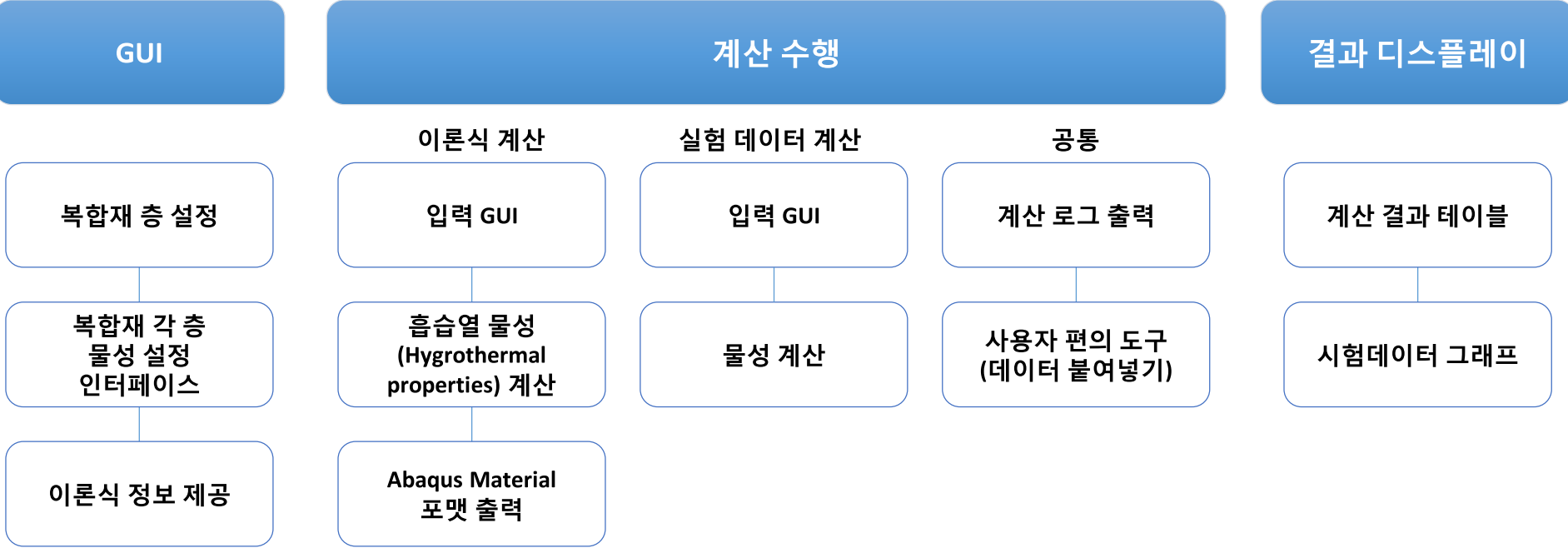


복합재료 물성 생성 S/W 사용 Manual (Ver.1.0)

문의 : DYETEC연구원 윤현성 전임 연구원

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항 목	내 용	비 고
운영체제	Windows 7 이상 64비트 운영체제	
메모리	16GB 이상	
필요 라이브러리	Microsoft Visual Studio 2017 재배포 패키지	vc_redist.x64.exe 파일로 제공
개발도구	Visual Studio 2017	
프로그래밍 언어	C++	



복합재료
물성 생성
S/W



Material Properties

Name	Density(kg/m3)	Young's Modulus(GPa)	Poisson's Ratio
Glass	2500	70.0	0.2
Epoxy	1200	3.0	0.3

Fiber(%) Thickness(mm) Angle(deg) H

0.5 1.0 45.0 1.0

Stress Matrix

S Matrix Scale Factor 0.01 S Matrix with Angle 0.01

C Matrix Scale Factor 1 C Matrix with Angle 1

Information for laminate

No.	Fiber	Matrix	Fiber	Thickness	Angle
1	Glass	Epoxy	0.5	1	45
2	Glass	Epoxy	0.5	1	45

Material properties for laminated (homogenized)

Properties	Unit	Value	Properties	Unit	Value
E1	GPa	7.05123	E2	GPa	7051.23
G12	GPa	7.05123	G23	GPa	7051.23
G13	GPa	0.146	G21	GPa	0.999997
ν12		0.000001	ν13		0.000001
ν23		0.000001	ν31		0.000001
ν32		0.000001	ν11		0.000001
ν22		0.000001	ν33		0.000001
ν11		0.000001	ν21		0.000001
ν21		0.000001	ν32		0.000001
ν31		0.000001	ν12		0.000001
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ν11		0.000001			

The fiber aspect ratio describes the relation of fiber diameter and length, equation (1).

$$\text{aspect ratio} = \frac{l}{d} \quad (1)$$

The fibre volume fraction v_f or mass fraction w_f is the portion of the total composite that consists of fibres, equation (2) and (3).

$$v_f = \frac{V_f}{V_c} \quad (2)$$

$$w_f = \frac{\rho_f v_f}{\rho_f v_f + \rho_m (1 - v_f)} \quad (3)$$

Where V_f and V_c are the total fiber-/composite volume, ρ_f and ρ_m are fiber/matrix densities.

$$\text{Longitudinal Young's modulus} \quad E_1 = v_f E_{f1} + v_m E_m \quad (5)$$

$$\text{Transverse Young's modulus} \quad E_2 = \left(\frac{\sqrt{v_f}}{E_{b2}} + \frac{1 - \sqrt{v_f}}{E_m} \right)^{-1} \quad (6)$$

$$\text{where } E_{b2} = \sqrt{v_f} E_{f2} + (1 - \sqrt{v_f}) E_m$$

$$\text{Longitudinal Shear modulus} \quad G_{12} = \left(\frac{\sqrt{v_f}}{G_{b12}} + \frac{1 - \sqrt{v_f}}{G_m} \right)^{-1} \quad (7)$$

$$\text{where } G_{b12} = \sqrt{v_f} G_{f12} + (1 - \sqrt{v_f}) G_m$$

$$\text{Transverse Shear modulus} \quad G_{23} = \left(\frac{\sqrt{v_f}}{G_{b23}} + \frac{1 - \sqrt{v_f}}{G_m} \right)^{-1} \quad (8)$$

$$\text{where } G_{b23} = \sqrt{v_f} G_{f23} + (1 - \sqrt{v_f}) G_m$$

$$\text{Longitudinal Poisson ratio} \quad v_{12} = v_{f12} v_f + v_m v_m \quad (9)$$

$$\text{Transverse Poisson ratio} \quad v_{23} = \frac{E_2}{2G_{23}} - 1 \quad (9)$$

$v_{f/m}$ is the fibre/matrix volume fraction,.

$E_{f1/2}$ is Young's modulus for the fibres in longitudinal and transverse direction.

E_m is Young's modulus of the matrix.

G_{f12} and G_m are the shear moduli for fibre and matrix.

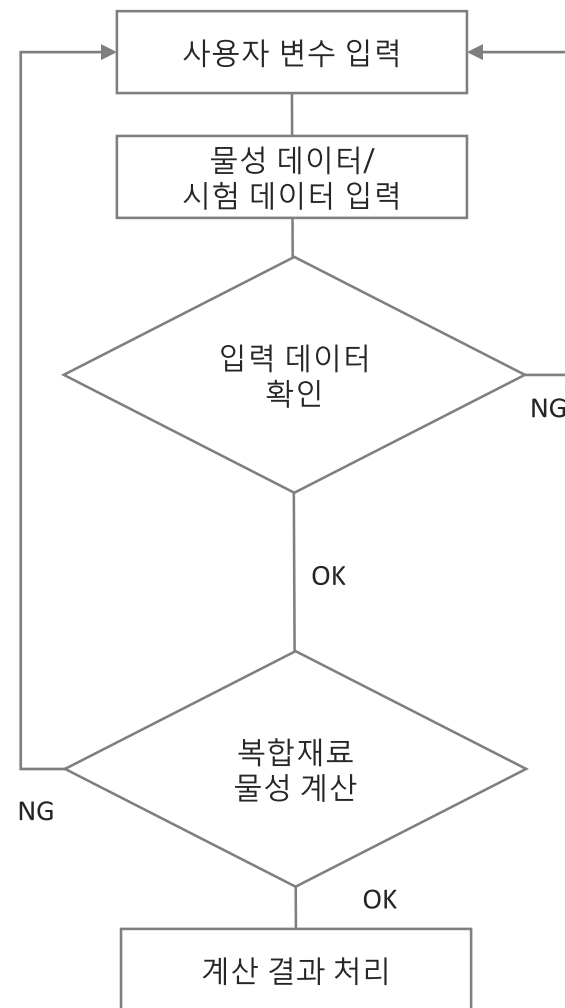
v_{f12} and v_m are the poisons ratios for fibres and matrix.

■ 계산 프로세스

- 사용자 입력
 - 물성 데이터, 시험 데이터
- 입력 데이터 확인
- 계산 실행

■ 결과 처리 프로세스

- 계산 결과 테이블화
- 시험데이터 그래프 출력



• 통합 GUI 구성

- 모듈 접근과 기능 접근을 위한 리본툴바
- 입력 설정을 위한 모듈 선택 패널
- 사용자 입력과 해석 결과 출력을 위한 다중 View

The screenshot shows the 'Composites Properties Evaluation Program' interface. It features a ribbon menu at the top, a main menu on the left, and three main view areas: 'Input View', 'Result View', and 'Log View'.

리본 메뉴 (Ribbon Menu): Located at the top, it includes tabs for 'Theoretical Formula', 'Experimental Formula', and 'Experimental Formula Result'. It also contains buttons for 'New', 'Apply', 'Calculate', 'Menu View', 'Log View', 'Status Bar', and 'Version'.

모듈 메뉴 (Module Menu): Located on the left, it shows a tree view with 'Theoretical Formula', 'Experimental Formula', 'Experimental Lamina #1', 'Experimental Lamina #2', and 'Theory'.

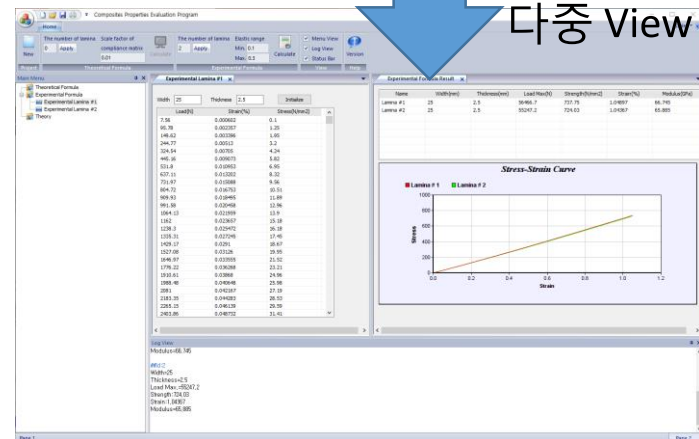
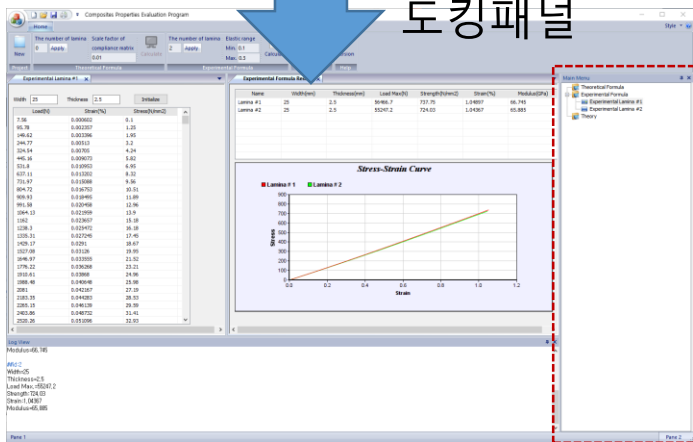
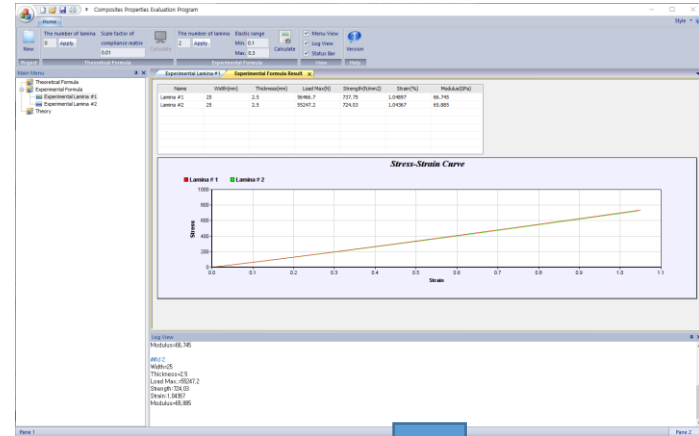
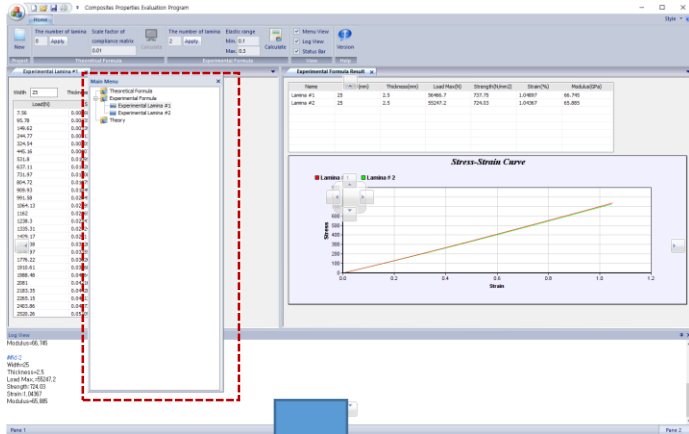
입력 View (Input View): This view displays input parameters for 'Experimental Lamina #1'. It includes fields for 'Width' (25), 'Thickness' (2.5), and 'Initialize'. Below these is a table with columns 'Load(N)', 'Strain(%)', and 'Stress(N/mm2)'. The table contains 25 rows of data.

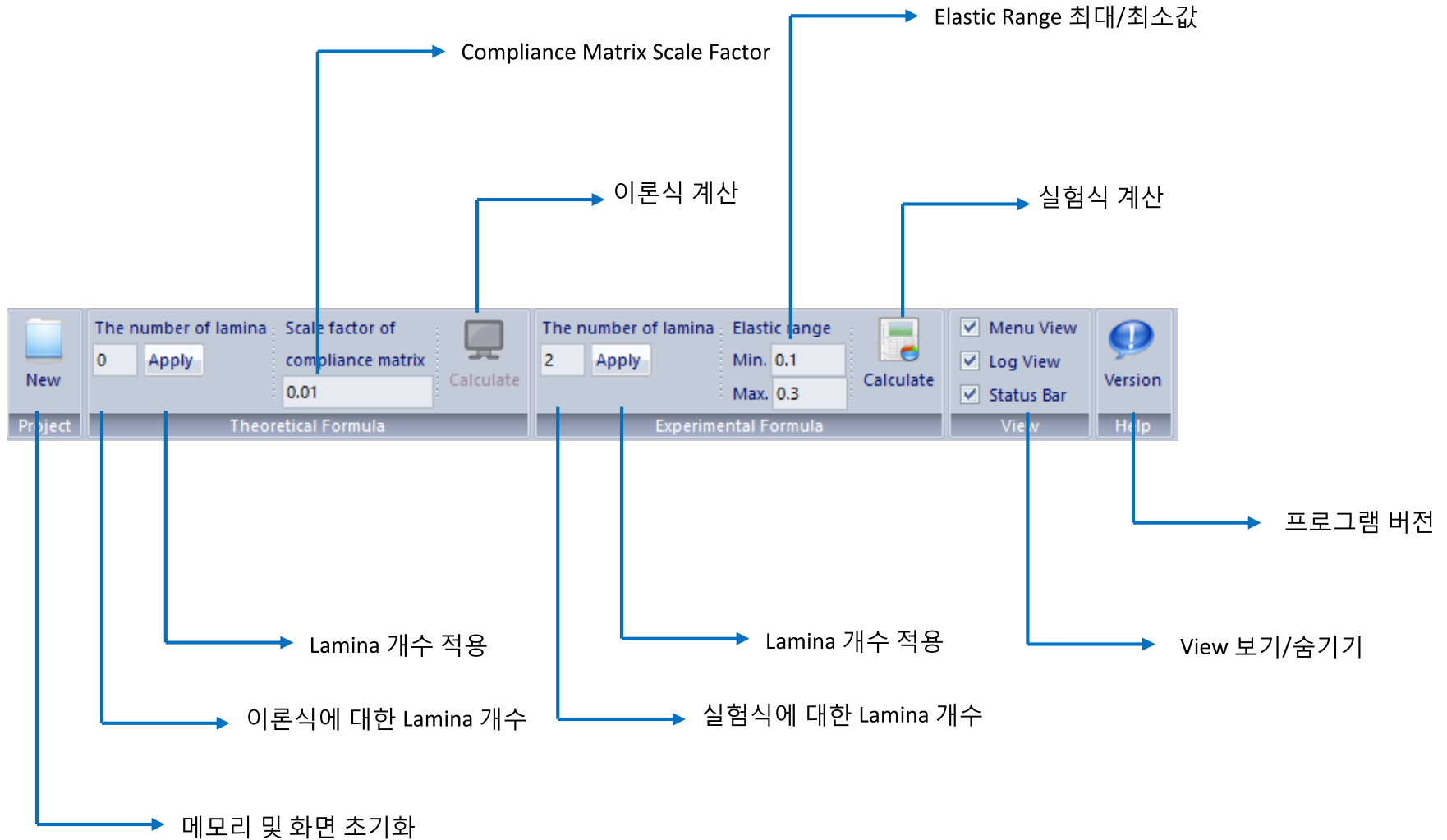
결과 출력 View (Result View): This view displays the 'Experimental Formula Result' and a 'Stress-Strain Curve'. The result table shows properties for 'Lamina #1' and 'Lamina #2'. The stress-strain curve plots 'Stress' (0 to 900) against 'Strain' (0.0 to 1.2) for both laminae.

로그 View (Log View): This view displays the 'Log View' output, showing calculated values for 'Modulus', 'Width', 'Thickness', 'Load Max', 'Strength', 'Strain', and 'Modulus'.

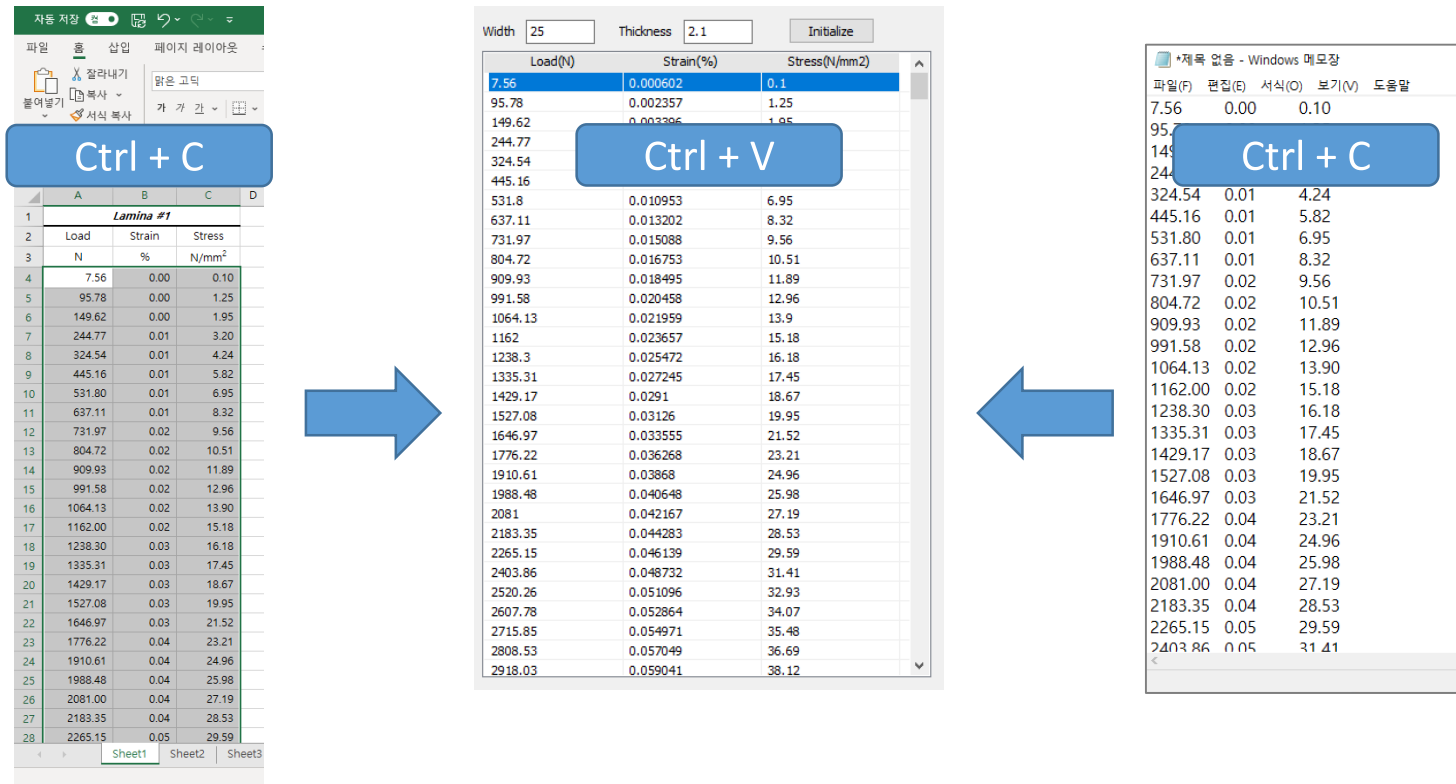
Name	Width(mm)	Thickness(mm)	Load Max(N)	Strength(N/mm2)	Strain(%)	Modulus(GPa)
Lamina #1	25	2.5	56466.7	737.75	1.04897	66.745
Lamina #2	25	2.5	55247.2	724.03	1.04367	65.885

- 모듈 선택 패널은 도킹패널 형태로 구성하여 사용자의 기호에 따라 배치 가능
- 다중 View는 직관적인 입력 UI 제공과 다양한 결과 동시 가시화 가능



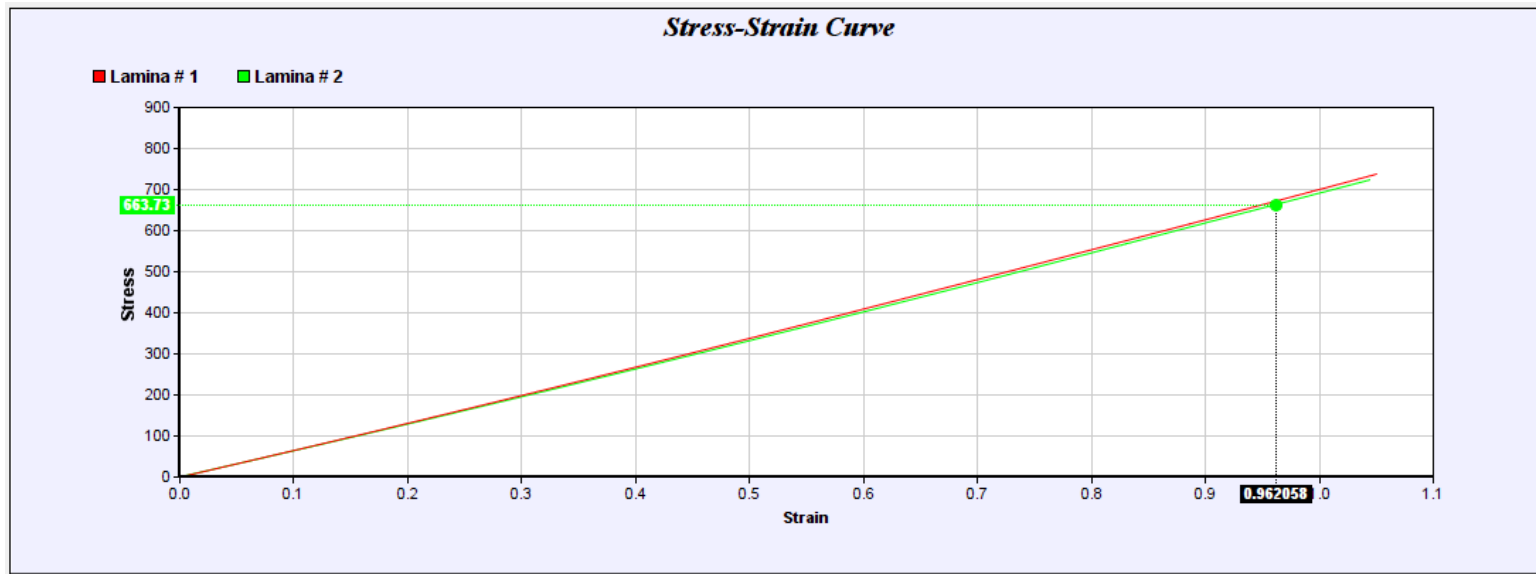


- 시험데이터 등의 값을 입력할 경우 붙여넣기 편의 기능을 제공
- Microsoft Excel 및 문서편집기를 통한 복사/붙여넣기 가능

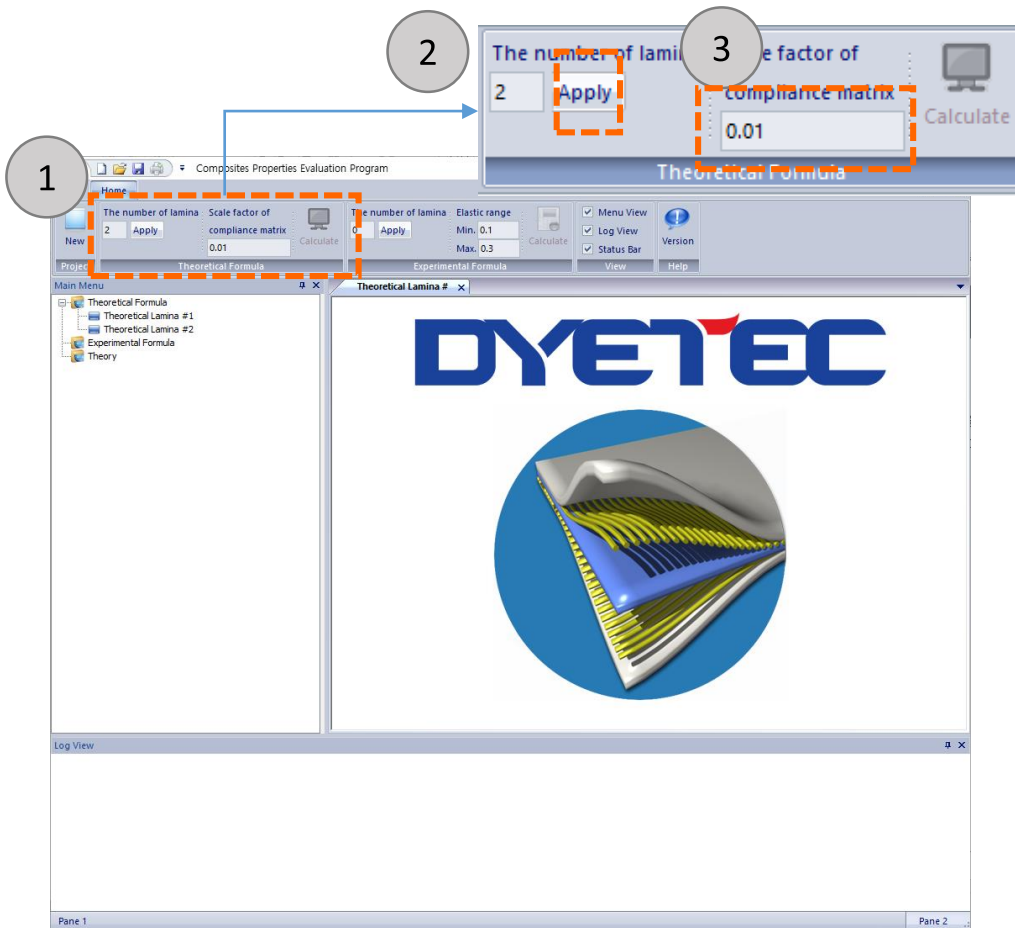


[엑셀 데이터 붙여넣기]

- 시험 데이터 그래프 출력에 대한 x, y 값 표시
- 마우스 커서 이동에 대한 x, y 값 표시

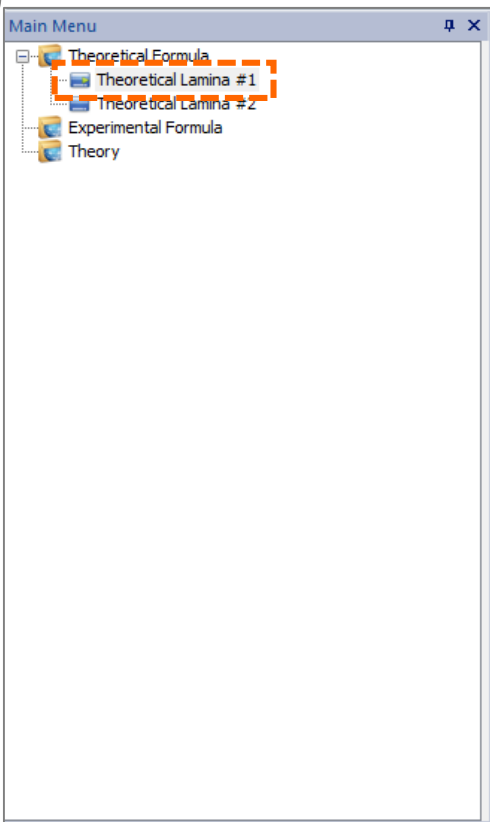


[마우스 커서 이동에 따른 x, y 값 표시]

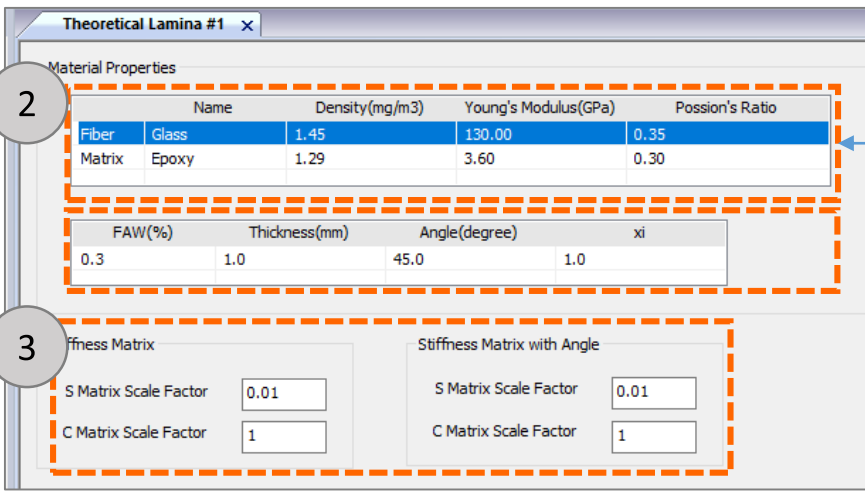


1. Lamina 개수 입력
2. Apply 버튼 클릭
3. Scale factor of compliance matrix 입력

1



2



3

1. Main Menu의 Lamina #1 클릭
2. Material Properties 입력
 - Excel과 문서편집기에서 복사/붙여넣기 가능
3. Matrix scale factor 입력
4. Lamina #2에 대해서도 동일하게 진행

	A	B	C	D	E
1	A. Input data for material properties				
2		Material	Density	Young's modulus	Poisson's ratio
3	Unit		mg/m ³	GPa	
4	Fiber	Glass	1.45	130.00	0.35
5	Matrix	Epoxy	1.29	3.60	0.30
6					

1

The number of lamina:

Scale factor of compliance matrix:

Theoretical Formula

2

Information for laminate

No.	Fiber	Matrix	FAW	Thickness	Angle
1	Glass	Epoxy	0.3	1	45
2	Glass	Epoxy	0.3	1	45

3

Material properties for laminate(Homogenization)

Properties	Unit	Value
Ex	GPa	7.05123
Ey	GPa	7.05122
Gxy	GPa	5.149
NUxy		0.999997
NUyx		0.730225
ETAxxy		-0.461397
ETAxxy		-0.461394

4

Translat for ABAQUS

Properties	Unit	Value
E1	MPa	7051.23
E2	MPa	7051.22
NU12		0.999997
G12	MPa	5149
G13	MPa	5149
G23	MPa	5149

5

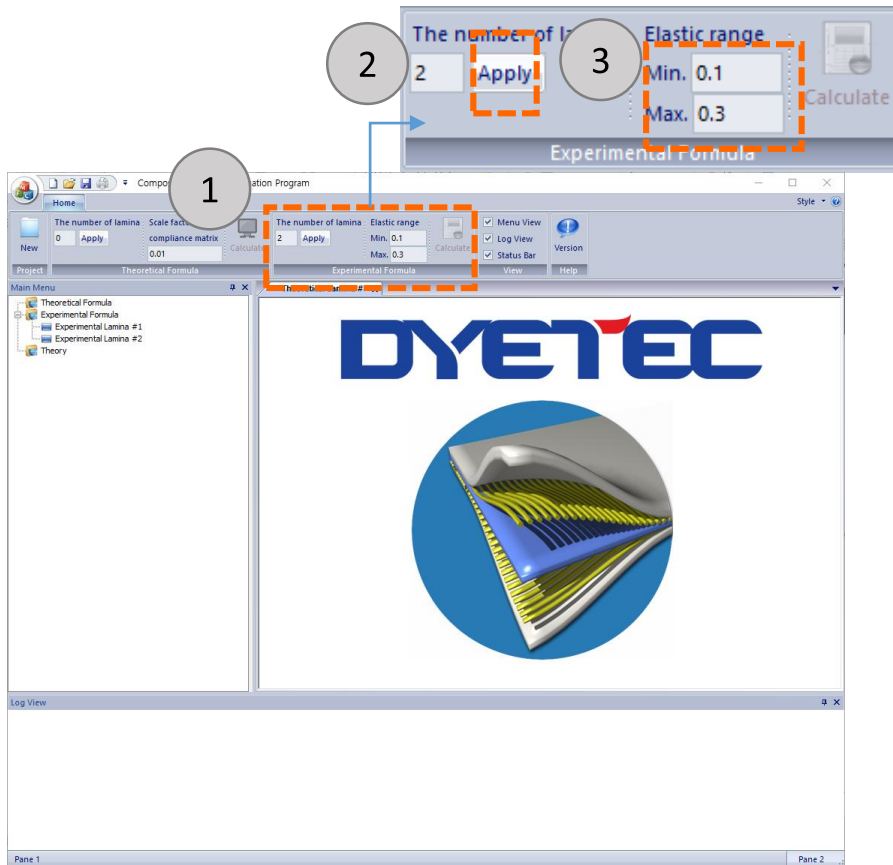
Material properties card

*Material, name=Composite

*Elastic, type=LAMINA

7051.231306, 7051.222673, 0.999997, 5148.996949, 5148.996949, 5148.996949

- 1. 리본 메뉴의 Calculate 클릭
- 2. Laminate 정보 확인
- 3. 계산된 laminate 확인
- 4. Abaqus 물성 확인
- 5. Abaqus 해석을 위한 card 확인



1. Lamina 개수 입력
2. Apply 버튼 클릭
3. Elastic range 최소, 최대값입력

The screenshot illustrates the VEPoTex software interface for inputting lamina information. It is divided into three main sections, each highlighted with a numbered circle:

- 1. Main Menu:** A sidebar menu on the left with options: Theoretical Formula, Experimental Formula, Experimental Lamina #1, Experimental Lamina #2, and Theory. 'Experimental Lamina #1' is highlighted with a red dashed box.
- 2. Lamina Properties:** A central panel with input fields for 'Width' (25) and 'Thickness' (2.5), and an 'Initialize' button.
- 3. Experimental Data Table:** A table with three columns: Load(N), Strain(%), and Stress(N/mm2). The table contains 20 rows of data. The first row is highlighted in blue.

On the right side of the interface, there is a secondary window showing a spreadsheet view of the data table, with a green dashed box highlighting the first row of data.

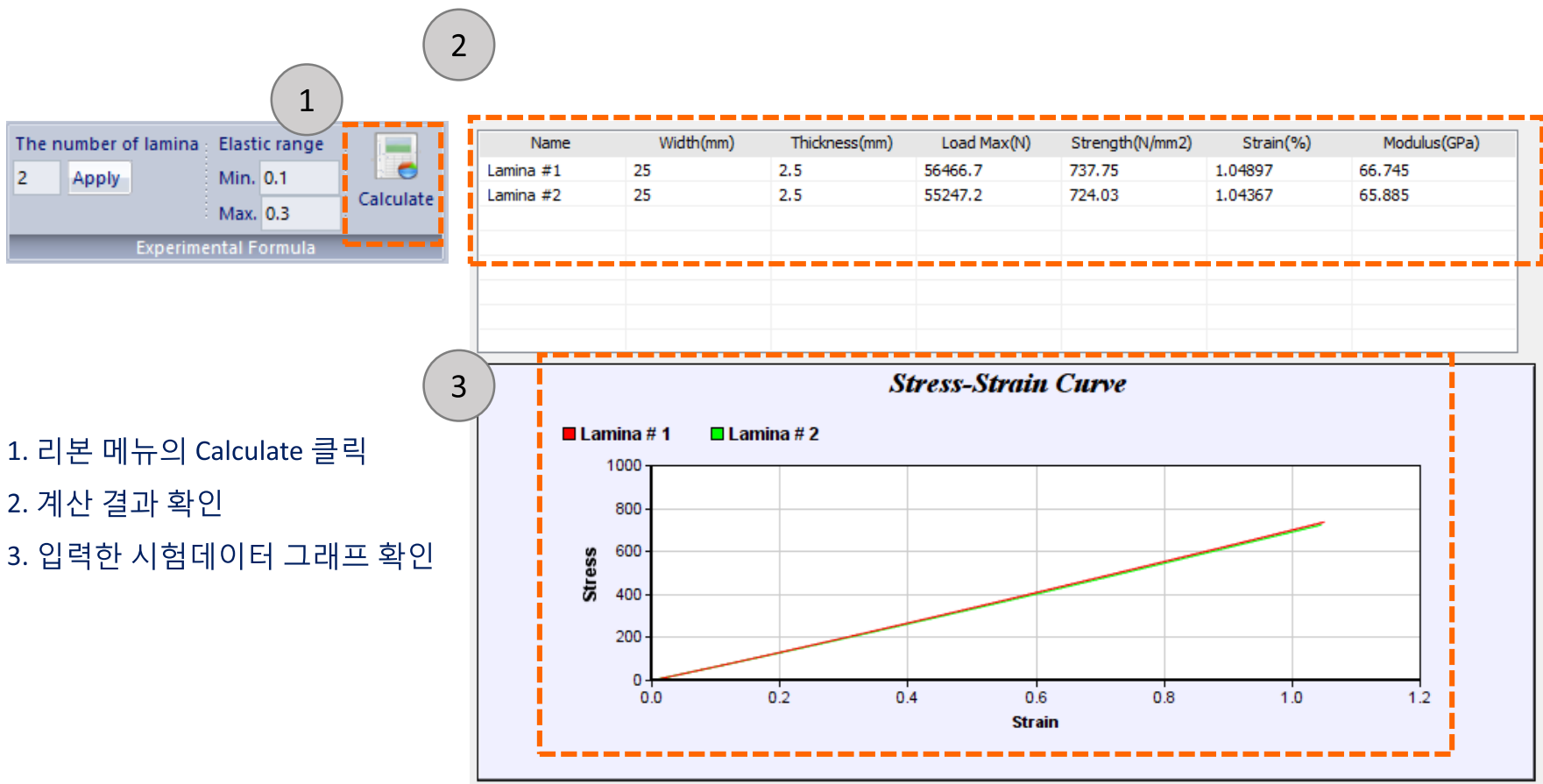
	Load(N)	Strain(%)	Stress(N/mm2)
1	7.56	0.000602	0.10
2	95.78	0.002357	1.25
3	149.62	0.003396	1.95
4	244.77	0.005130	3.20
5	324.54	0.007050	4.24
6	445.16	0.009073	5.82
7	531.80	0.010953	6.95
8	637.11	0.013202	8.32
9	731.97	0.015088	9.56
10	804.72	0.016753	10.51
11	909.93	0.018495	11.89
12	991.58	0.020458	12.96
13	1064.13	0.021959	13.90
14	1162.00	0.023657	15.18
15	1238.30	0.025472	16.18
16	1335.31	0.027245	17.45
17	1429.17	0.029100	18.67
18	1527.08	0.031260	19.95
19	1646.97	0.033555	21.52
20	1776.22	0.036268	23.21
21	1910.61	0.038680	24.96
22	1988.48	0.040648	25.98
23	2081.00	0.042167	27.19
24	2183.35	0.044283	28.53
25	2265.15	0.046139	29.59

1. Main Menu의 Lamina #1 클릭

2. Lamina의 폭과 두께 입력

3. 시험데이터 입력

- Excel과 문서편집기에서 복사/붙여넣기 이용



- 1. 리본 메뉴의 Calculate 클릭
- 2. 계산 결과 확인
- 3. 입력한 시험데이터 그래프 확인