

Numerical Investigation Of Embedded Steel Connections In Extra-large Laminated Glass Panels Under Wind Loading

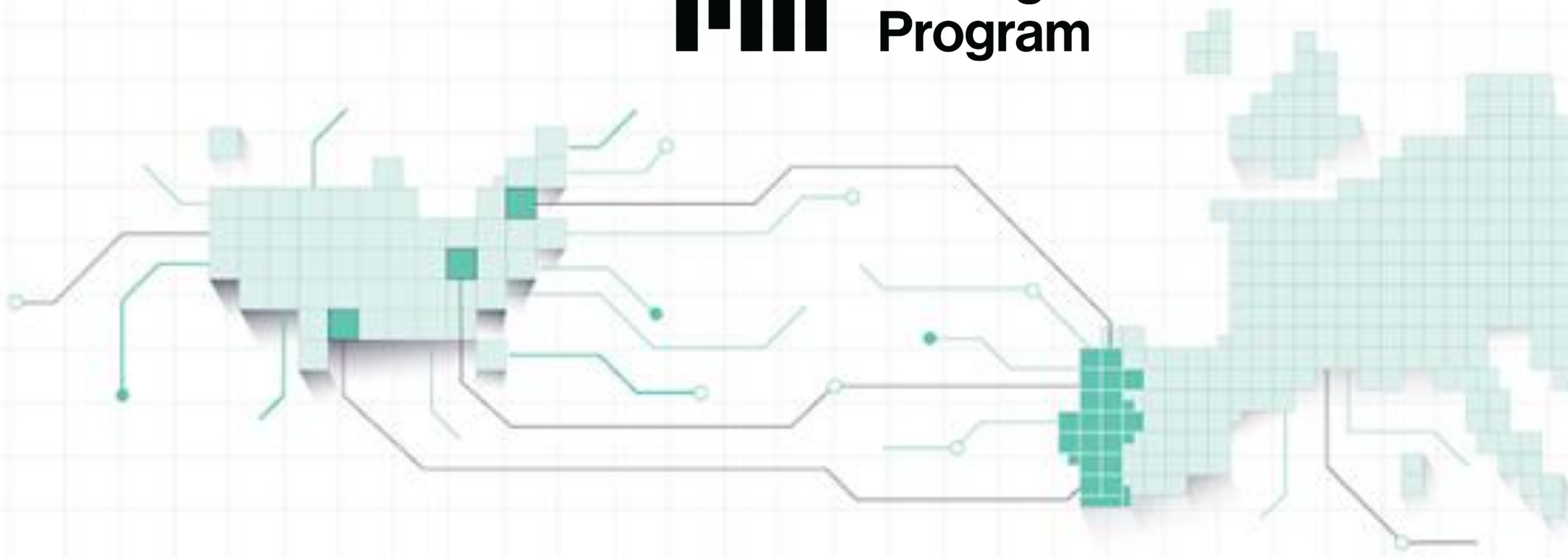


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RESEARCH GAP and OBJECTIVES

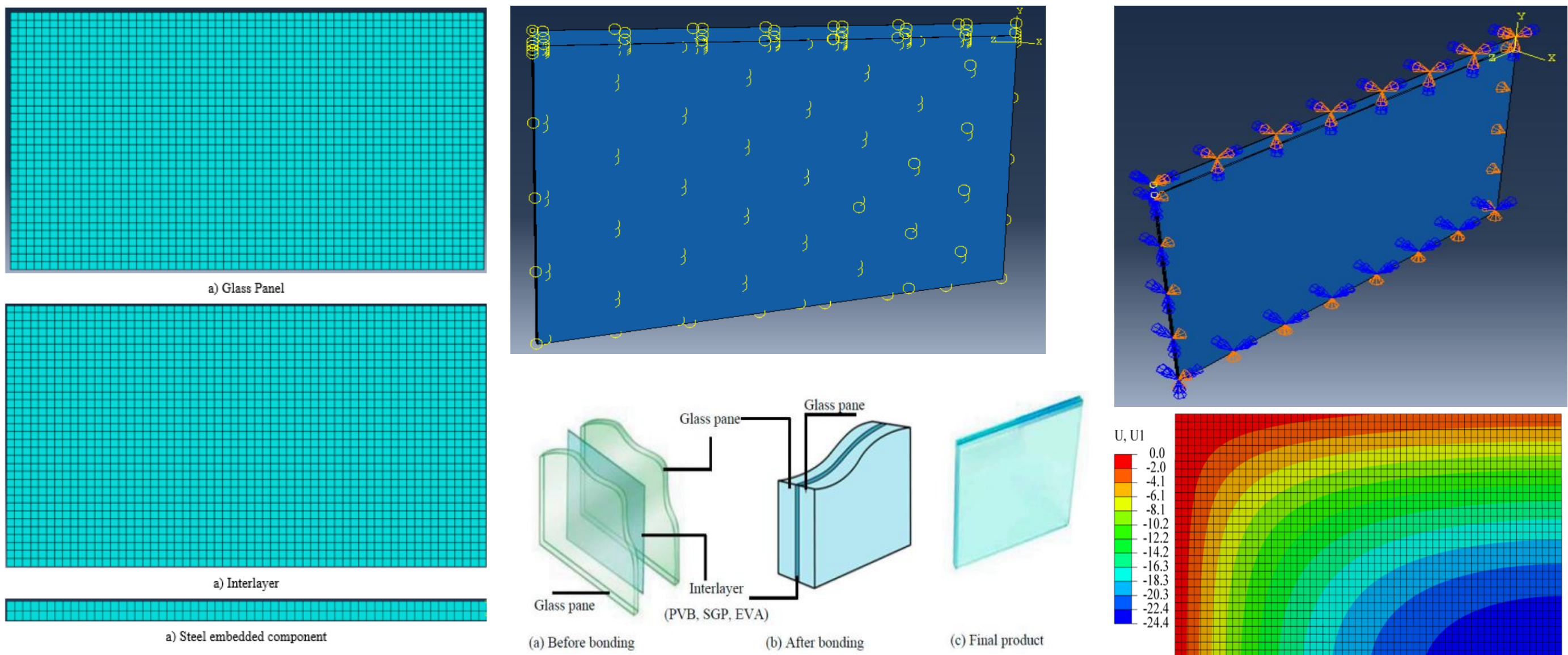


Research Objectives:

- Develop integrated 3D FE model of the complete panel-connection system.
- Quantify global deformation and glass stress under wind loading.
- Characterize local steel and PVB load-transfer response.
- Investigate the effects of glass thickness and embedded steel length.
- Establish the governing global-local interaction.

Existing research has largely investigated laminated glass panel behaviour and embedded connection mechanisms separately, with focus on their coupled response in extra-large panels. The interaction between global deformation, glass stress, PVB interlayer load transfer and local steel effect remains insufficiently quantified. In particular, the influence of glass thickness and embedded steel length on the redistribution of structural demand between the panel and connection has not been systematically evaluated within an integrated numerical framework.

3D FINITE ELEMENT MODELS



Panel Dimension	Model	Materials	Loading	Interactions
3250 x 6000 mm (Extra-Large Panels)	3D quarter-symmetry FE model	Glass: E = 70 GPa PVB: hyperelastic Stainless Steel: Linear Elastic	Self-weight + 4 kPa uniform wind pressure	Glass-PVB-steel interface

PARAMETRIC NUMERICAL STUDY

Design matrix (9 configurations)

		Glass thickness		
		G10 (10 mm)	G20 (20 mm)	G30 (30 mm)
Embedded steel length	S40 (40 mm)	LG-S40-G10	LG-S40-G20	LG-S40-G30
	S70 (70 mm)	LG-S70-G10	LG-S70-G20	LG-S70-G30
	S100 (100 mm)	LG-S100-G10	LG-S100-G20	LG-S100-G30

Parameters:

- Glass thickness: 10, 20, 30 mm
- Embedded steel length: 40, 70, 100 mm
- PVB thickness: constant at this stage
- Total FE configurations: 9, in this study

Response quantities:

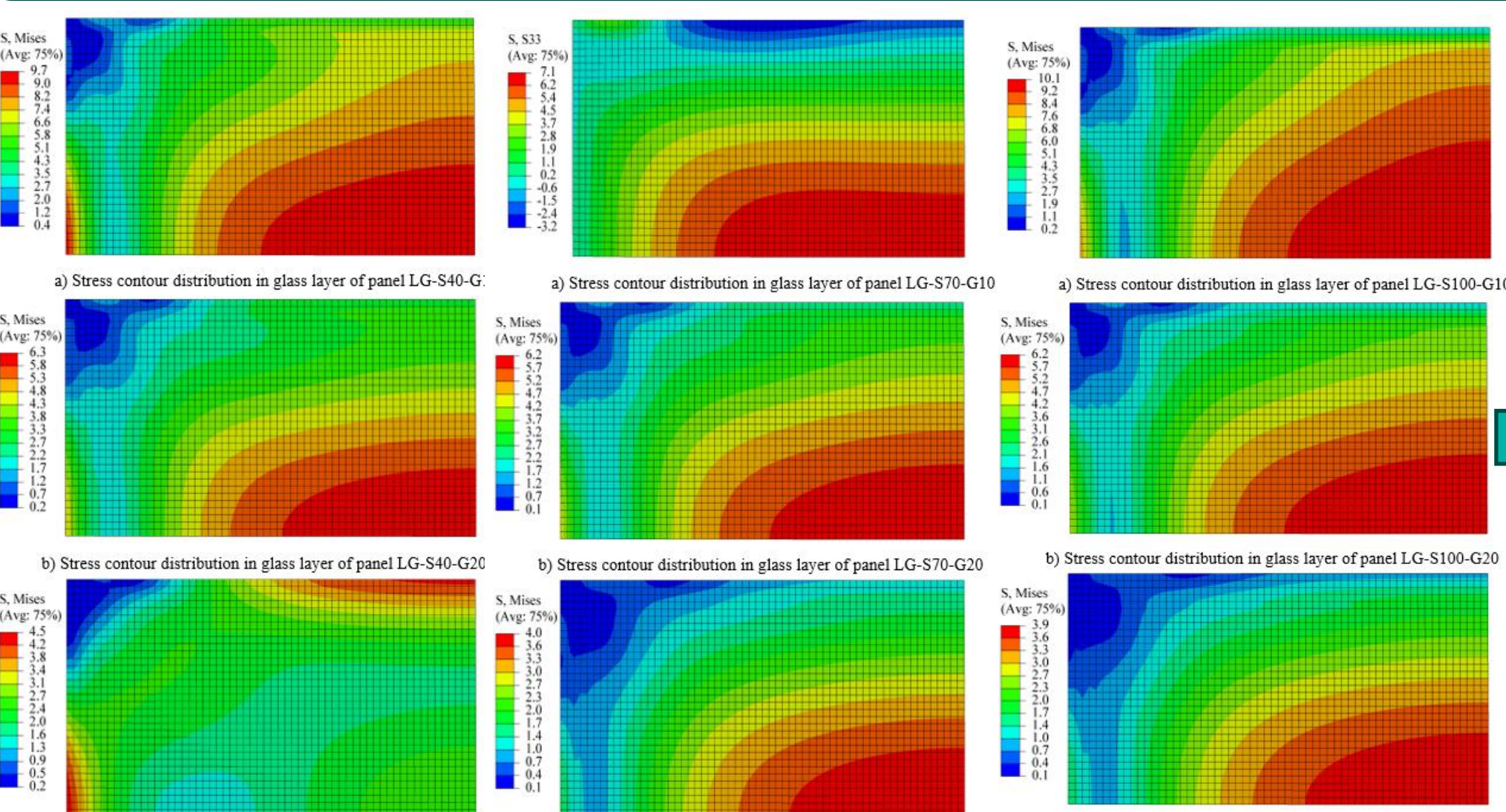
Global Response:

- out-of-plane displacement
- glass stress
- pressure-displacement

Local Response:

- Embedded steel stress
- PVB shear response
- load-transfer mechanism

NUMERICAL RESULTS, GLOBAL-LOCAL RESPONSE



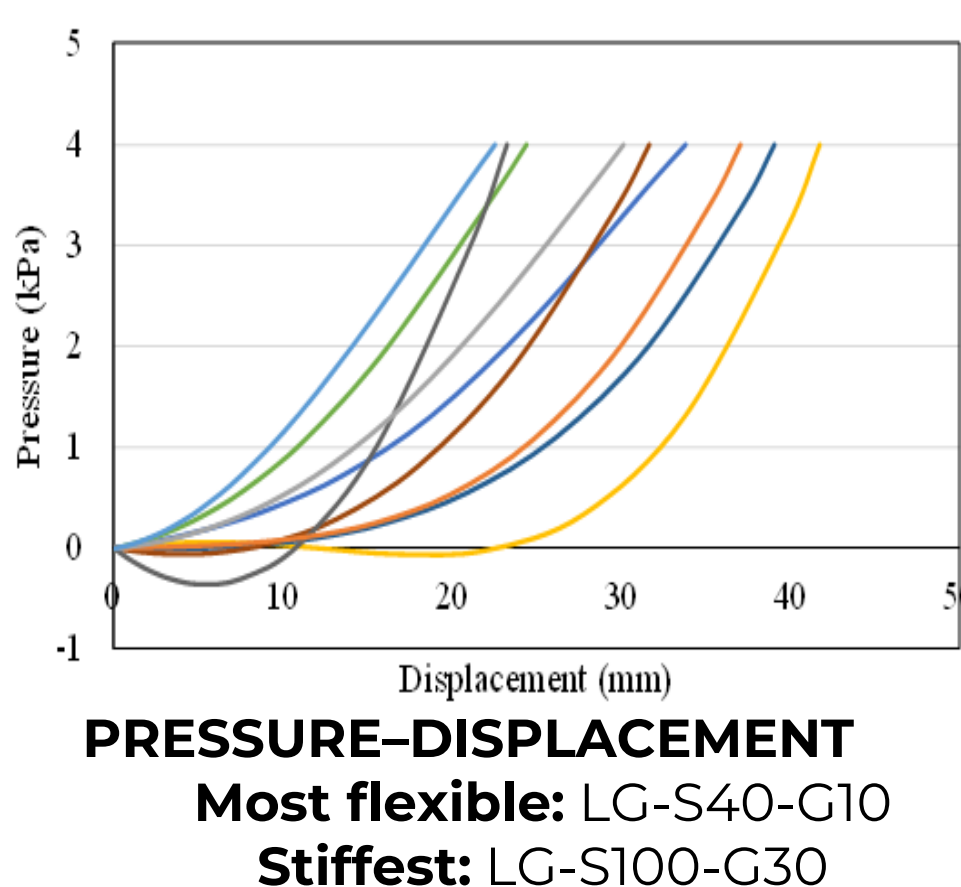
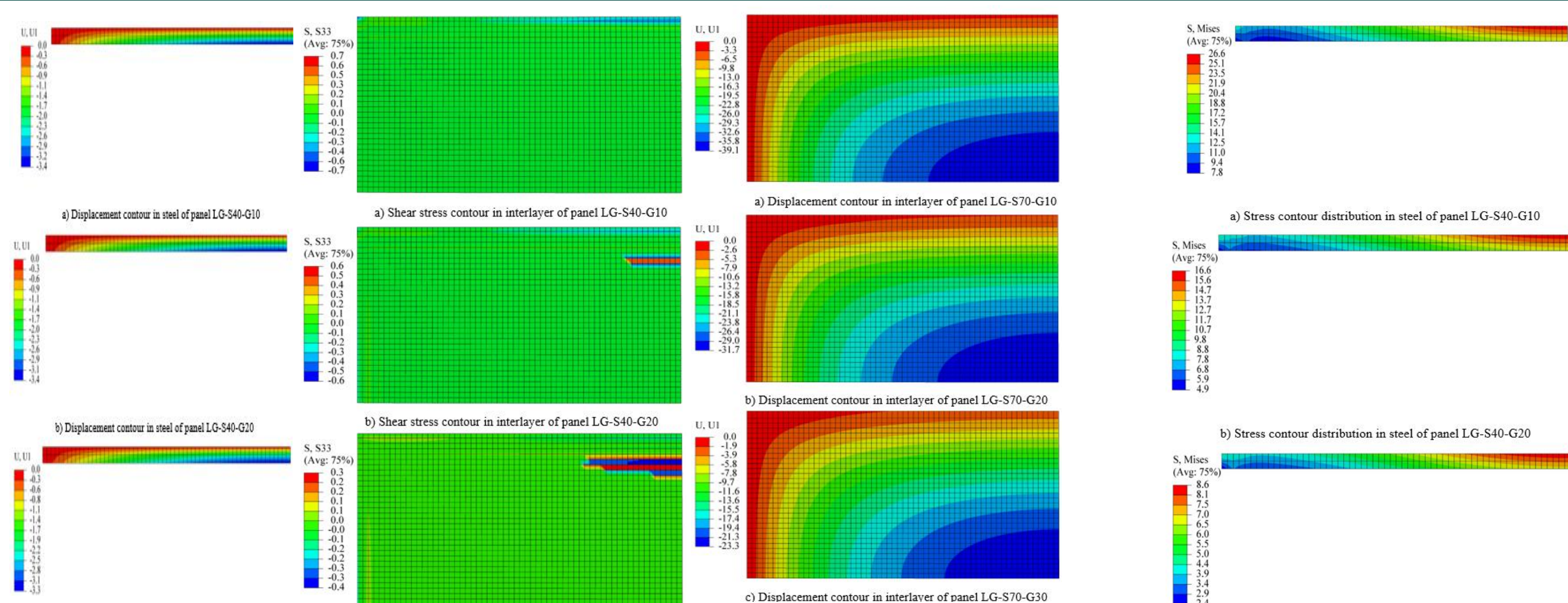
GLASS STRESS
S40: 9.7 → 4.5 MPa (-53.6%)
S70: 7.1 → 4.0 MPa (-43.7%)
S100: 10.1 → 3.9 MPa (-61.4%)
Overall reduction: 43.7–61.4%
Governing global parameter: Glass thickness

Key Results GLOBAL-LOCAL INTERACTION

GLASS THICKNESS ↑
U1 ↓39–42%
Glass stress ↓43.7–61.4%

EMBEDDED LENGTH ↑
Steel U1 magnitude ↑58.8%
Steel stress at G30 ↑102.3%

PVB RESPONSE
Stress ↓28.6–45.0%



CONCLUSIONS & SCIENTIFIC CONTRIBUTION

- Glass thickness governs global stiffness and deformation
- Embedded steel length controls local load transfer
- PVB transfers demand between glass and steel connection
- Integrated 3D FE framework enables connection optimisation

Funded by: