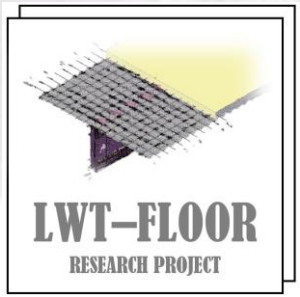
Project title: **Innovative lightweight cold-formed steel-concrete composite floor system**
Acronym: **LWT-FLOOR** Project ID: **UIP-2020-02-2964**
4th LWT-FLOOR Project Workshop

Influence of shear connection and end supports onto self-vibrations of cold-formed steel concrete composite floor

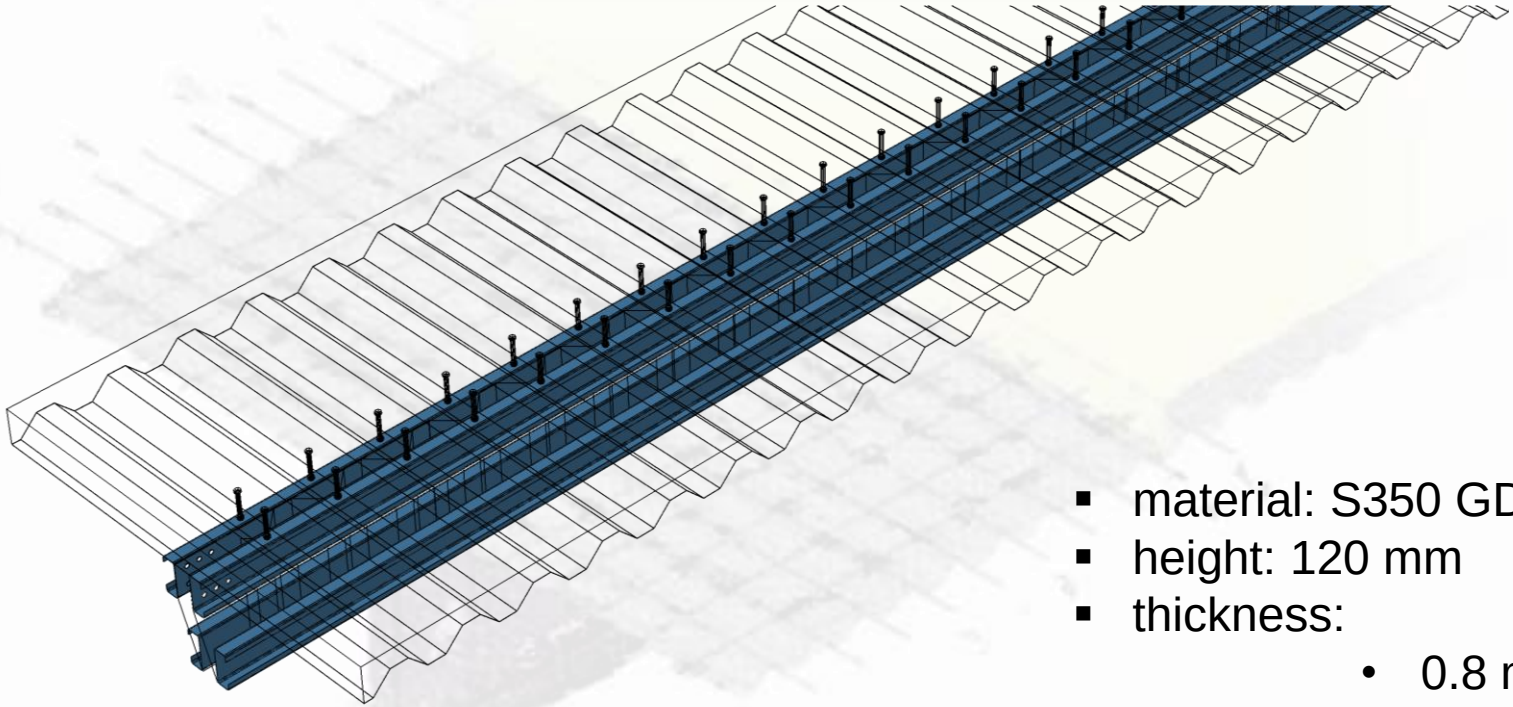
Utjecaj posmične veze i ležajnih uvjeta na vlastite vibracije spregnute međukatne konstrukcije formirane od hladno oblikovanog čelika i betona

