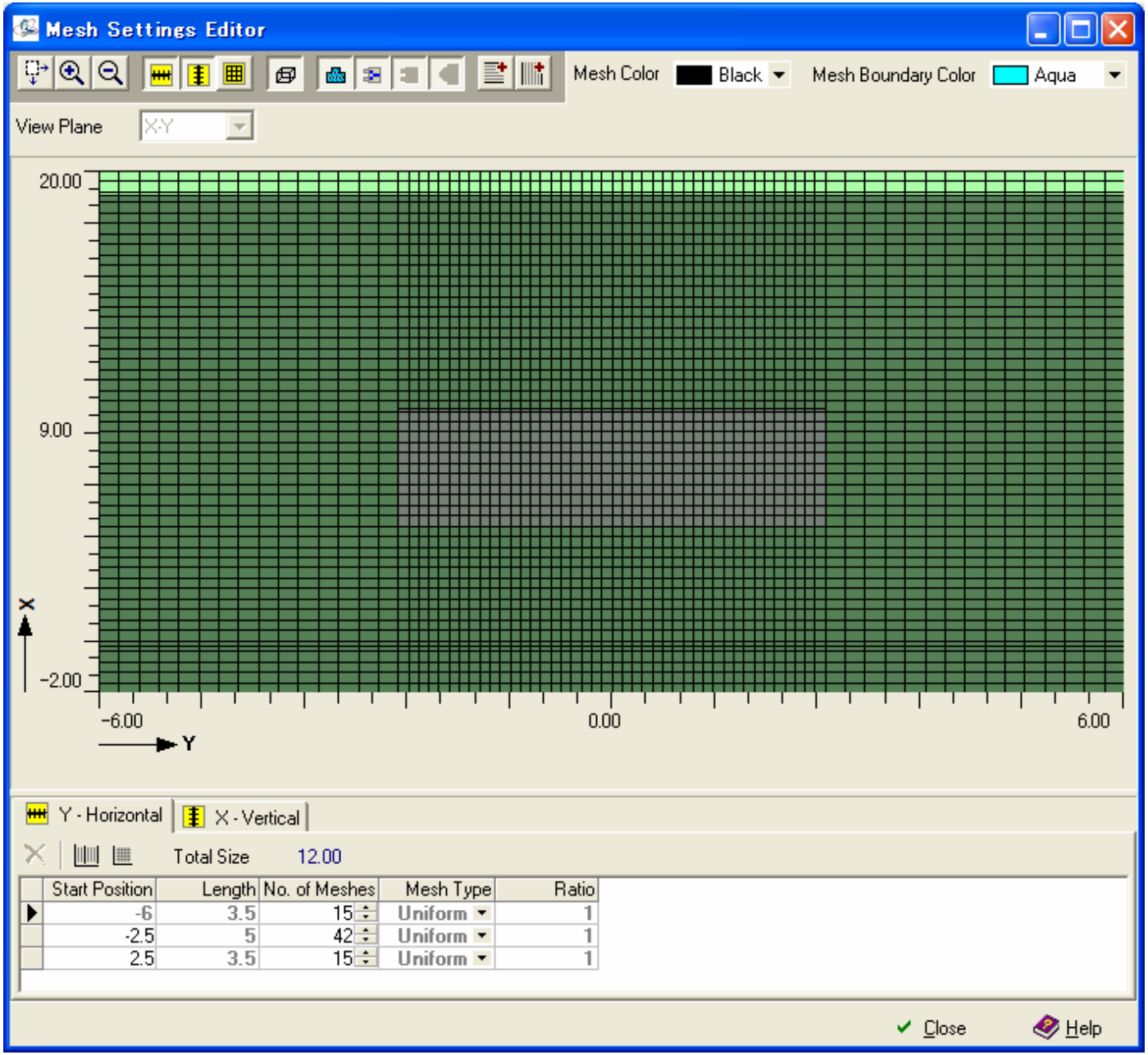

Mesh Settings Editor
Mesh Color
Black
Mesh Boundary Color
Aqua
View Plane
X-Y
20.00
9.00
-2.00
X
-6.00
0.00
6.00
Y
Y - Horizontal
X - Vertical
Total Size
12.00
Start Position
Length
No. of Meshes
Mesh Type
Ratio
-6
3.5
15
Uniform
1
-2.5
5
42
Uniform
1
2.5
3.5
15
Uniform
1
Close
Help

図7．Y（横）方向メッシュ

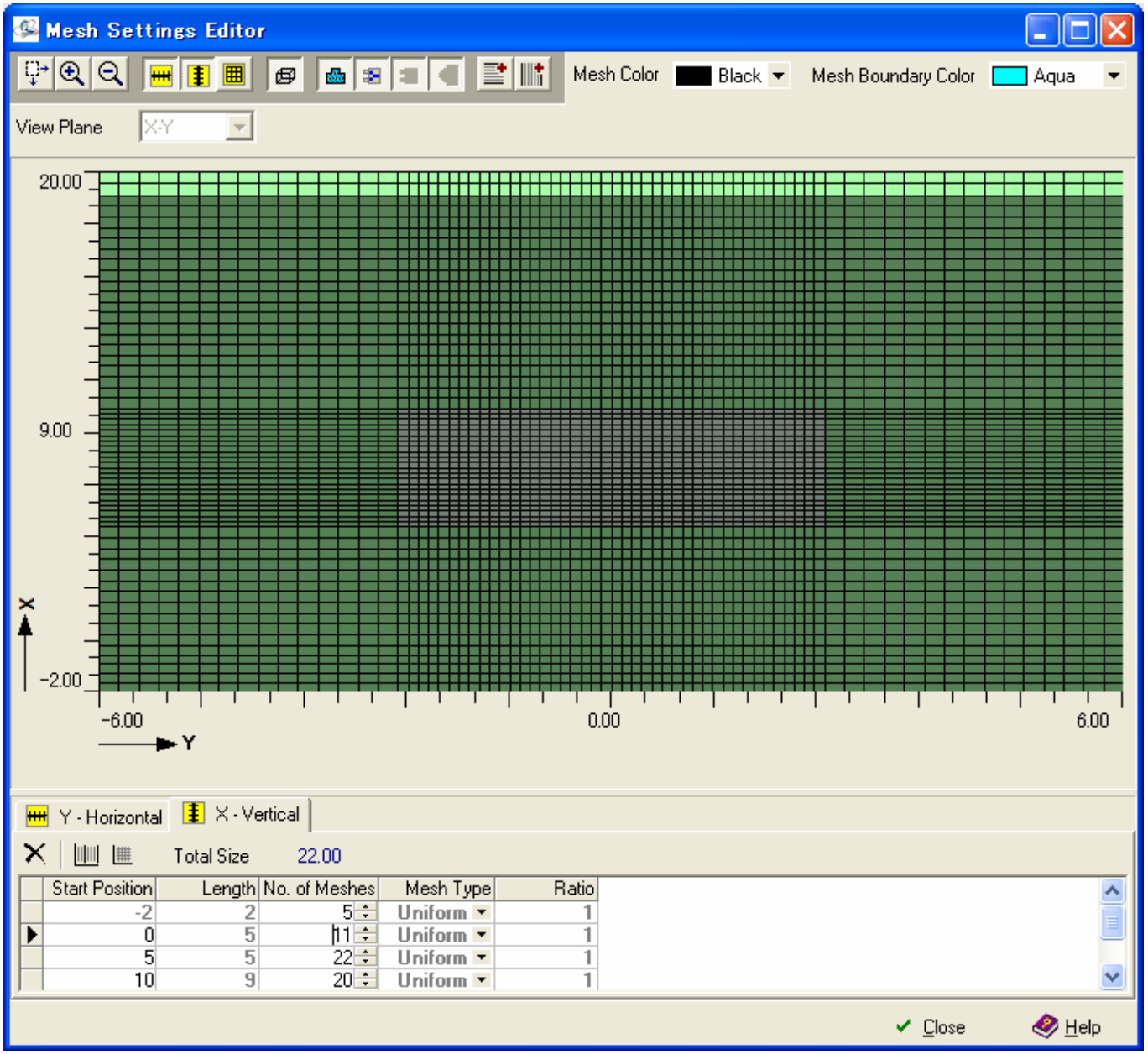

Mesh Settings Editor
Mesh Color
Black
Mesh Boundary Color
Aqua
View Plane
X-Y
20.00
9.00
-2.00
X
-6.00
0.00
6.00
Y
Y - Horizontal
X - Vertical
Total Size
22.00
Start Position
Length
No. of Meshes
Mesh Type
Ratio
-2
2
5
Uniform
1
0
5
11
Uniform
1
5
5
22
Uniform
1
10
9
20
Uniform
1
Close
Help

図8．X（縦）方向メッシュ

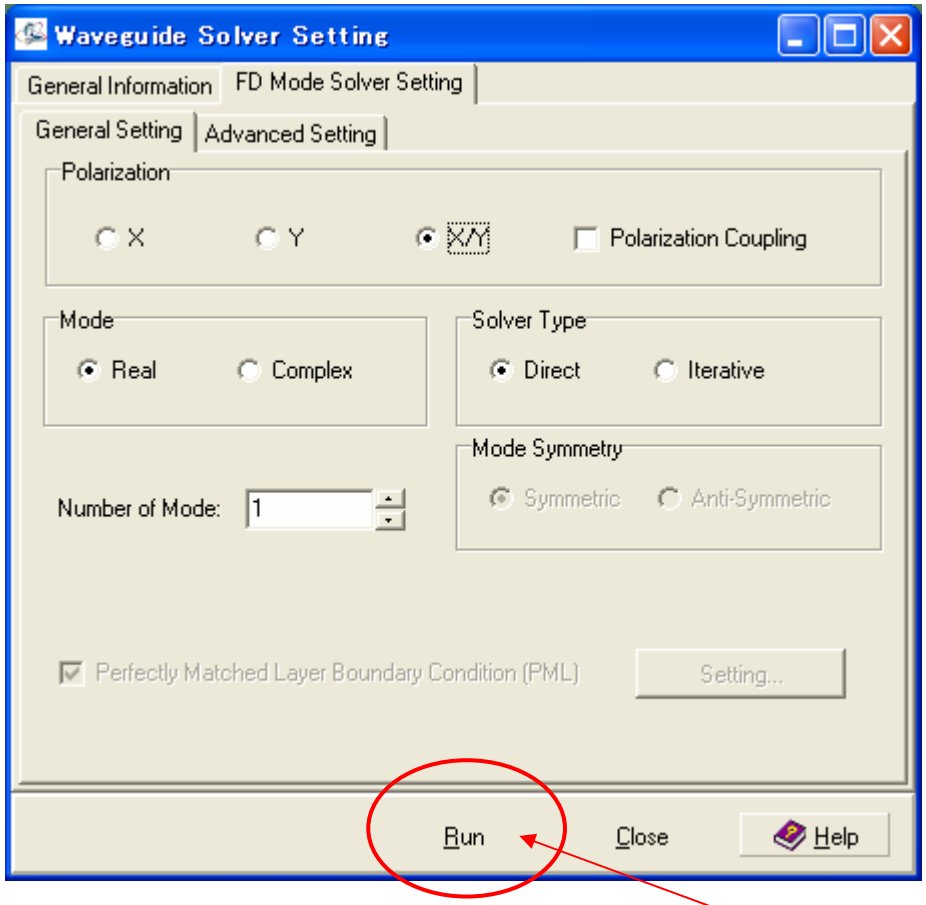


図9．偏波選択

構造的には偏波依存が無い導波路構造としているが、ここでは練習のために両偏波での計算を選択した。

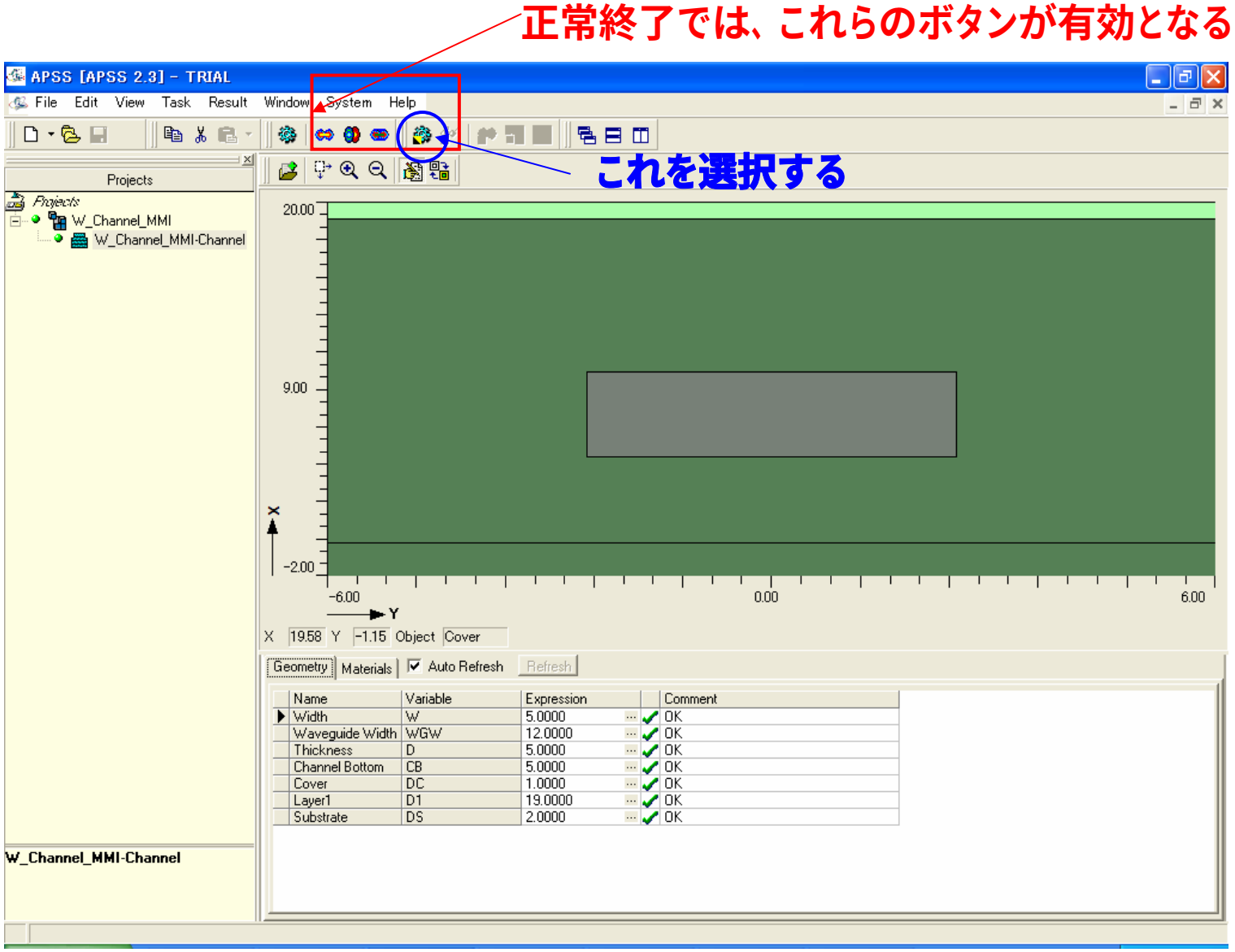

正常終了では、これらのボタンが有効となる
これを選択する
APSS [APSS 2.3] - TRIAL
File Edit View Task Result Window System Help
Projects
W_Channel_MMI
W_Channel_MMI-Channel
20.00
9.00
-2.00
-6.00
0.00
6.00
X
Y
X 19.58 Y -1.15 Object Cover
Geometry Materials Auto Refresh Refresh
Name Variable Expression Comment
Width W 5.0000 OK
Waveguide Width WGW 12.0000 OK
Thickness D 5.0000 OK
Channel Bottom CB 5.0000 OK
Cover DC 1.0000 OK
Layer1 D1 19.0000 OK
Substrate DS 2.0000 OK
W_Channel_MMI-Channel

図10．実行後の画面

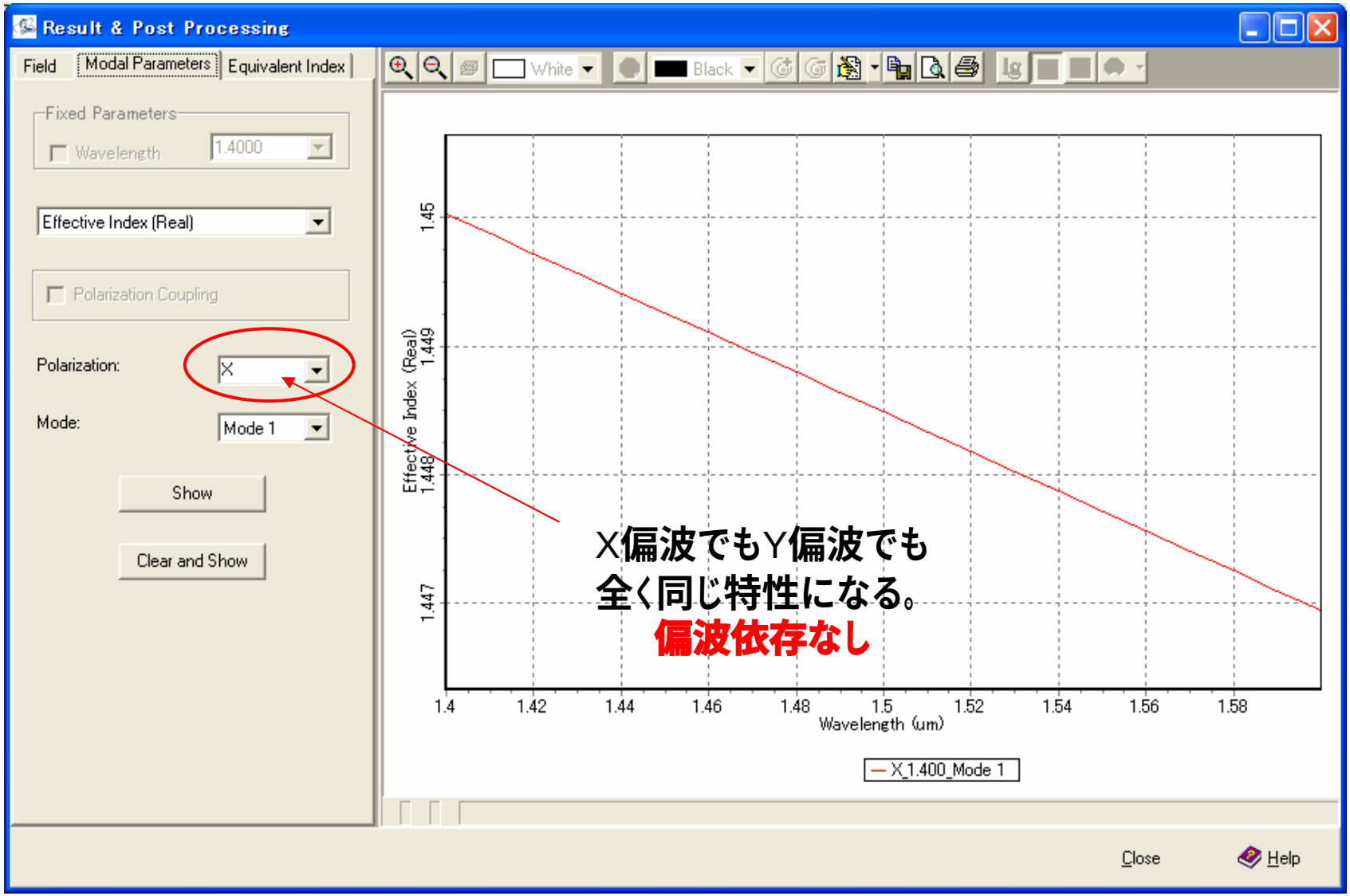


図11．波長と等価屈折率

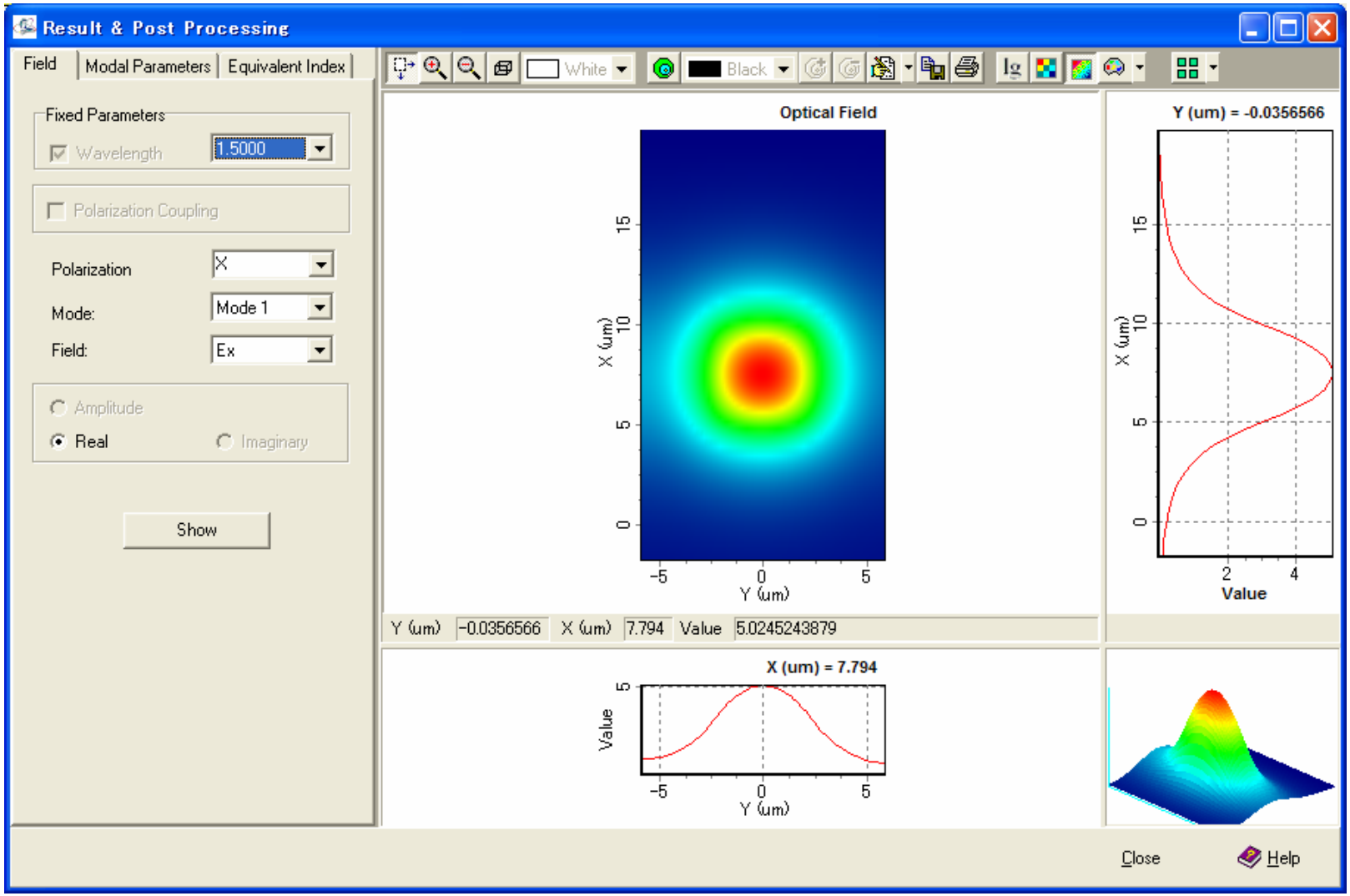


図12．フィールド分布(@1.5μm)

ここまでが導波路設計

ここからデバイス設計

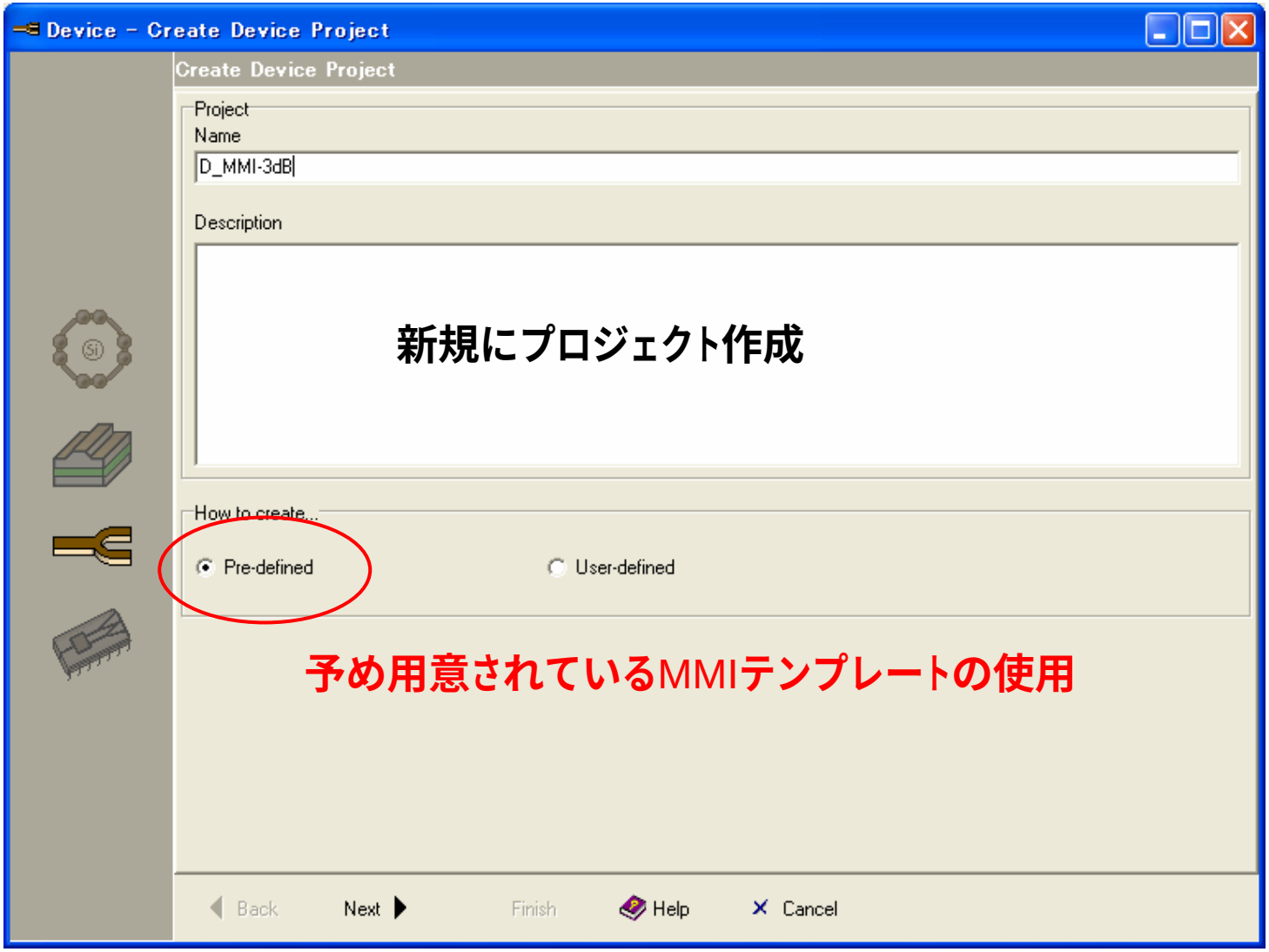


図１３．D_MMI-3dBのデバイスプロジェクト作成

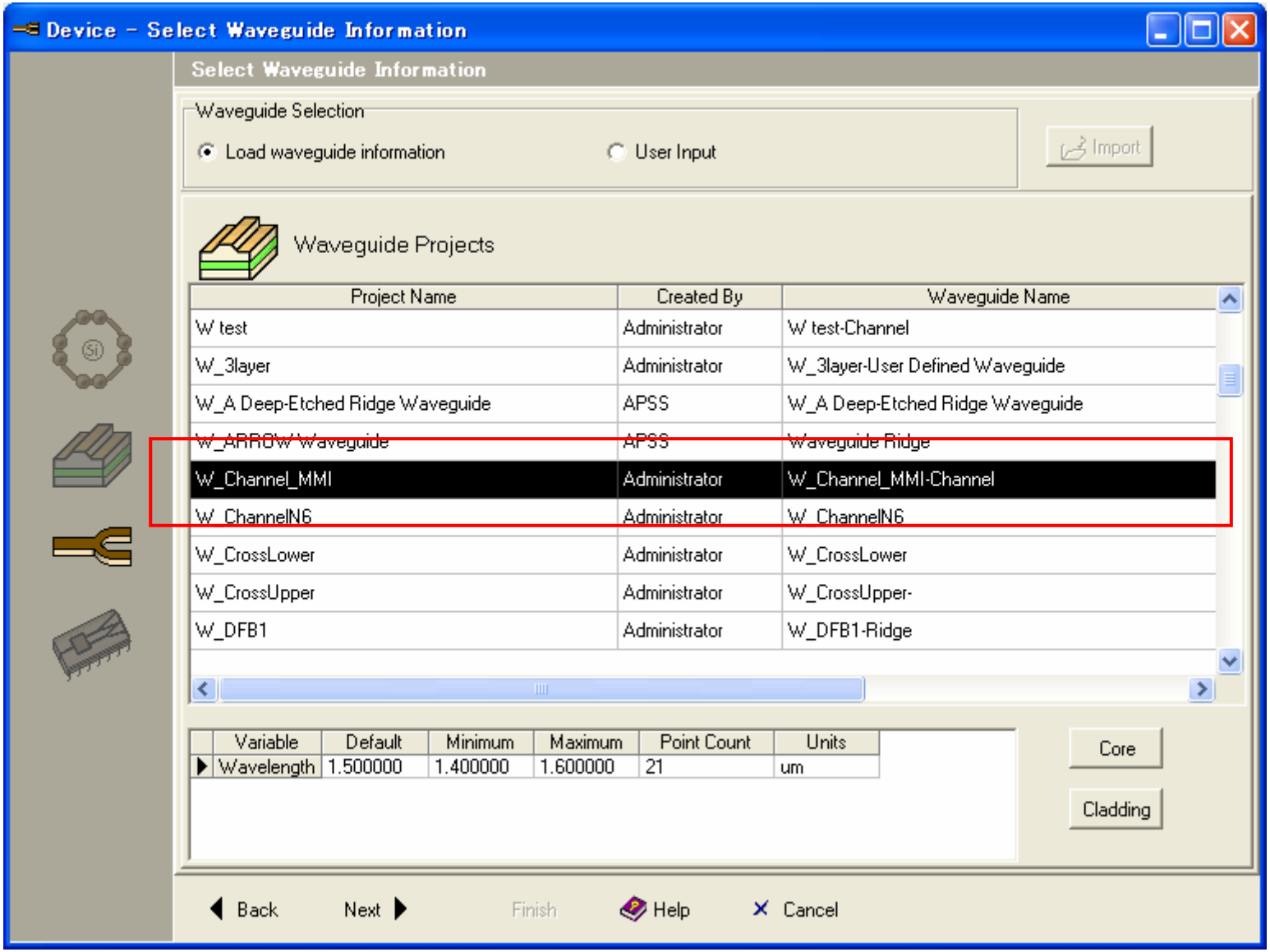


図１４．作成済みの導波路プロジェクトの選択

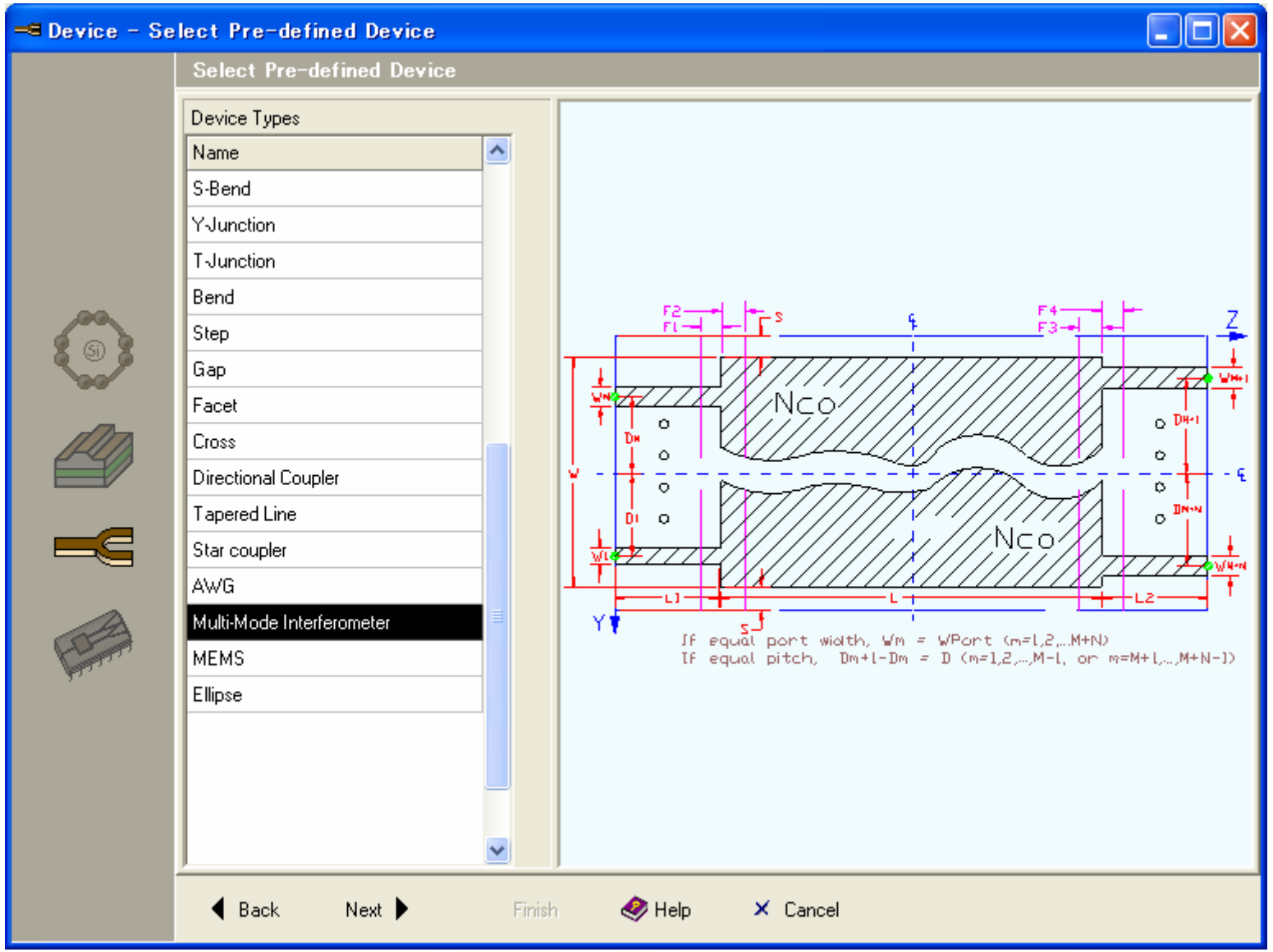


図１５．作成済みの導波路プロジェクトの選択

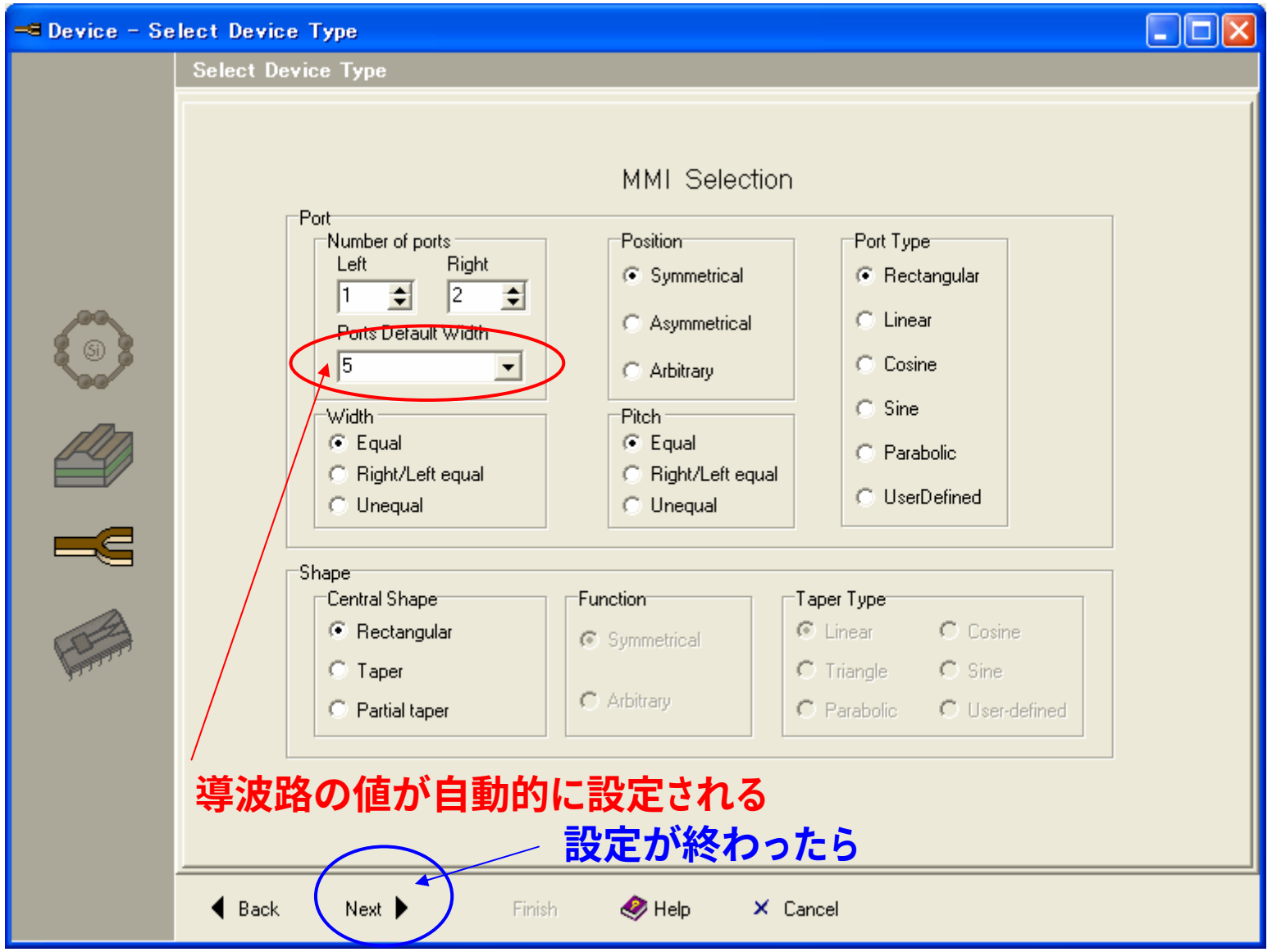


図16．対称型MMIの選択

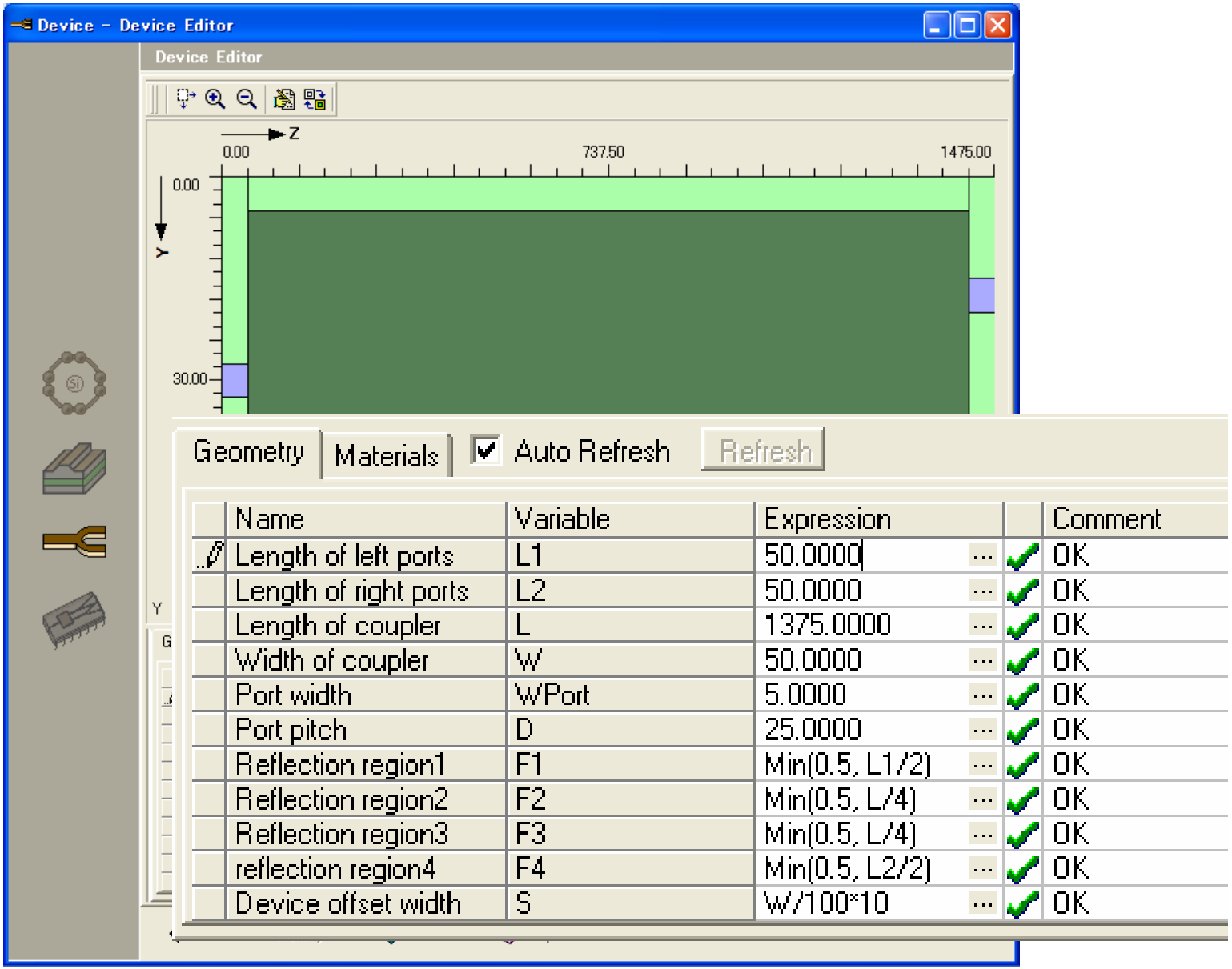


図17. MMIの寸法定義

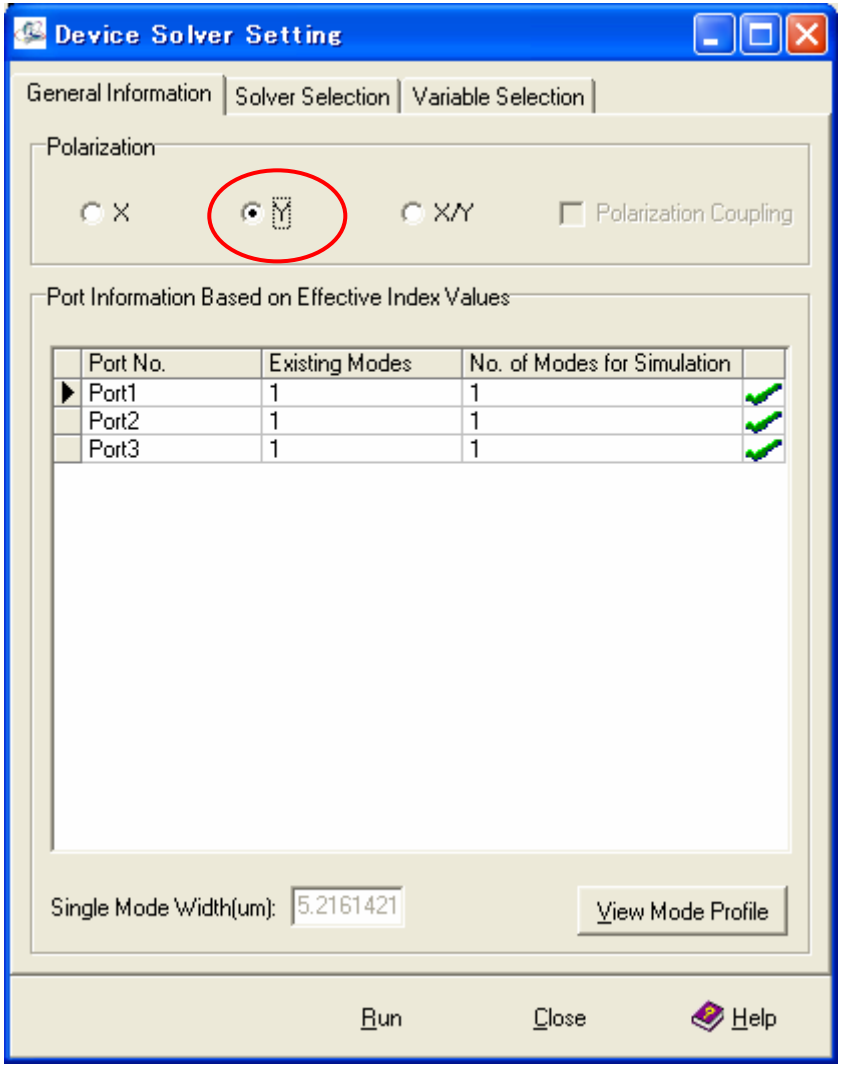


図17. TEモードの解析

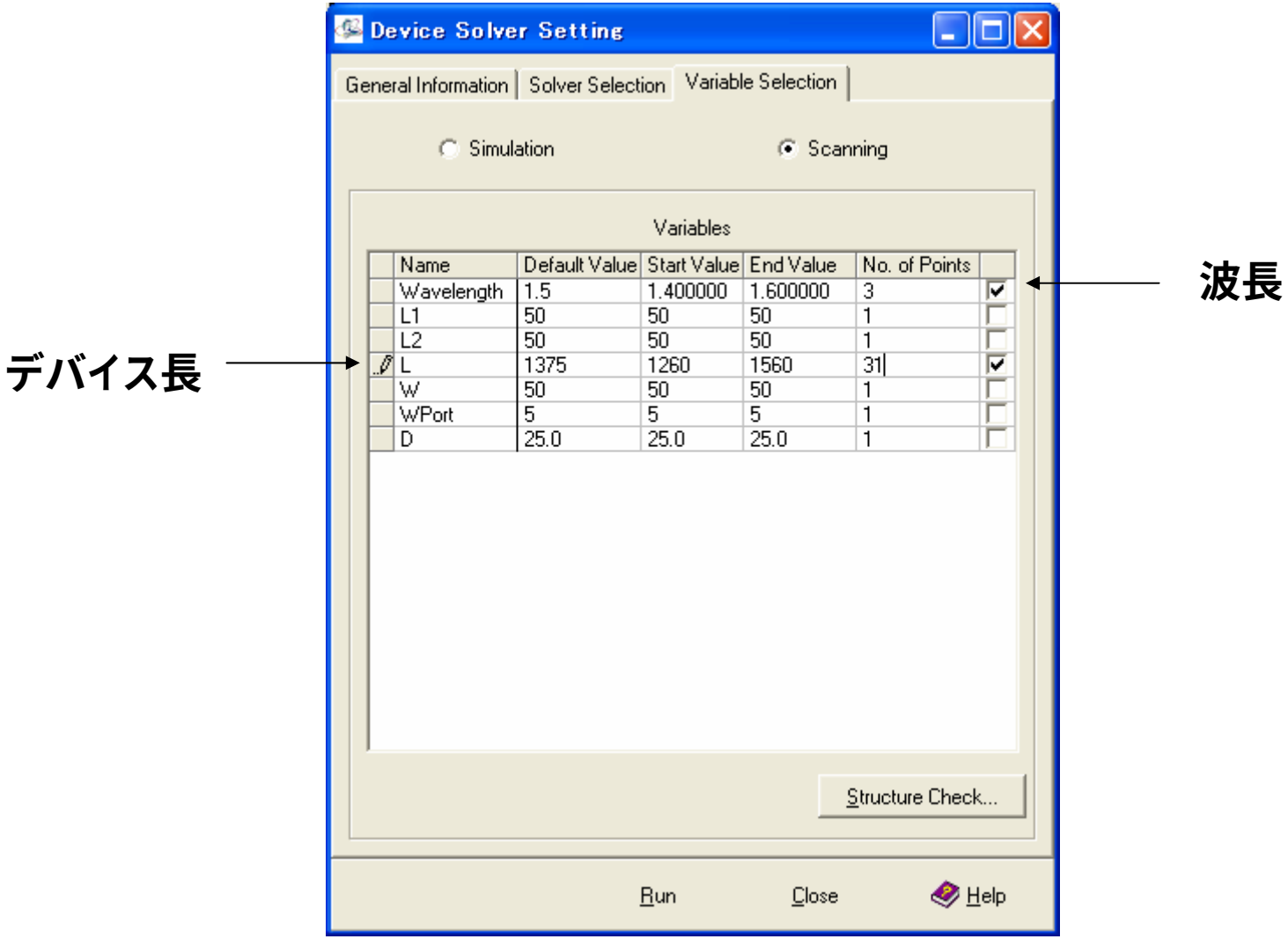
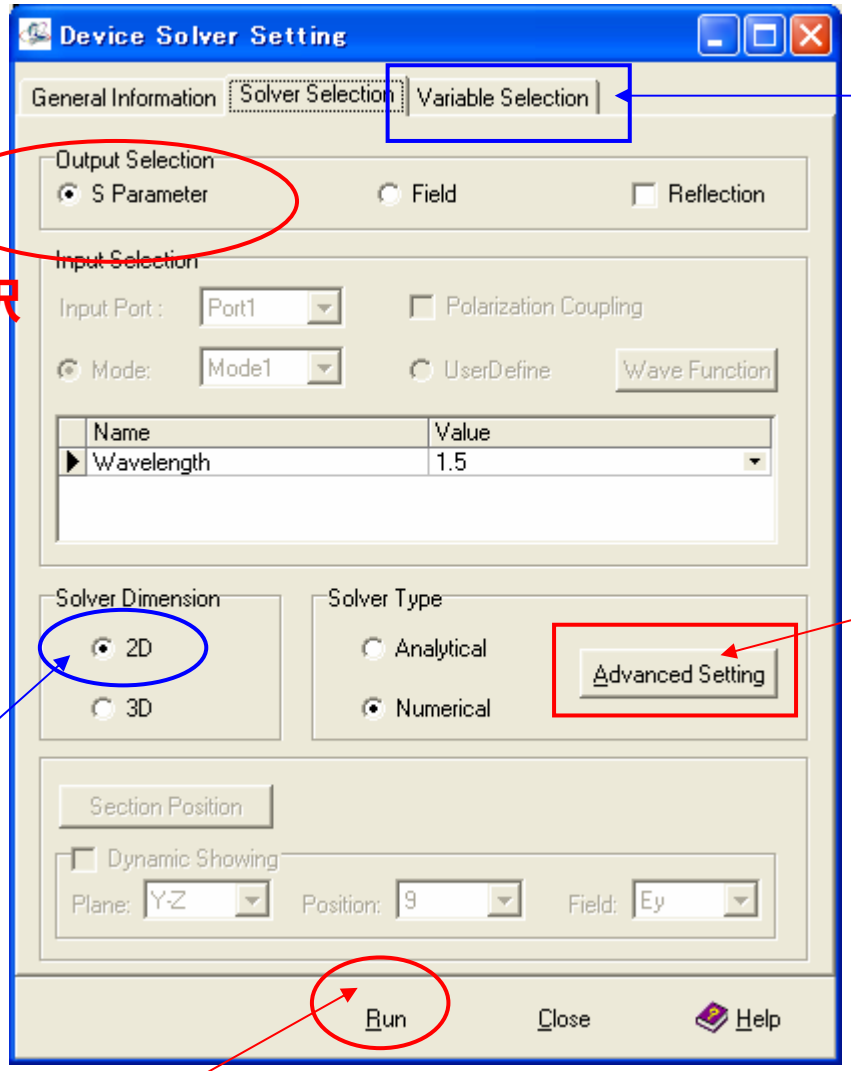


