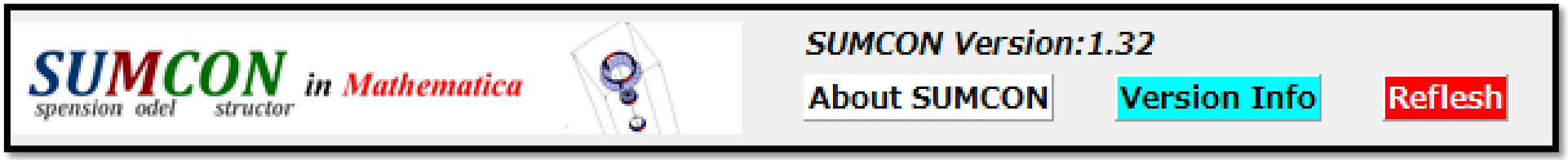


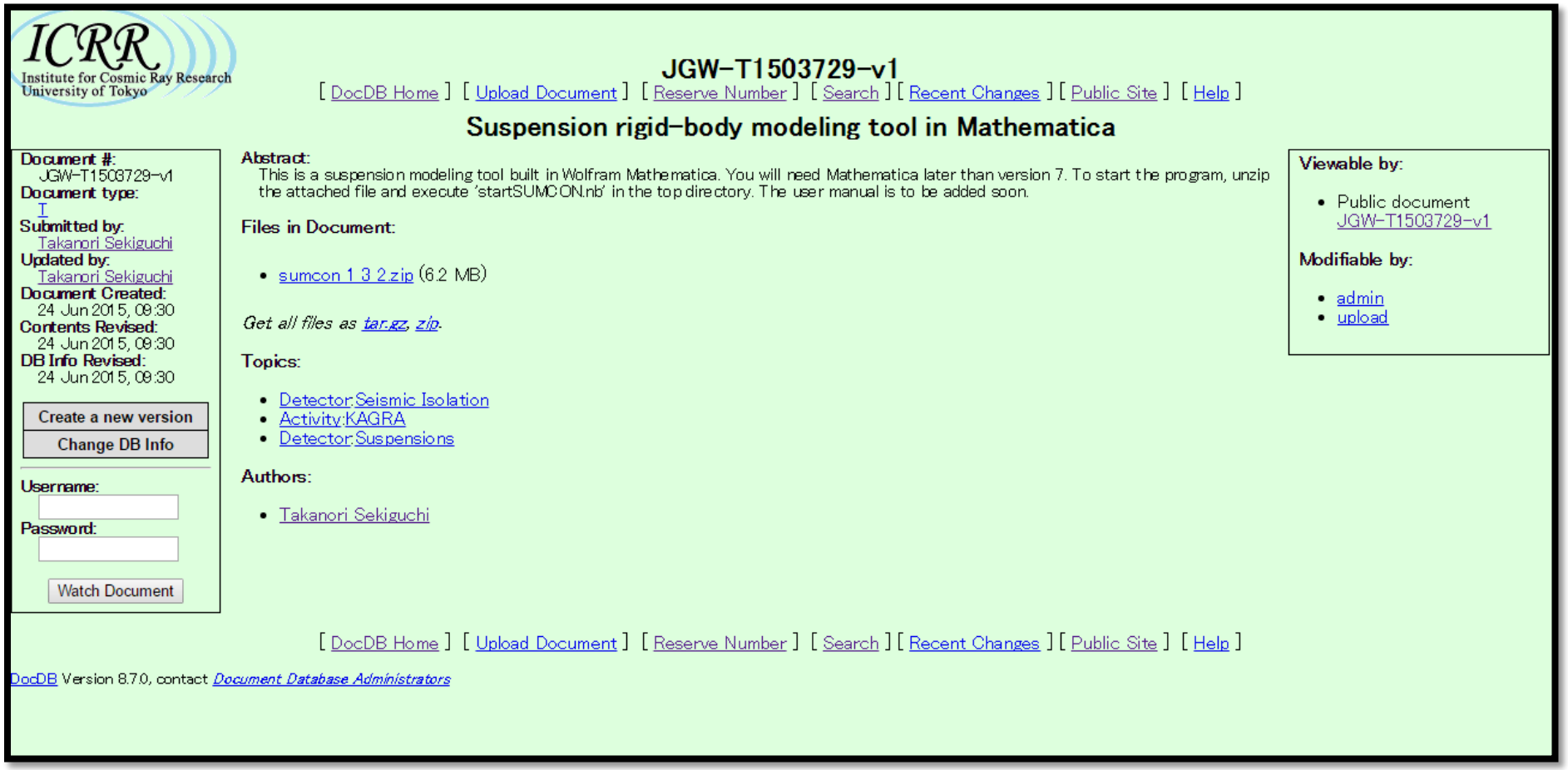
SUMCON User's Manual

Mechanical suspension modeling tool in Mathematica

Contents

❖ Preparation / Installation

1) Install the Modeling tools from the below URL ;
http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=3729



ICRR
Institute for Cosmic Ray Research
University of Tokyo

JGW-T1503729-v1

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Suspension rigid-body modeling tool in Mathematica

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Takanori Sekiguchi
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Takanori Sekiguchi
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24 Jun 2015, 09:30
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24 Jun 2015, 09:30
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Abstract:
This is a suspension modeling tool built in Wolfram Mathematica. You will need Mathematica later than version 7. To start the program, unzip the attached file and execute 'startSUMCON.nb' in the top directory. The user manual is to be added soon.

Files in Document:

- sumcon 1 3 2.zip (6.2 MB)

Get all files as tar.gz, zip.

Topics:

- Detector:Seismic Isolation
- Activity:KAGRA
- Detector:Suspensions

Authors:

- Takanori Sekiguchi

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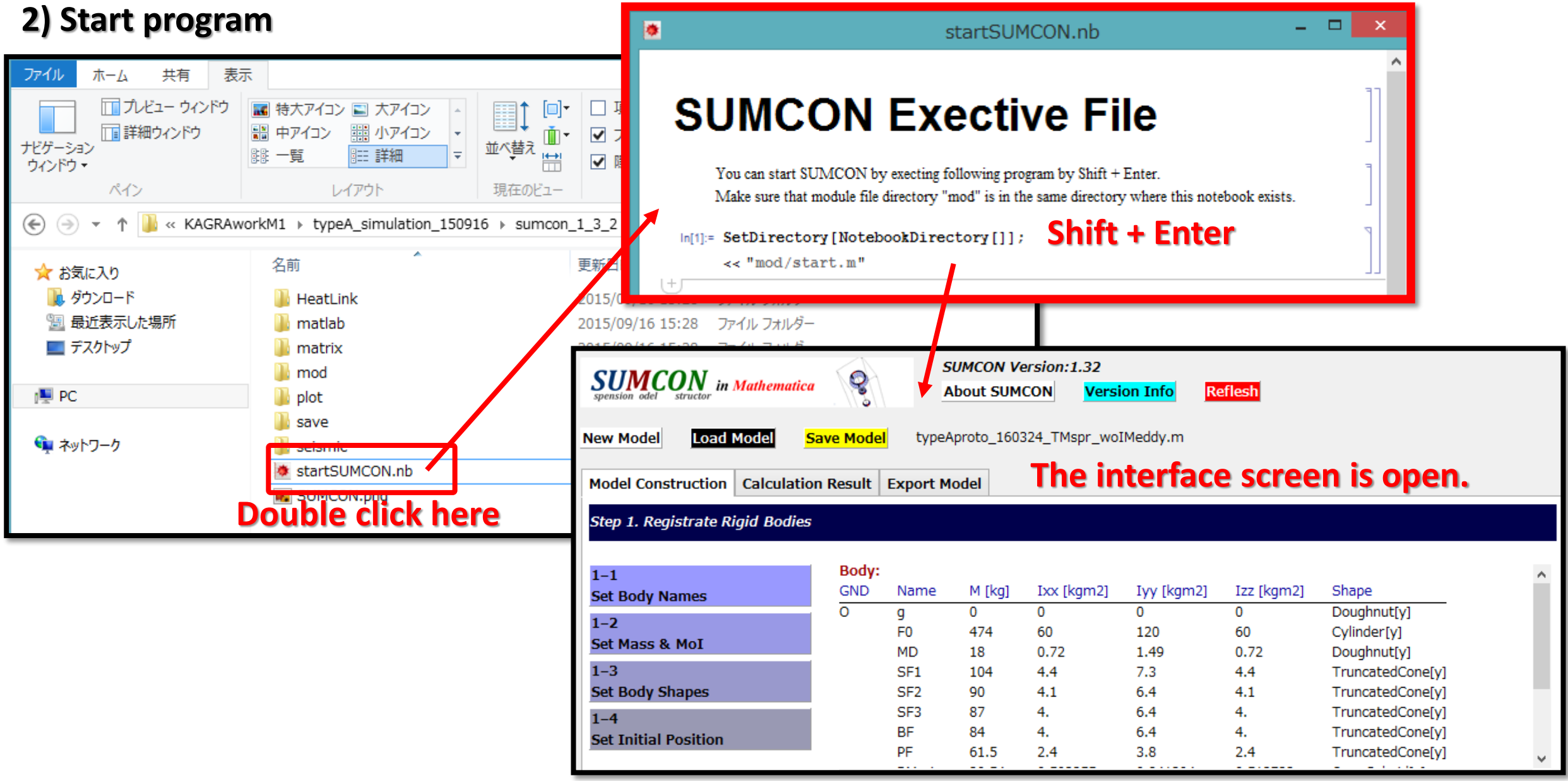
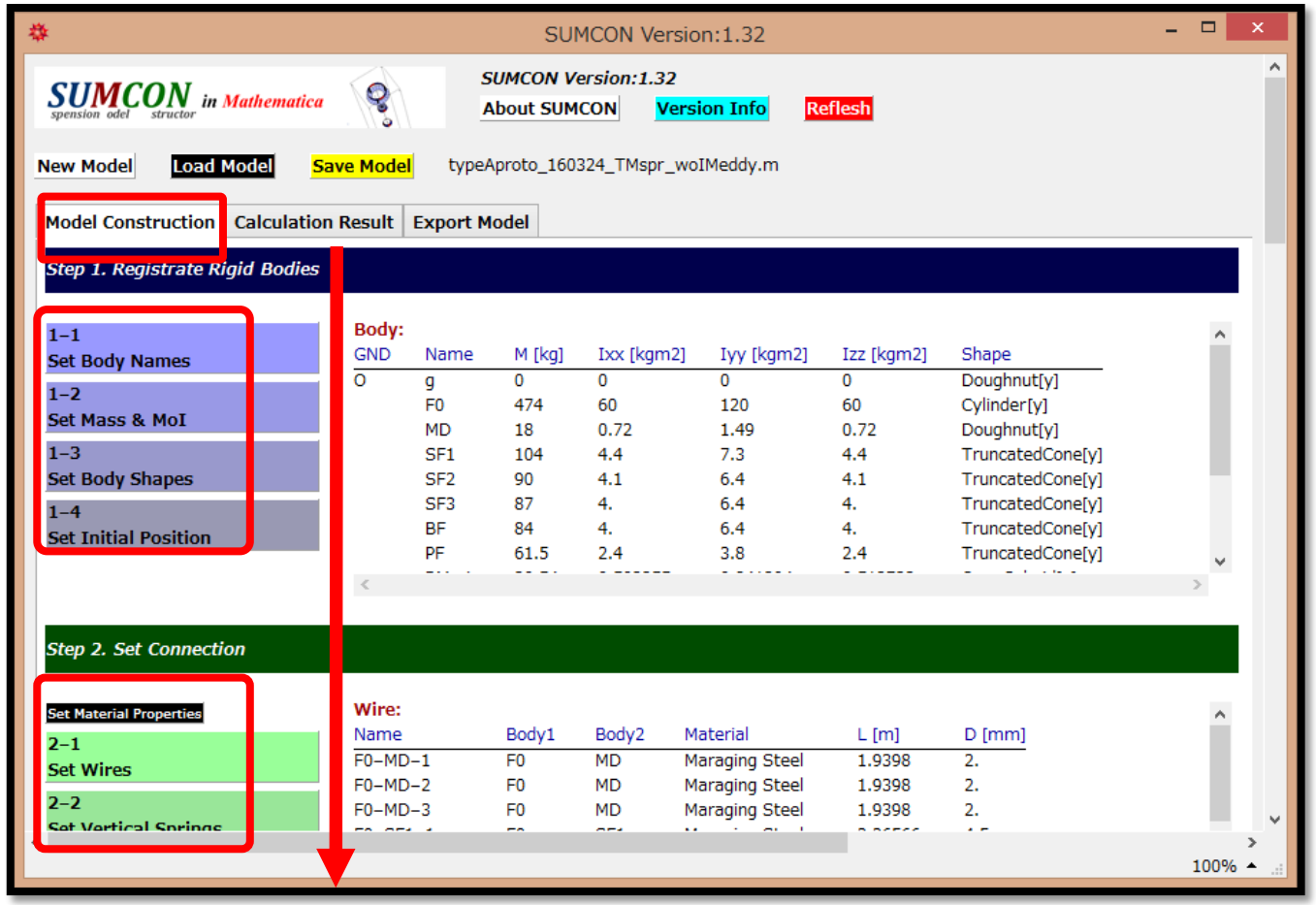
❖ Preparation / Starting the program

2) Start program

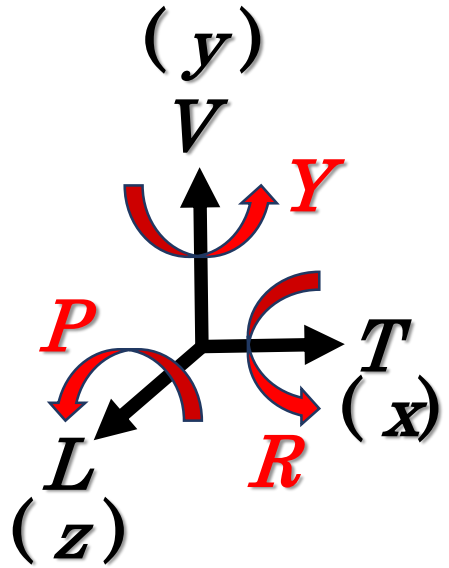


❖ Model construction

1) You should registrate suspension parameters as follows.

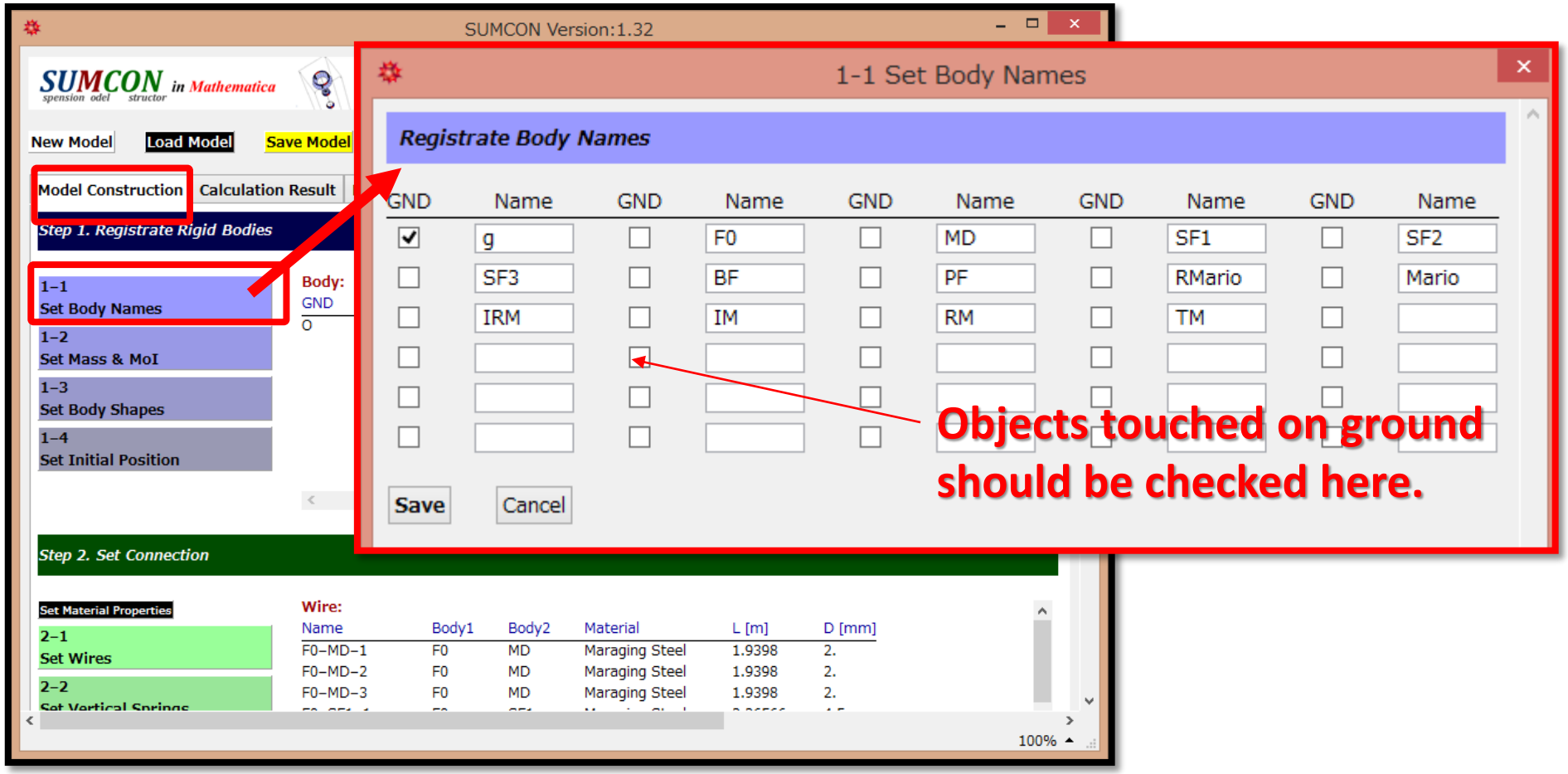


Axes definition



❖ Model construction / Step 1. / Set Body Names

2) Set suspension names

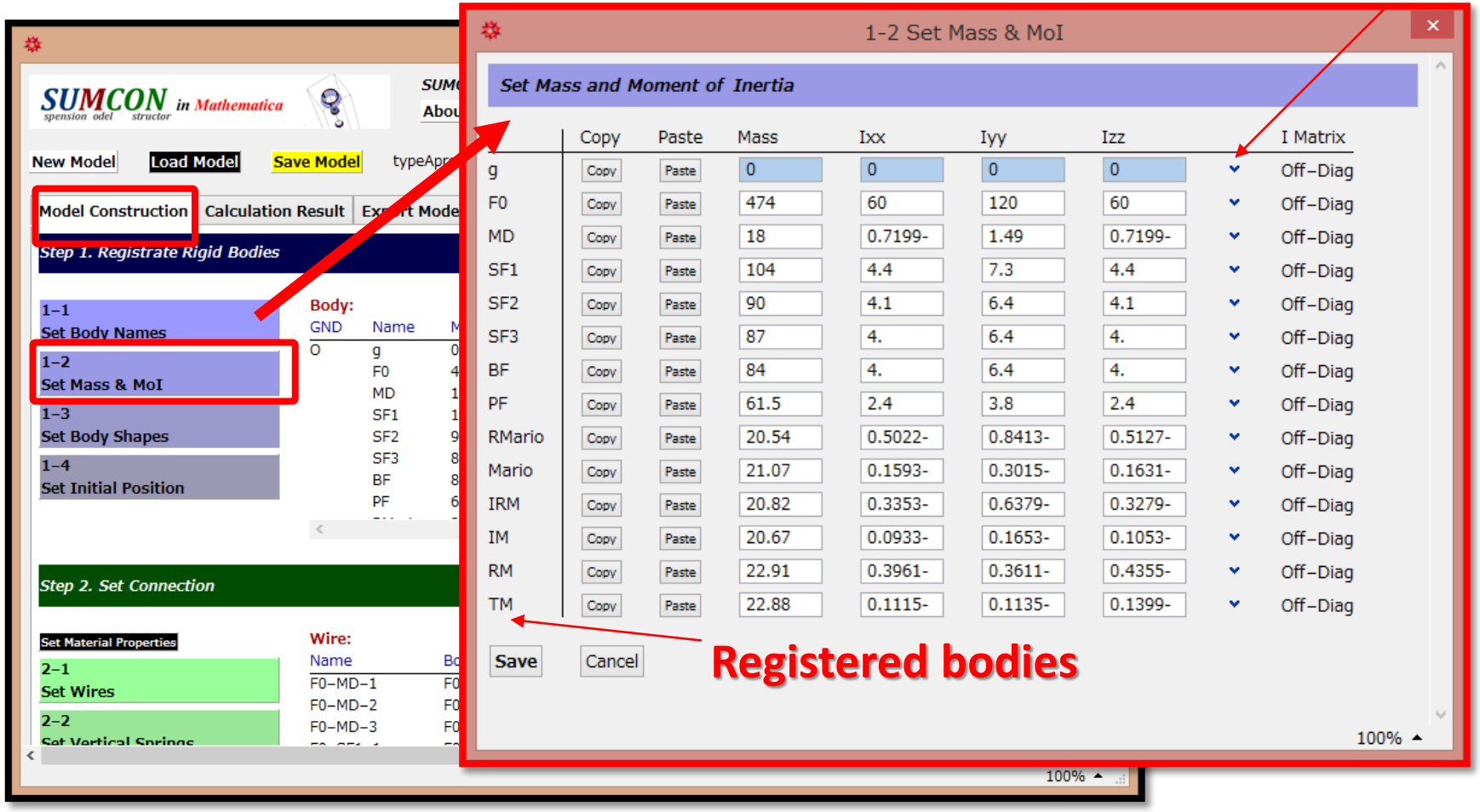


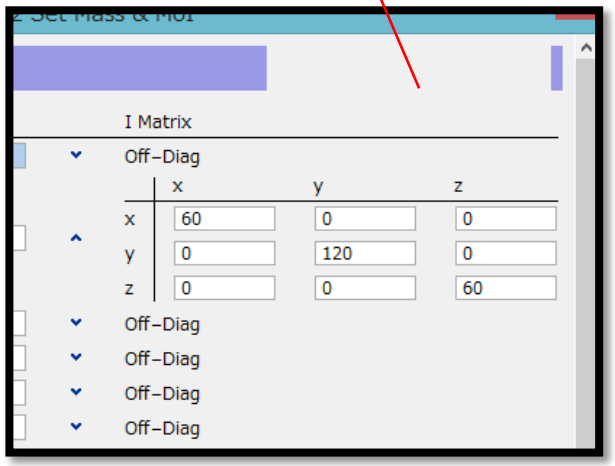
2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 1. / Set Mass&

If the inertia has non-diag elements,
Please click the “Off-diag”.
Registration page is open.

3) Set Masses and Moment of inertia

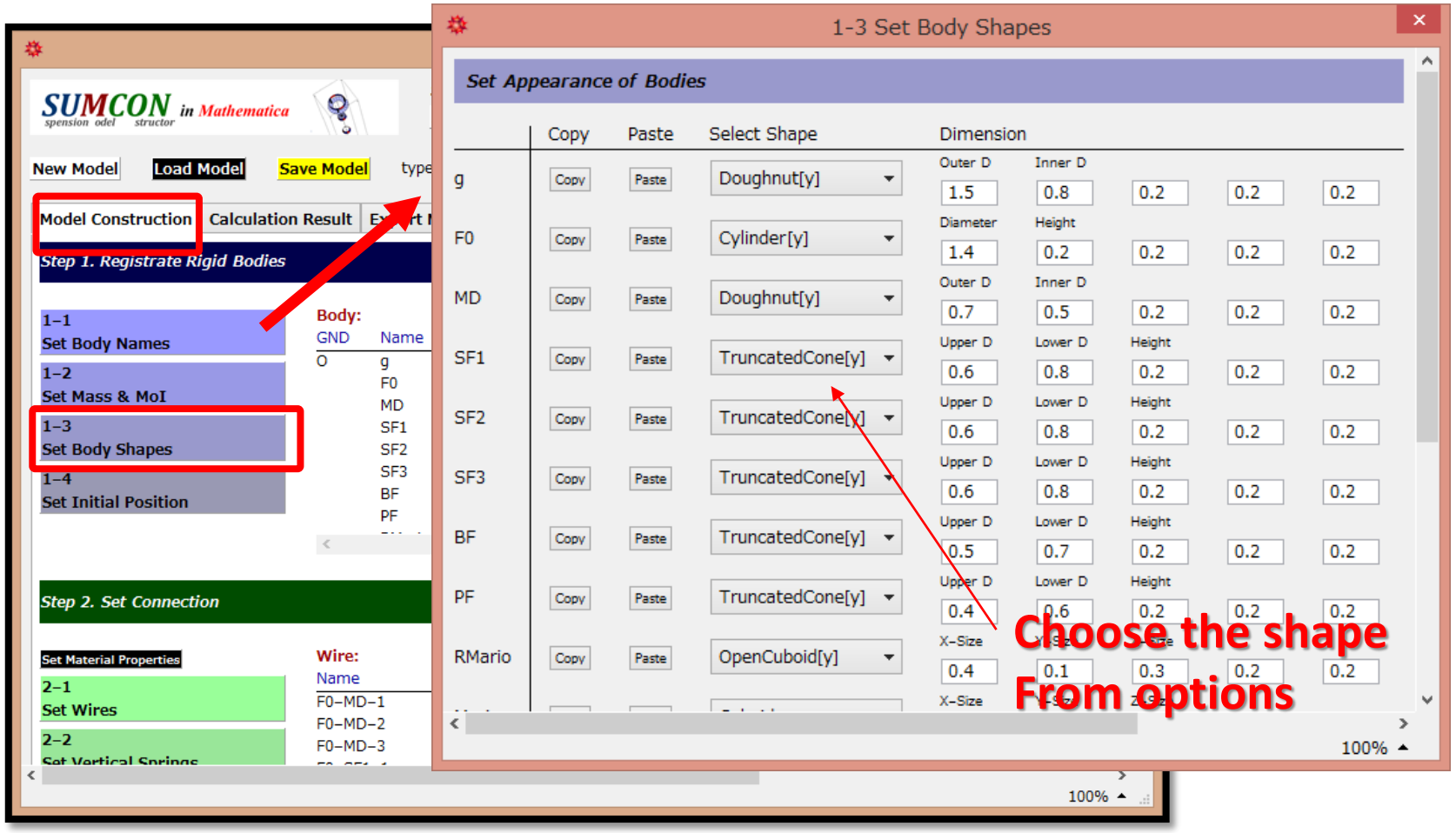




2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 1. / Body shape

4) Set suspension body shapes

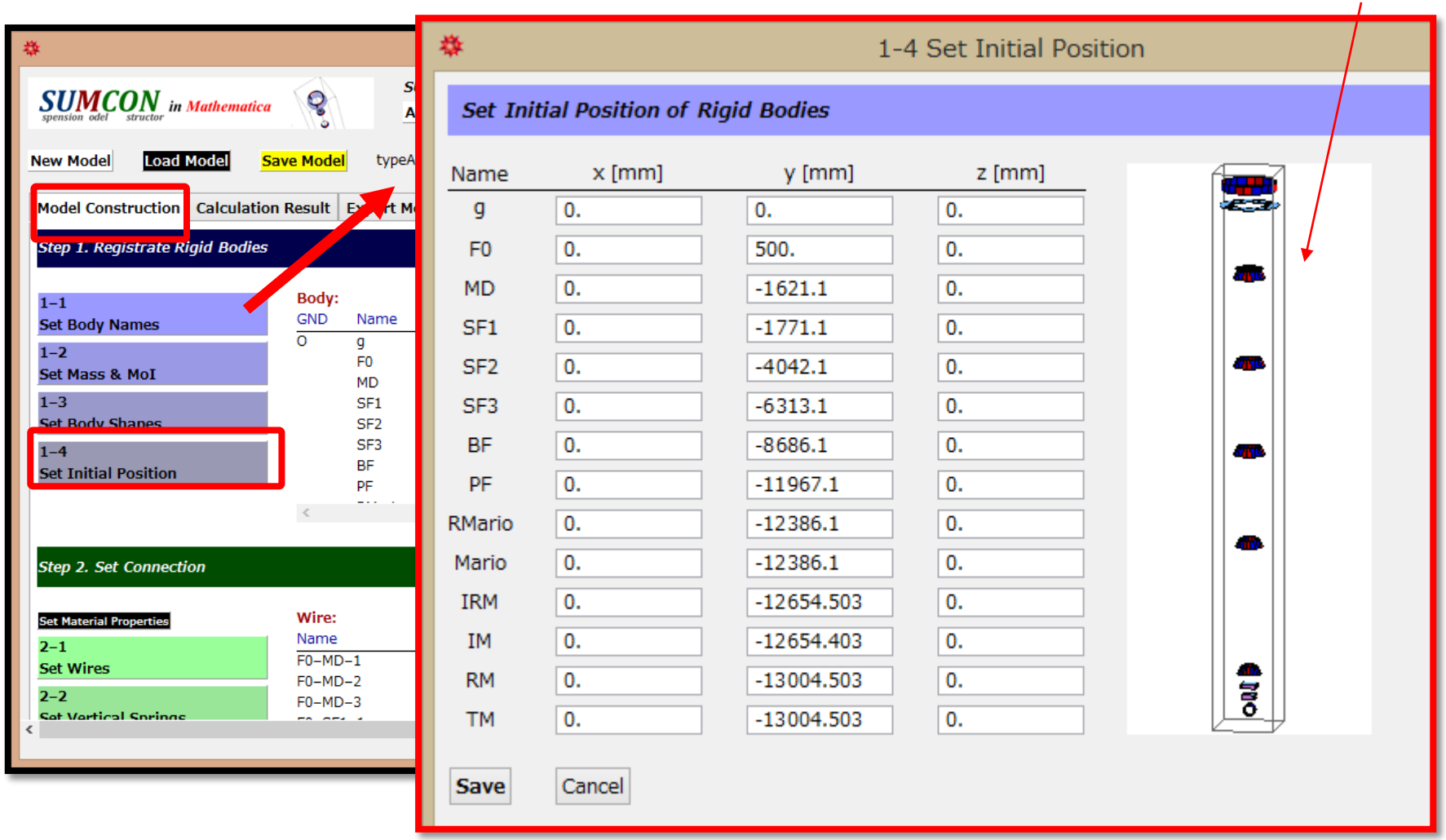


2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 1.

5) Set suspension initial positions

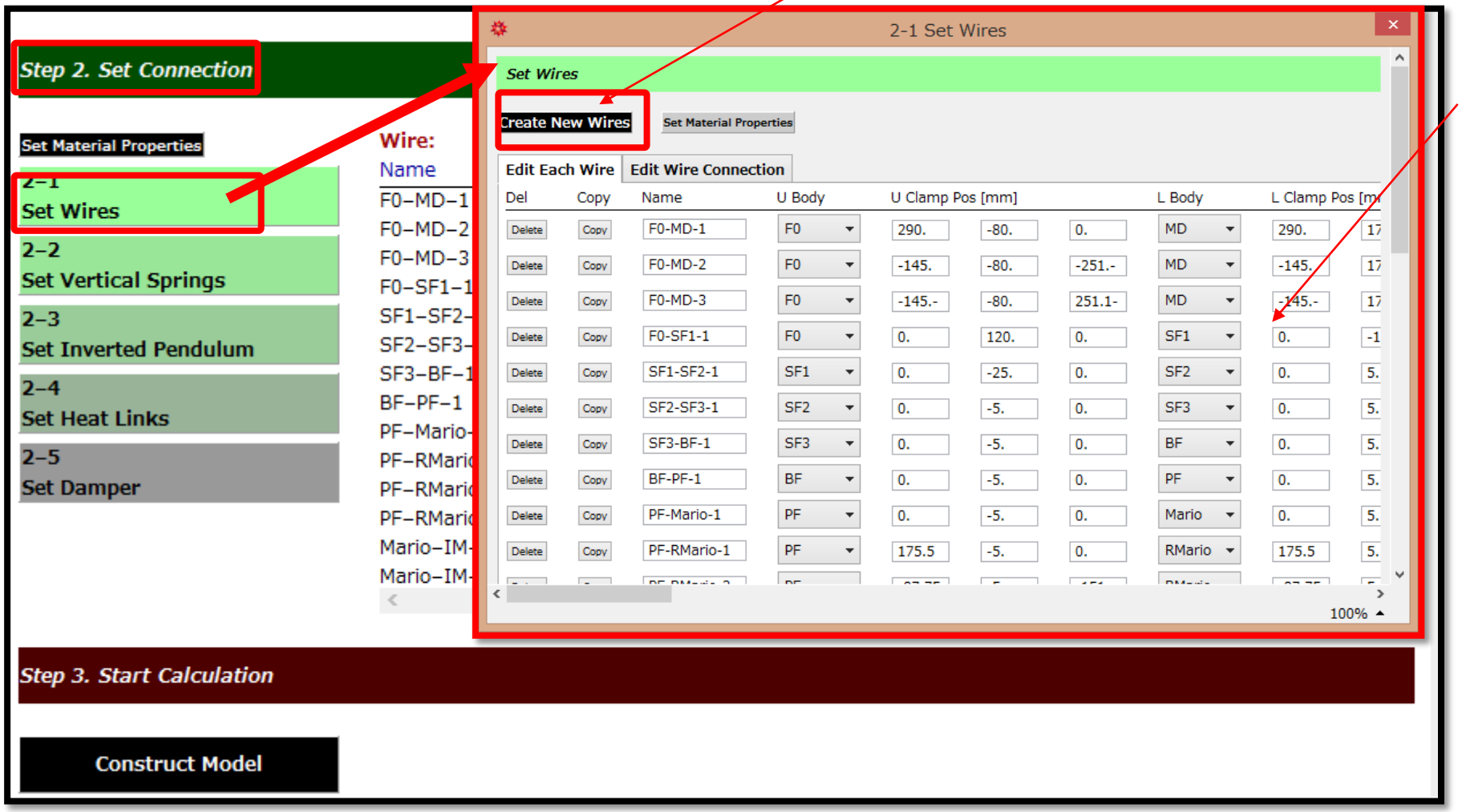
The shape, you chose in the step 1-3, should be reflected to this screen.



2) Click “save”, otherwise, the registered information is vanished.

❖ Model construction / Step 2. / Set wires

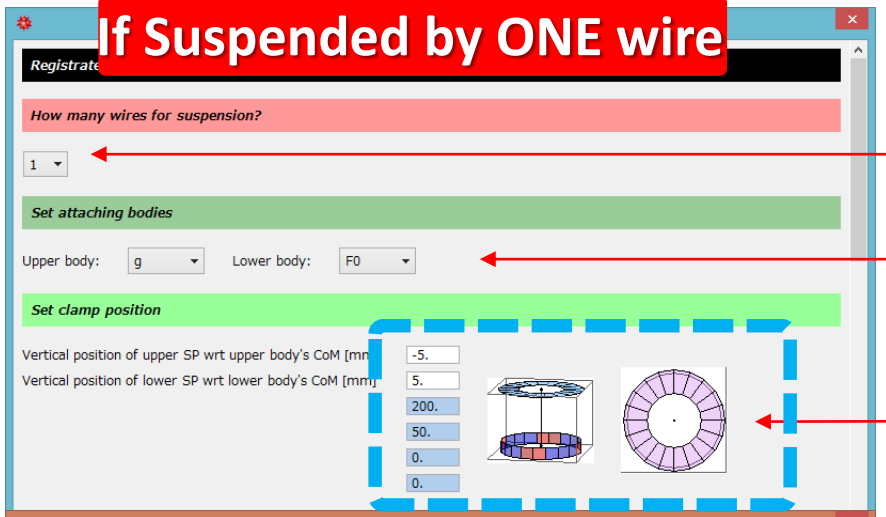
1) Set suspension wire information, by clinking here

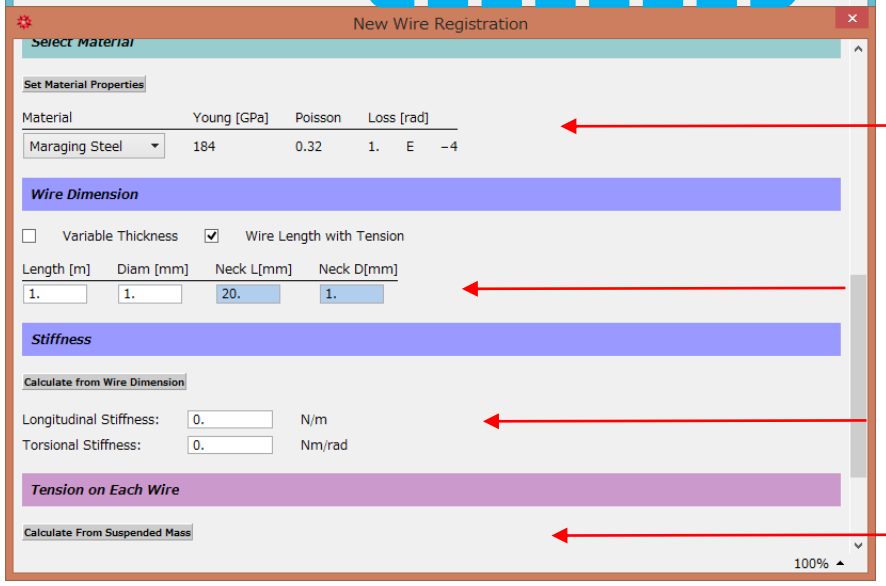


In more detail, please See p. 12 ~ p. 15

❖ Model construction / Step 2. / Set wires

2 - i) Set suspension wire information





The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

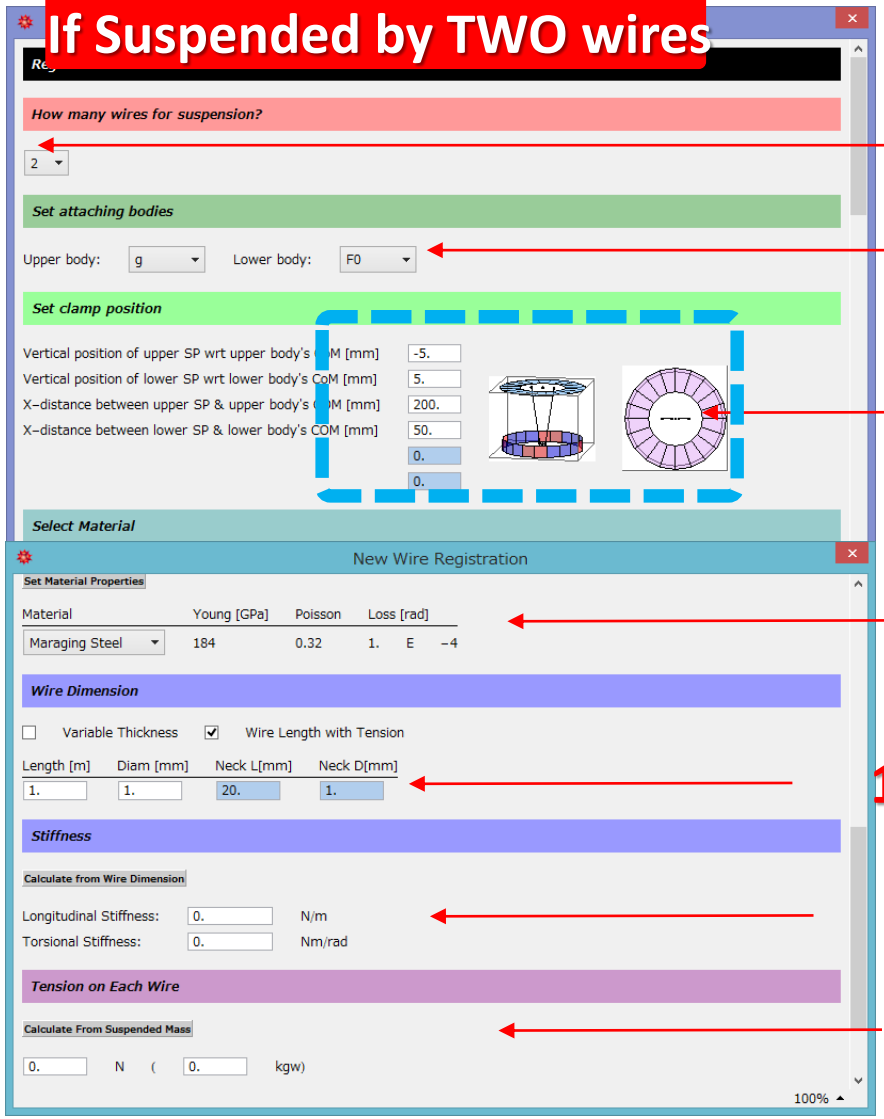
1)Length, 2) diameter, 3) Neck length, 4) Neck dimeter

Wire stiffness

Tension on each wire

❖ Model construction / Step 2. / Set wires

2 - ii) Set suspension wire information



The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

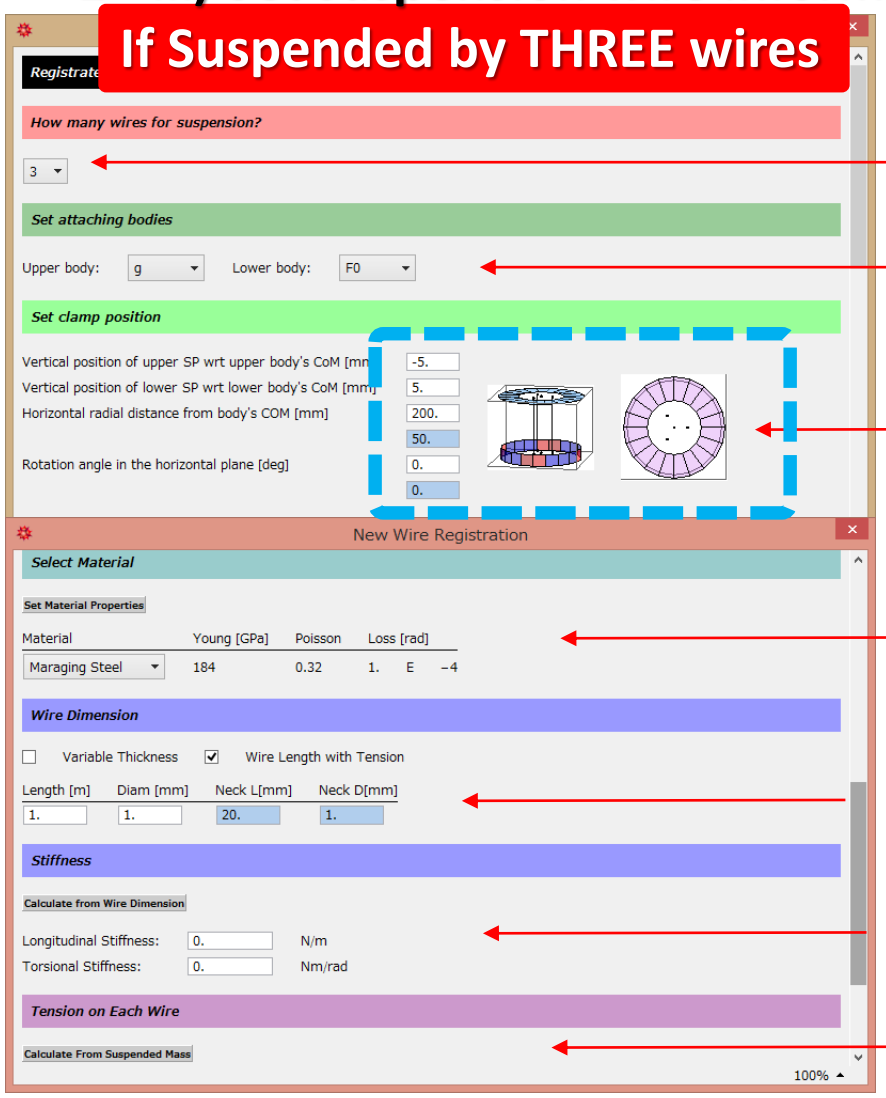
1)Length, 2) diameter, 3) Neck length, 4) Neck dimeter

Wire stiffness

Tension on each wire

❖ Model construction / Step 2. / Set wires

2 - iii) Set suspension wire information



The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

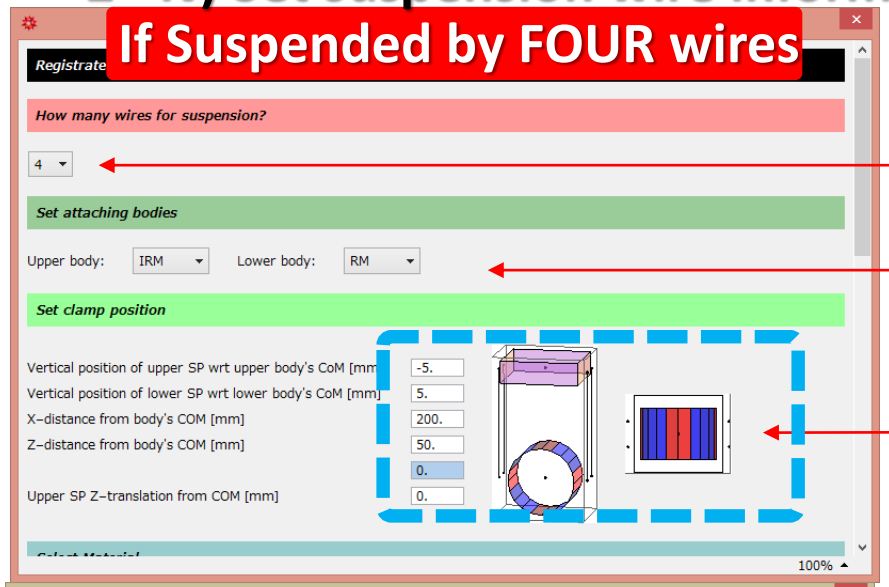
1)Length, 2) diameter, 3) Neck length, 4) Neck dimeter

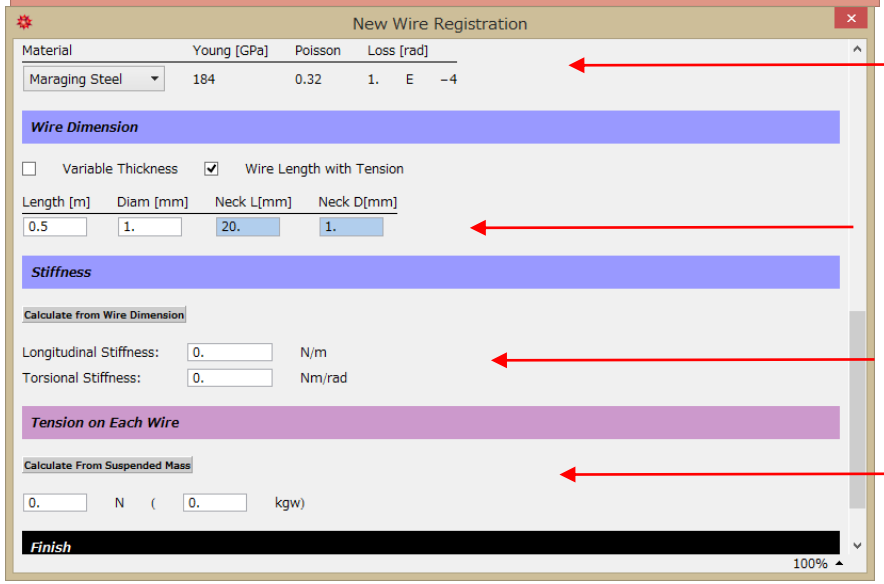
Wire stiffness

Tension on each wire

❖ Model construction / Step 2. / Set wires

2 - iv) Set suspension wire information





The number of the wires

Upper & lower body name

Suspension position of the upper & lower body
(From body's Center of Mas)

Wire material (They are registered already. mostly.)

1)Length, 2) diameter, 3) Neck length, 4) Neck dimeter

Wire stiffness

Tension on each wire

❖ Model construction / Step 2. / Set wires

This sheet is output automatically.

2-1 Set Wires

Edit Each Wire | Edit Wire Connection

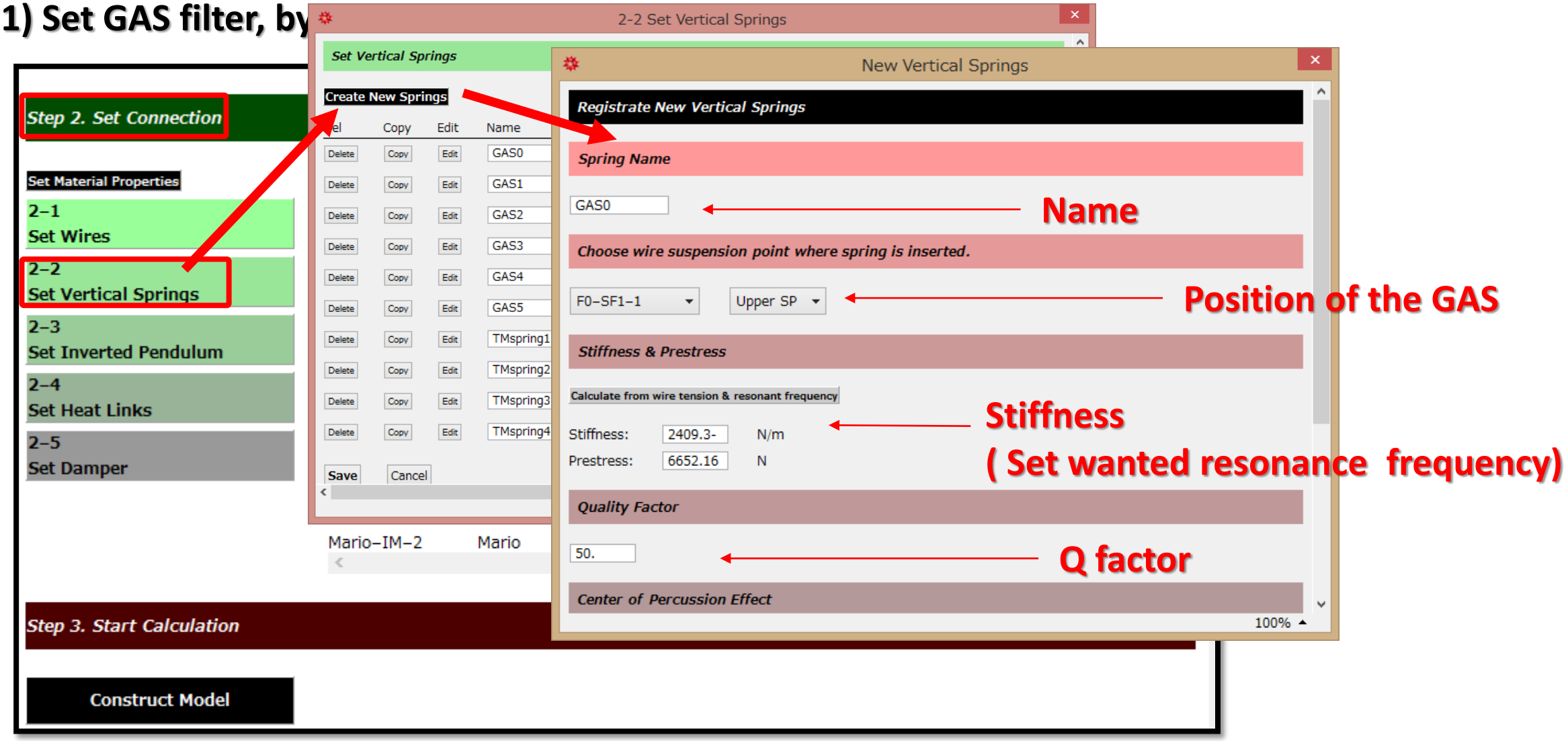
Del	Copy	Name	U Body	U Clamp Pos [mm]		L Body	L Clamp Pos [mm]			Mat	E [GPa]	Poission R	Los	[rad]		L [m]	D [mm]	NL [mm]	ND [mm]	T [N]	Upper Clamp Direction			Low
Delete	Copy	F0-MD-1	F0	290.	-80.	0.	MD	290.	17.	0.	C-70 Steel	200	0.3	3.	E	-4	1.6211	4.5000-	26.5	2.	294.3	0	-1	0	0
Delete	Copy	F0-MD-2	F0	-145.	-80.	-251.-	MD	-145.	17.	-251.-	C-70 Steel	200	0.3	3.	E	-4	1.6211	4.5000-	26.5	2.	294.3	0	-1	0	0
Delete	Copy	F0-MD-3	F0	-145.-	-80.	251.1-	MD	-145.-	17.	251.1-	C-70 Steel	200	0.3	3.	E	-4	1.6211	4.5000-	26.5	2.	294.3	0	-1	0	0
Delete	Copy	F0-SF1-1	F0	0.	120.	0.	SF1	0.	2.5	0.	Maraging Steel	184	0.32	1.	E	-4	2.2711	4.5000-	30.5	3.	6652.16	0	-1	0	0
Delete	Copy	SF1-SF2-1	SF1	0.	-44.	0.	SF2	0.	2.5	0.	Maraging Steel	184	0.32	1.	E	-4	2.271	4.5000-	30.5	3.	5546.5-	0	-1	0	0
Delete	Copy	SF2-SF3-1	SF2	0.	-44.	0.	SF3	0.	2.5	0.	Maraging Steel	184	0.32	1.	E	-4	2.271	4.5000-	30.5	3.	4440.99	0	-1	0	0
Delete	Copy	SF3-BF-1	SF3	0.	-44.	0.	BF	0.	2.5	0.	Maraging Steel	184	0.32	1.	E	-4	2.373	4.5000-	30.5	3.	3335.4	0	-1	0	0
Delete	Copy	BF-PF-1	BF	0.	-54.5	0.	PF	0.	1.5	0.	Maraging Steel	184	0.32	1.	E	-4	3.281	4.5000-	30.5	3.	2354.4	0	-1	0	0
Delete	Copy	PF-Mario-1	PF	0.	-79.0-	0.	Mario	0.	1.5	0.	Maraging Steel	184	0.32	1.	E	-4	0.169	4.5000-	40.5	2.	712.206	0	-1	0	0
Delete	Copy	PF-RMario-1	PF	0.	20.	-175.5	RMario	0.	17.	-175.5	Copper Beryllium	134	0.3	5.	E	-6	0.287	4.5000-	40.5	2.	857.394	0	-1	0	0
Delete	Copy	PF-RMario-2	PF	151.9-	20.	87.75	RMario	151.9-	17.	87.75	Copper Beryllium	134	0.3	5.	E	-6	0.287	4.5000-	40.5	2.	857.394	0	-1	0	0
Delete	Copy	PF-RMario-3	PF	-151.-	20.	87.75	RMario	-151.-	17.	87.75	Copper Beryllium	134	0.3	5.	E	-6	0.287	4.5000-	40.5	2.	857.394	0	-1	0	0
Delete	Copy	Mario-IM-1	Mario	94.	-5.	110.	IM	94.	5.	110.	Copper Beryllium	134	0.3	5.	E	-6	0.2684-	0.6	0.	0.6	464.994	0	-1	0	0
Delete	Copy	Mario-IM-3	Mario	-94.	-5.	110.	IM	-94.	5.	110.	Copper Beryllium	134	0.3	5.	E	-6	0.2684-	0.6	0.	0.6	464.994	0	-1	0	0
Delete	Copy	Mario-IM-4	Mario	-94.	-5.	-110.	IM	-94.	5.	-110.	Copper Beryllium	134	0.3	5.	E	-6	0.2684-	0.6	0.	0.6	464.994	0	-1	0	0
Delete	Copy	RMario-IRM-1	RMario	171.7	5.	161.	IRM	171.7	30.	161.	Copper Beryllium	134	0.3	5.	E	-6	0.2425-	0.6	0.	0.6	610.182	0	-1	0	0
Delete	Copy	RMario-IRM-2	RMario	171.7	5.	-161.	IRM	171.7	30.	-161.	Copper Beryllium	134	0.3	5.	E	-6	0.2425-	0.6	0.	0.6	610.182	0	-1	0	0
Delete	Copy	RMario-IRM-3	RMario	-171.7	5.	161.	IRM	-171.7	30.	161.	Copper Beryllium	134	0.3	5.	E	-6	0.2425-	0.6	0.	0.6	610.182	0.	-1.	0.	0.
Delete	Copy	RMario-IRM-4	RMario	-171.7	5.	-161.	IRM	-171.7	30.	-161.	Copper Beryllium	134	0.3	5.	E	-6	0.2425-	0.6	0.	0.6	610.182	0.	-1.	0.	0.
Delete	Copy	IM-TM-1	IM	114.2	-40.	29.2	TM	114.2	-30.	29.2	Sapphire	345	0.3	2.	E	-7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IM-TM-2	IM	114.2	-40.	-29.2	TM	114.2	-30.	-29.2	Sapphire	345	0.3	2.	E	-7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IM-TM-3	IM	-114.2	-40.	29.2	TM	-114.2	-30.	29.2	Sapphire	345	0.3	2.	E	-7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IM-TM-4	IM	-114.2	-40.	-29.2	TM	-114.2	-30.	-29.2	Sapphire	345	0.3	2.	E	-7	0.33	1.6	0.	1.6	221.706	0	-1	0	0
Delete	Copy	IRM-RM-1	IRM	153.1-	50.	44.70-	RM	153.1-	50.	44.70-	Copper Beryllium	134	0.3	5.	E	-6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0
Delete	Copy	IRM-RM-2	IRM	153.1-	50.	-44.7-	RM	153.1-	50.	-44.7-	Copper Beryllium	134	0.3	5.	E	-6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0
Delete	Copy	IRM-RM-3	IRM	-153.-	50.	44.70-	RM	-153.-	50.	44.70-	Copper Beryllium	134	0.3	5.	E	-6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0
Delete	Copy	IRM-RM-4	IRM	-153.-	50.	-44.7-	RM	-153.-	50.	-44.7-	Copper Beryllium	134	0.3	5.	E	-6	0.3308-	0.6	0.	1.	362.97-	0	-1	0	0

Save | Cancel

100%

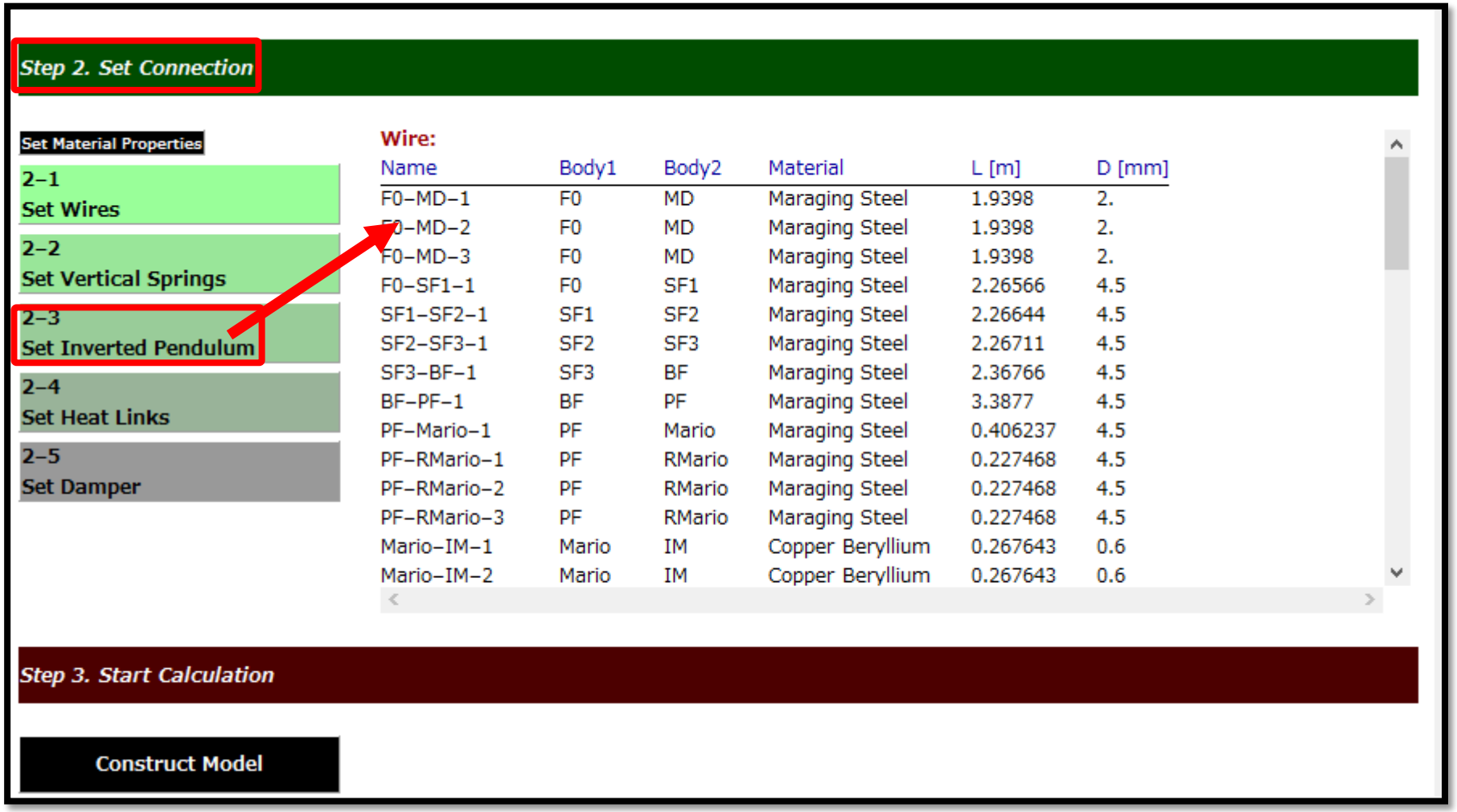
❖ Model construction / Step 2. / Set Vertical springs (GAS)