Andrea Rajić, Ivan Lukačević, Ivan Ćurković, Vlaho Žuvelek



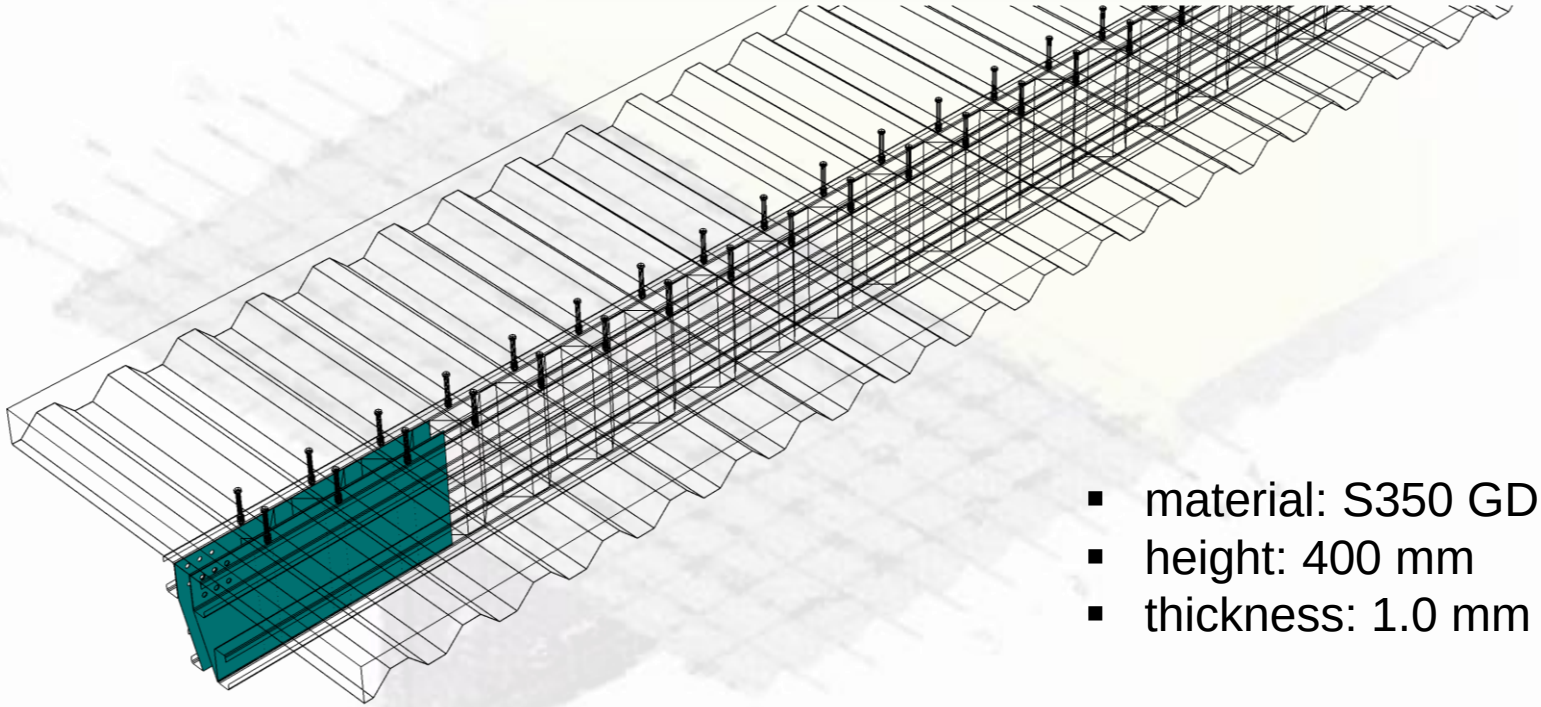
University of Zagreb/Faculty of Civil Engineering
http://www.grad.unizg.hr/lwtfloor