図18．TEモードの解析

波長とデバイス長を同時に変化させてスキャン計算を行なう。



導波路計算と同じ波長範囲、間隔とした。

このタブで修正可能

Sパラメータ計算の選択

次頁以降のメッシュ設定へ

今回は2次元とした。

2次元でも結構な計算量である

図19．TEモードの解析

全ての設定が終わると実行

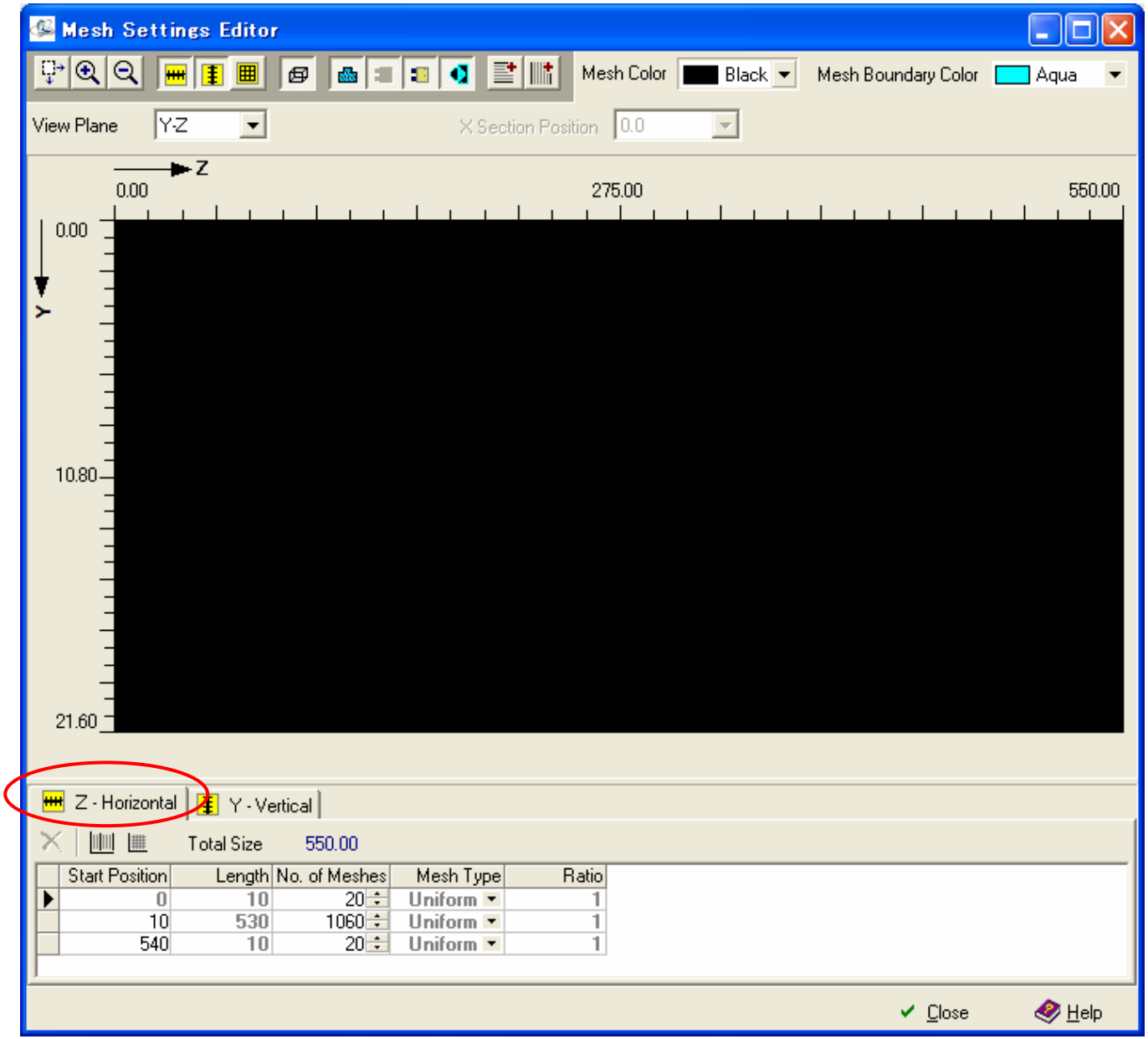


図20. Z方向のメッシュ設定

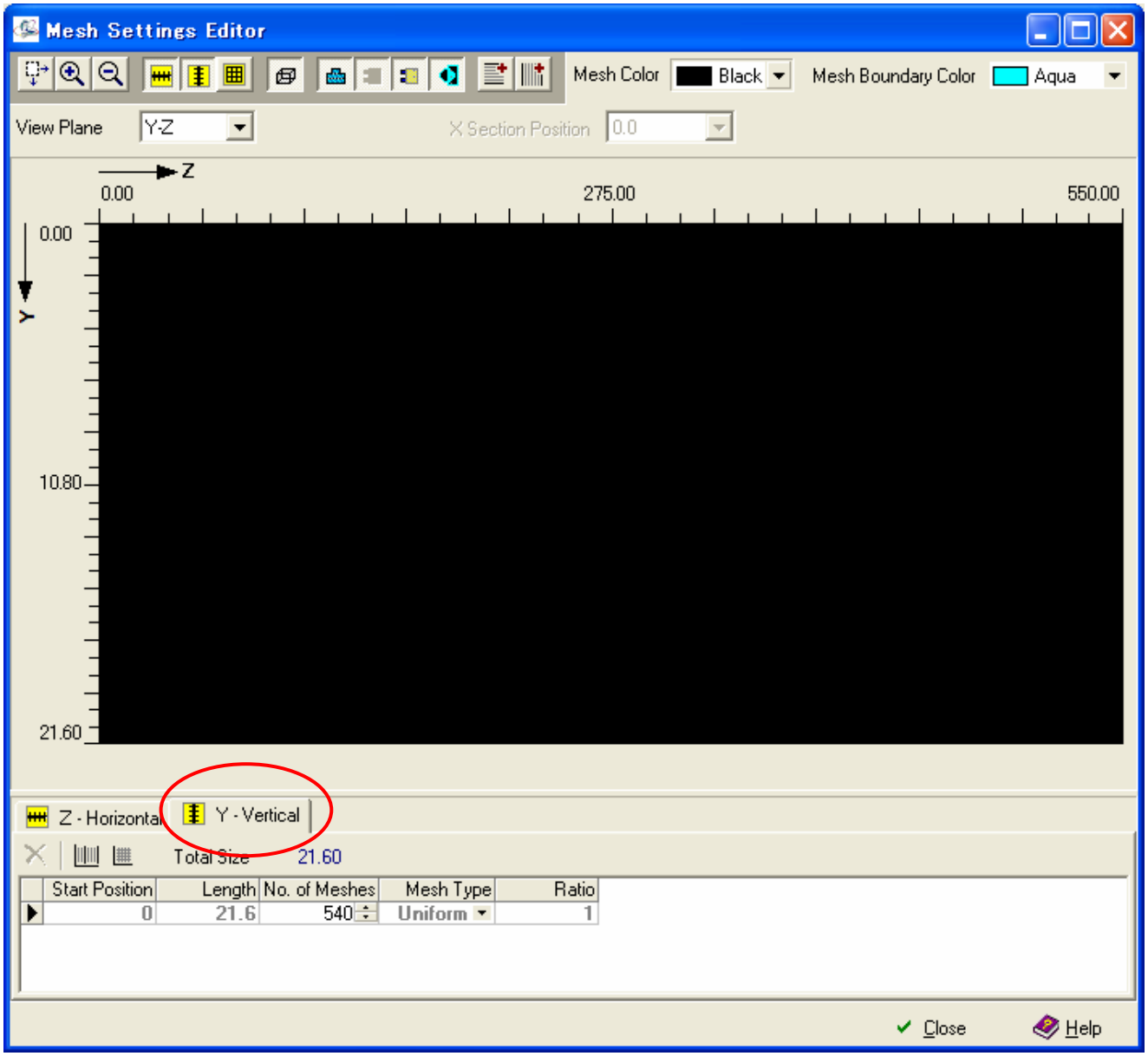


図21．Y方向のメッシュ設定

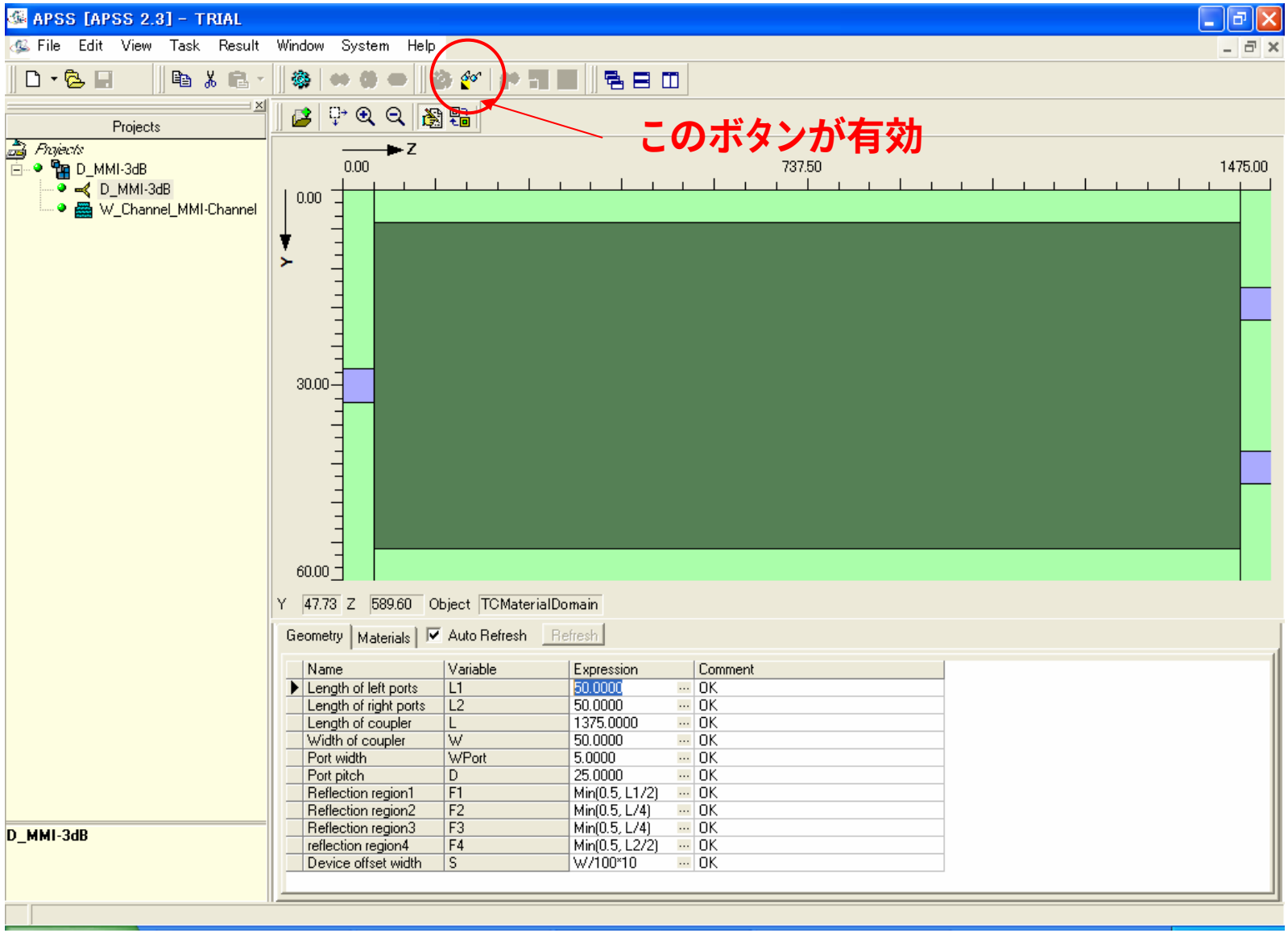


図２２．計算が正常に終了した状況

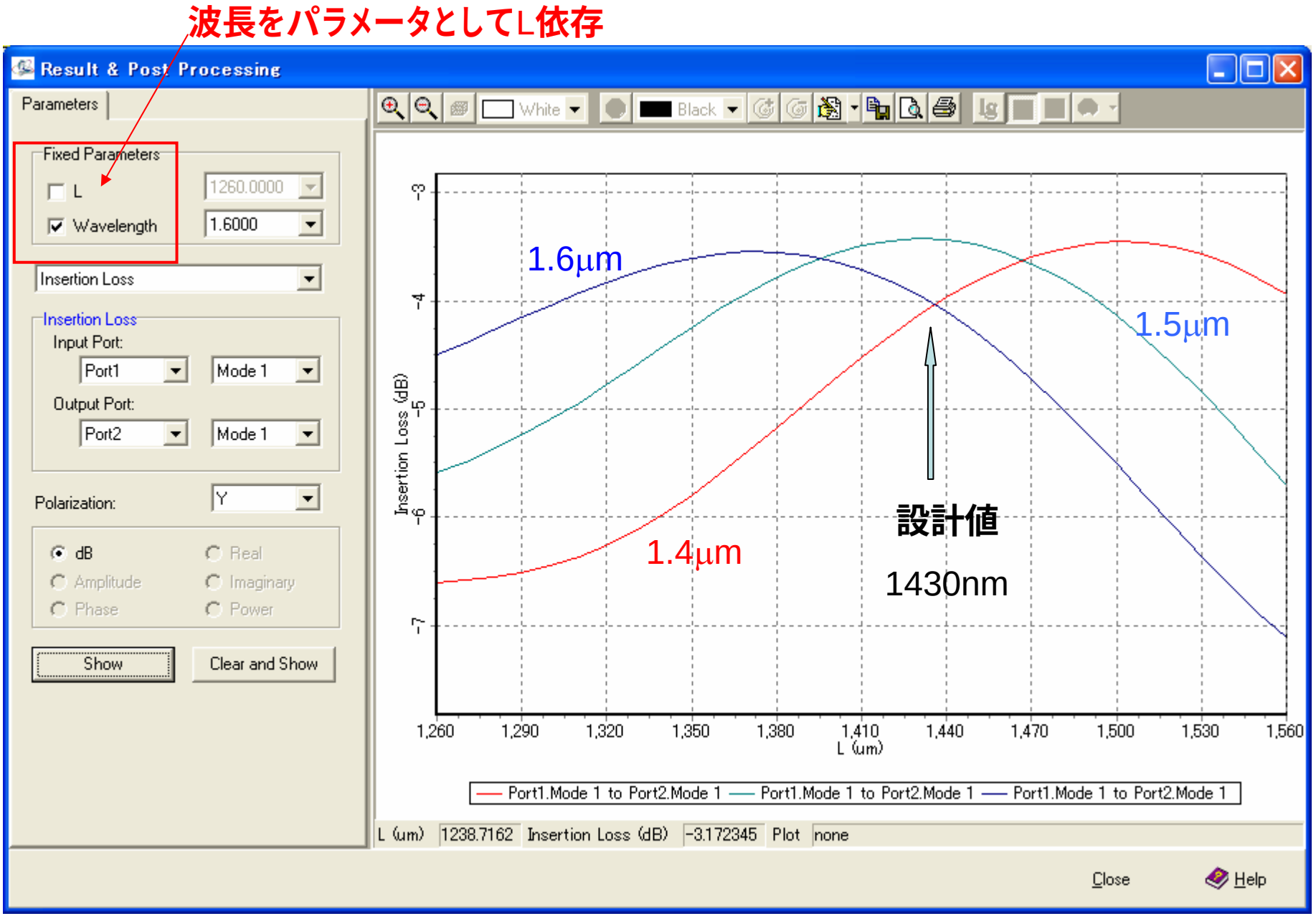


図23．挿入損失とデバイス長