1) Set GAS filter, by



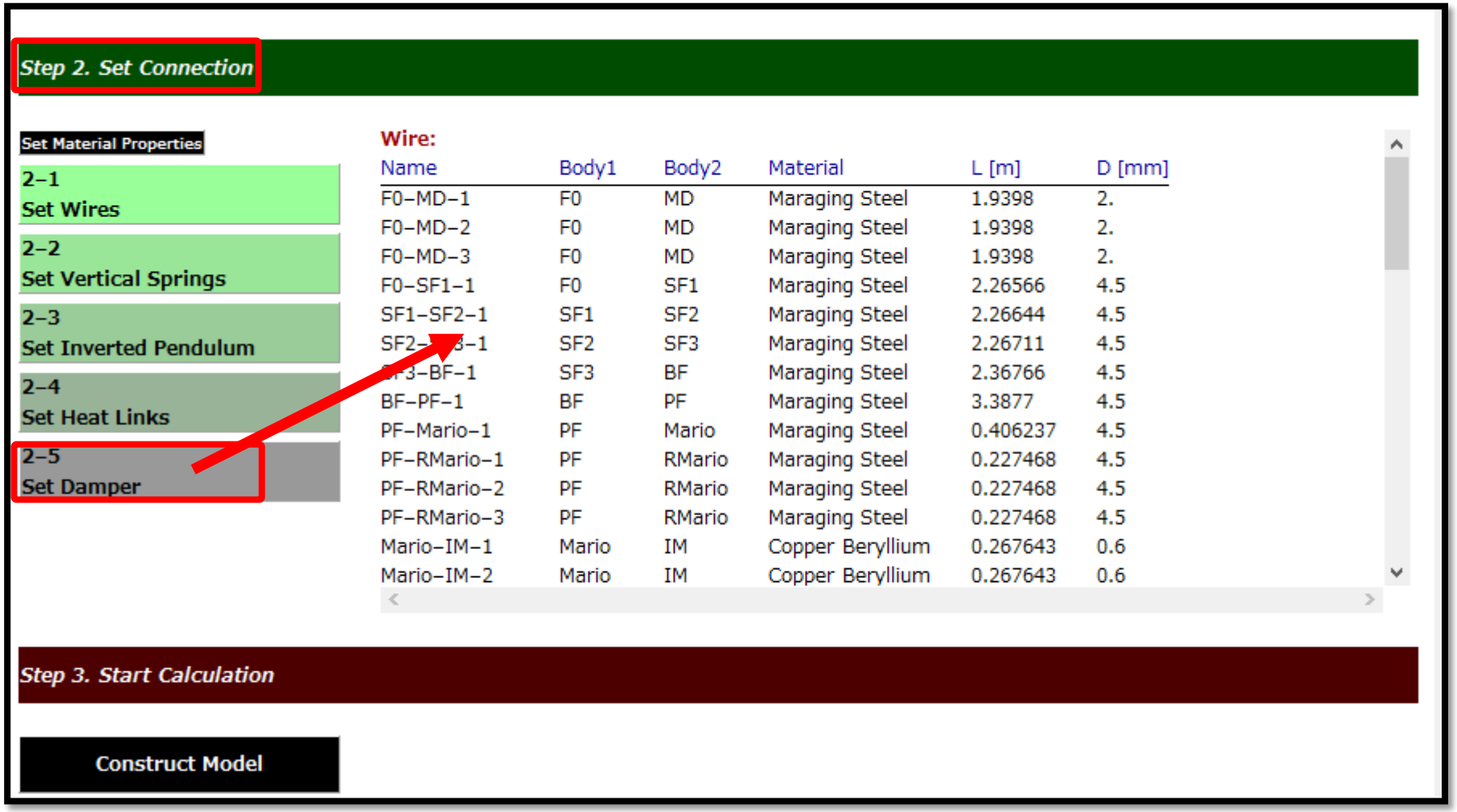
❖ Model construction / Step 2. / Set IP

1) Set Inverted Pendulum, by clinking here



❖ Model construction / Step 2. / Damper

1) Set Eddy current damper, by clinking here



❖ Model construction / Step 3.

1) Start the calculation, by clinking here

Step 2. Set Connection

Set Material Properties

2–1
Set Wires

2–2
Set Vertical Springs

2–3
Set Inverted Pendulum

2–4
Set Heat Links

2–5
Set Damper

Wire:

Name	Body1	Body2	Material	L [m]	D [mm]
F0–MD–1	F0	MD	Maraging Steel	1.9398	2.
F0–MD–2	F0	MD	Maraging Steel	1.9398	2.
F0–MD–3	F0	MD	Maraging Steel	1.9398	2.
F0–SF1–1	F0	SF1	Maraging Steel	2.26566	4.5
SF1–SF2–1	SF1	SF2	Maraging Steel	2.26644	4.5
SF2–SF3–1	SF2	SF3	Maraging Steel	2.26711	4.5
SF3–BF–1	SF3	BF	Maraging Steel	2.36766	4.5
BF–PF–1	BF	PF	Maraging Steel	3.3877	4.5
PF–Mario–1	PF	Mario	Maraging Steel	0.406237	4.5
PF–RMario–1	PF	RMario	Maraging Steel	0.227468	4.5
PF–RMario–2	PF	RMario	Maraging Steel	0.227468	4.5
PF–RMario–3	PF	RMario	Maraging Steel	0.227468	4.5
Mario–IM–1	Mario	IM	Copper Beryllium	0.267643	0.6
Mario–IM–2	Mario	IM	Copper Beryllium	0.267643	0.6

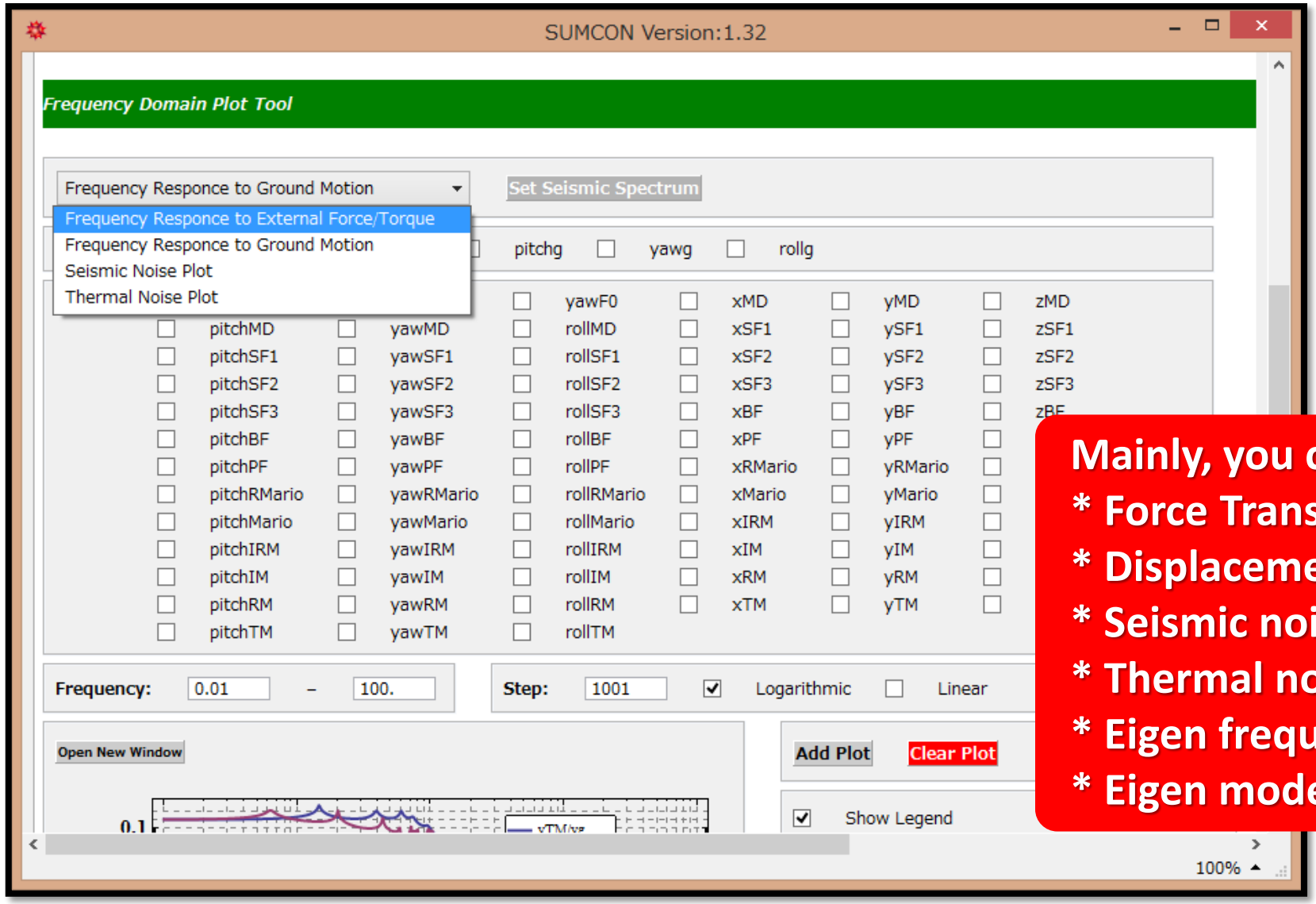
Step 3. Start Calculation

Construct Model

Start the run, by pushing here!

❖ Model construction / Step 3.

1) In the end, you can get the frequency response, and its eigen mode shapes!



You can click anywhere!
Please play with this tool!

(Some stuffs are to be added.)

Mainly, you can plot(get) ;
* Force Transfer function
* Displacement Transfer function
* Seismic noise
* Thermal noise
* Eigen frequency
* Eigen mode shape