LWT-FLOOR COMPOSITE BEAM



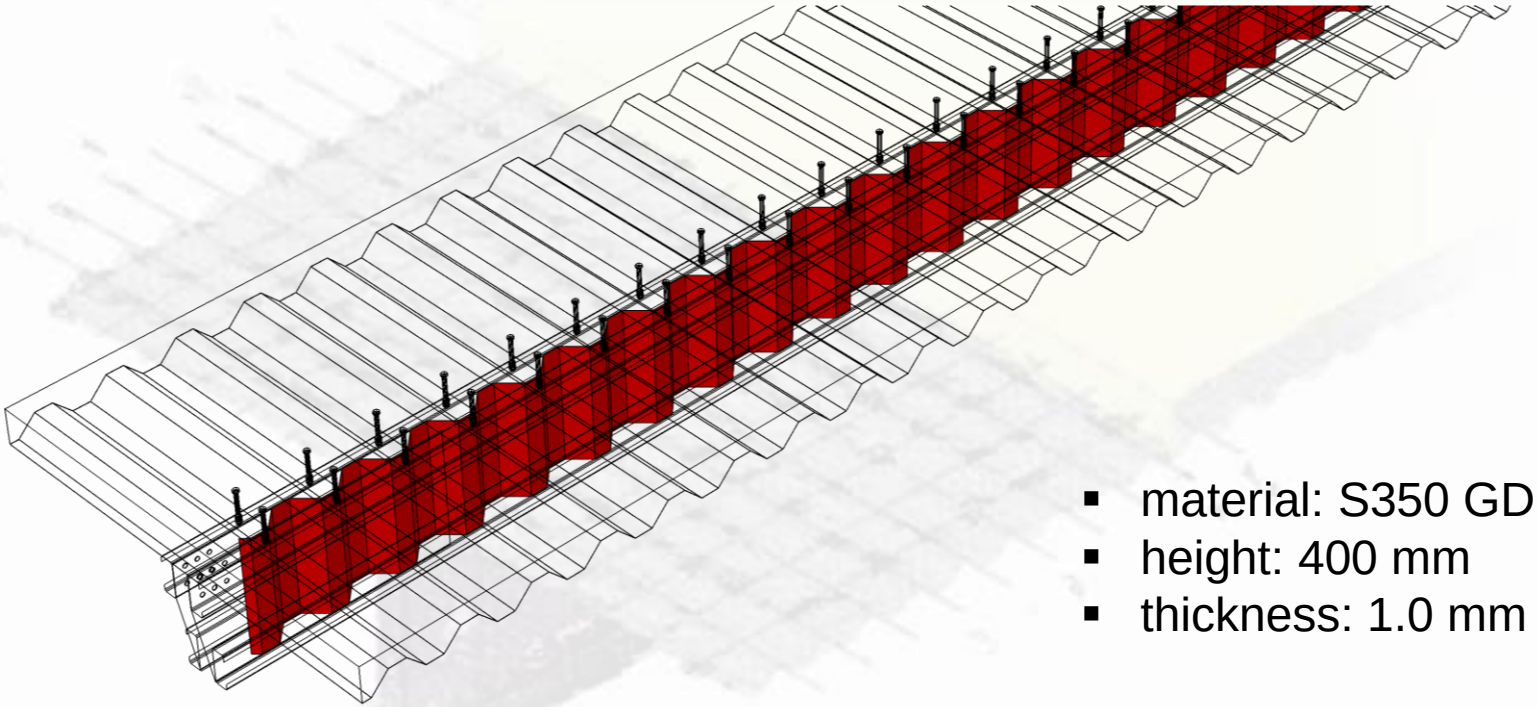
- material: S350 GD
- height: 120 mm
- thickness:
  - 0.8 mm
  - 1.0 mm
  - 2.5 mm
  - 3.0 mm

LWT-FLOOR COMPOSITE BEAM



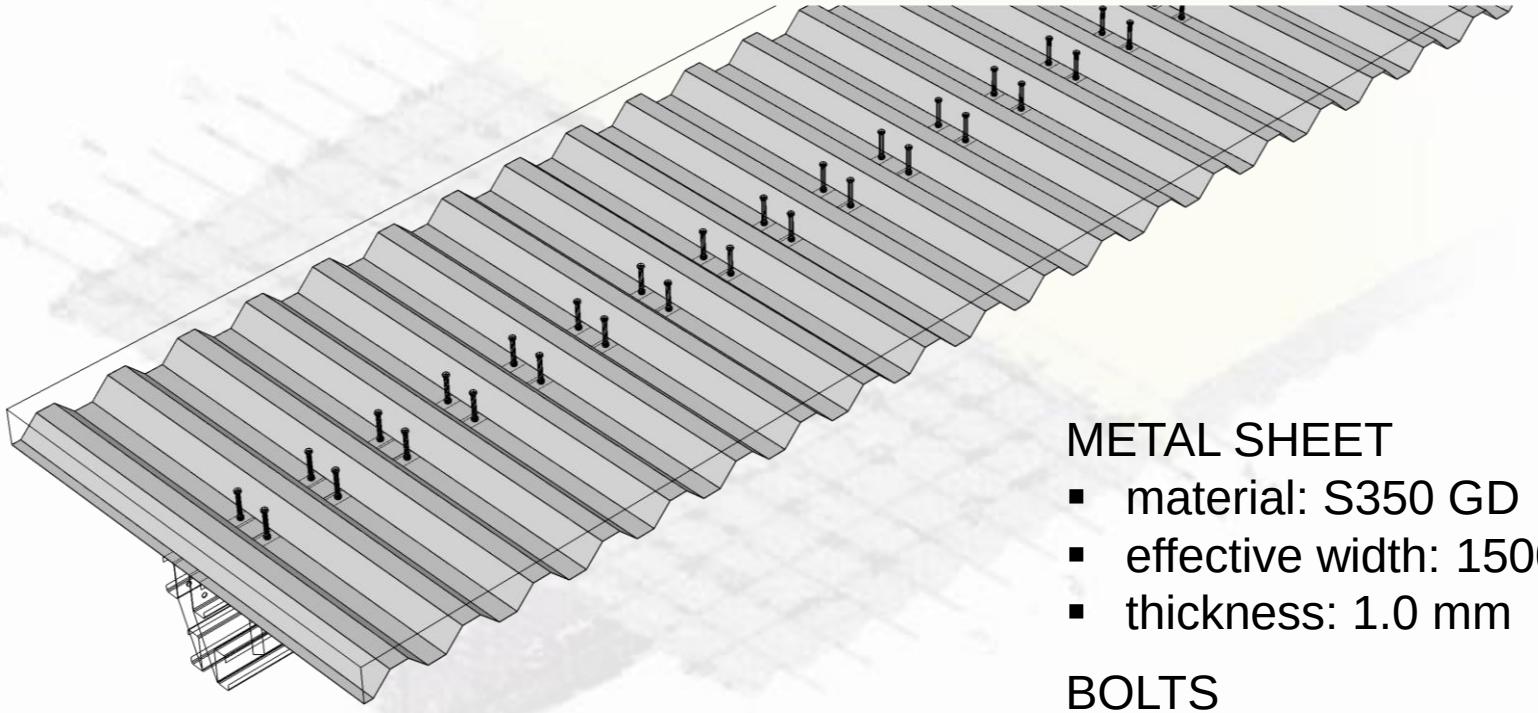
- material: S350 GD
- height: 400 mm
- thickness: 1.0 mm

LWT-FLOOR COMPOSITE BEAM



- material: S350 GD
- height: 400 mm
- thickness: 1.0 mm

LWT-FLOOR COMPOSITE BEAM



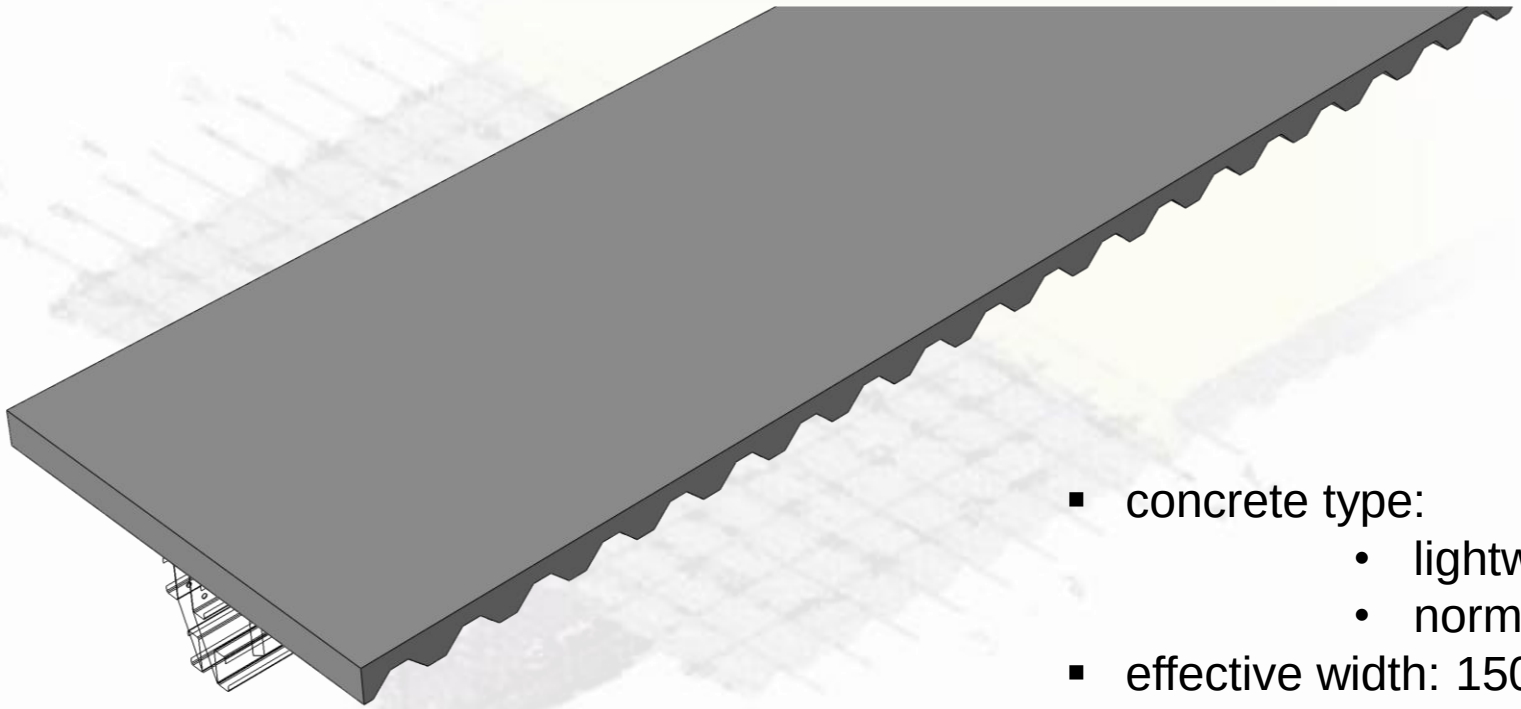
METAL SHEET

- material: S350 GD
- effective width: 1500 mm
- thickness: 1.0 mm

BOLTS

- quality: 8.8
- height: 117 mm
- diameter: 12 mm/16mm

LWT-FLOOR COMPOSITE BEAM



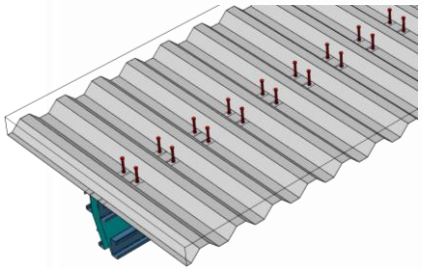
- concrete type:
  - lightweight
  - normal
- effective width: 1500 mm
- height: 120 mm

SHEAR CONNECTION

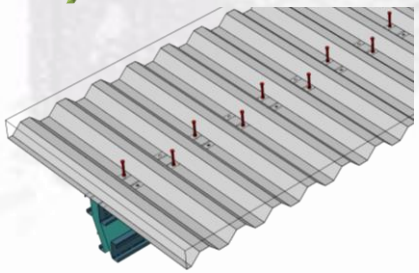
I)

Tie constraint:
- upper flange of C profile – metal sheet
- metal sheet – concrete slab

II)



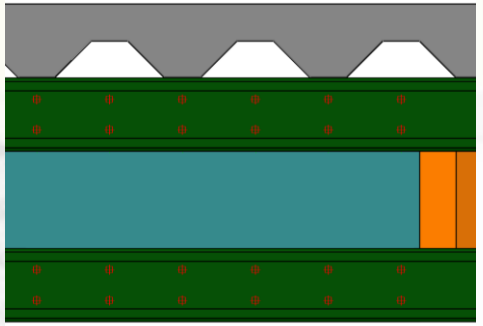
III)



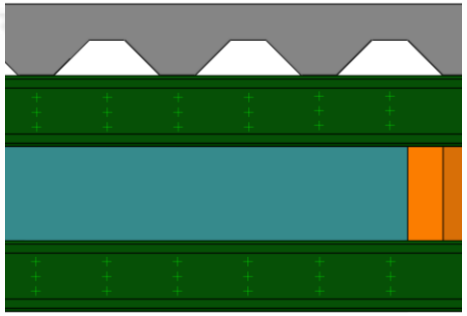
CONNECTION BETWEEN STEEL ELEMETS

I) Tie constraint

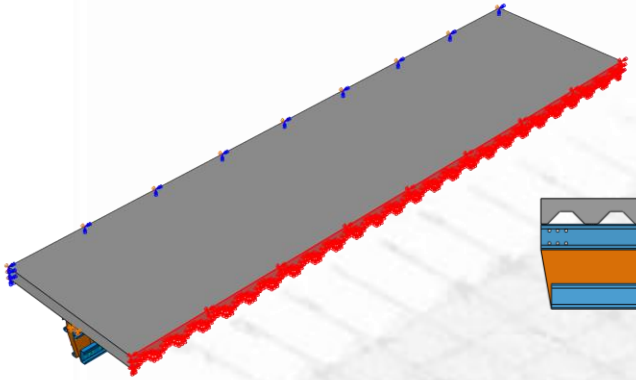
II)

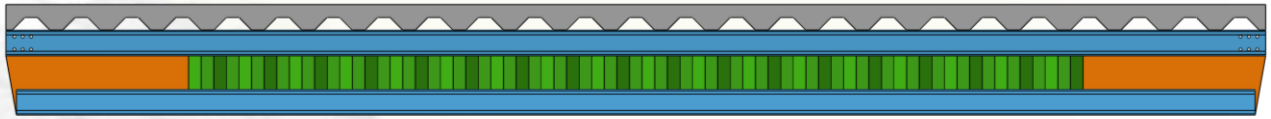


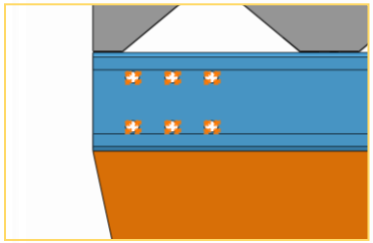
III)

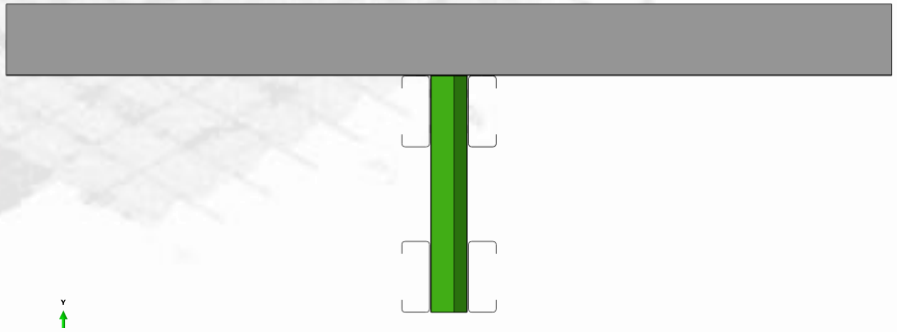


OVERALL GEOMETRY AND BC

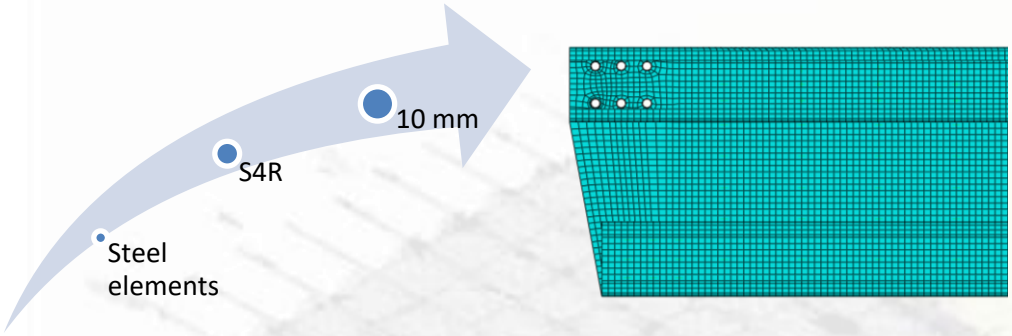








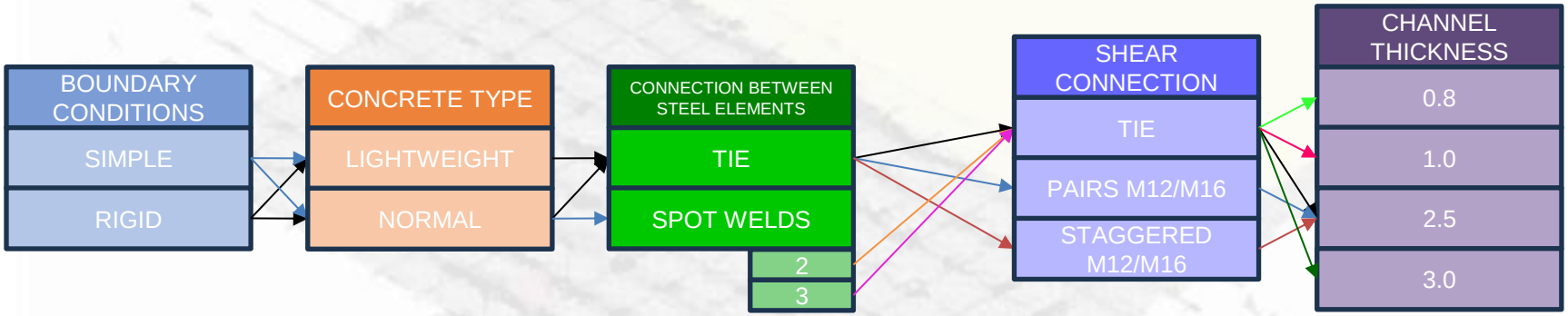
ELEMENT TYPE AND MESH SIZE

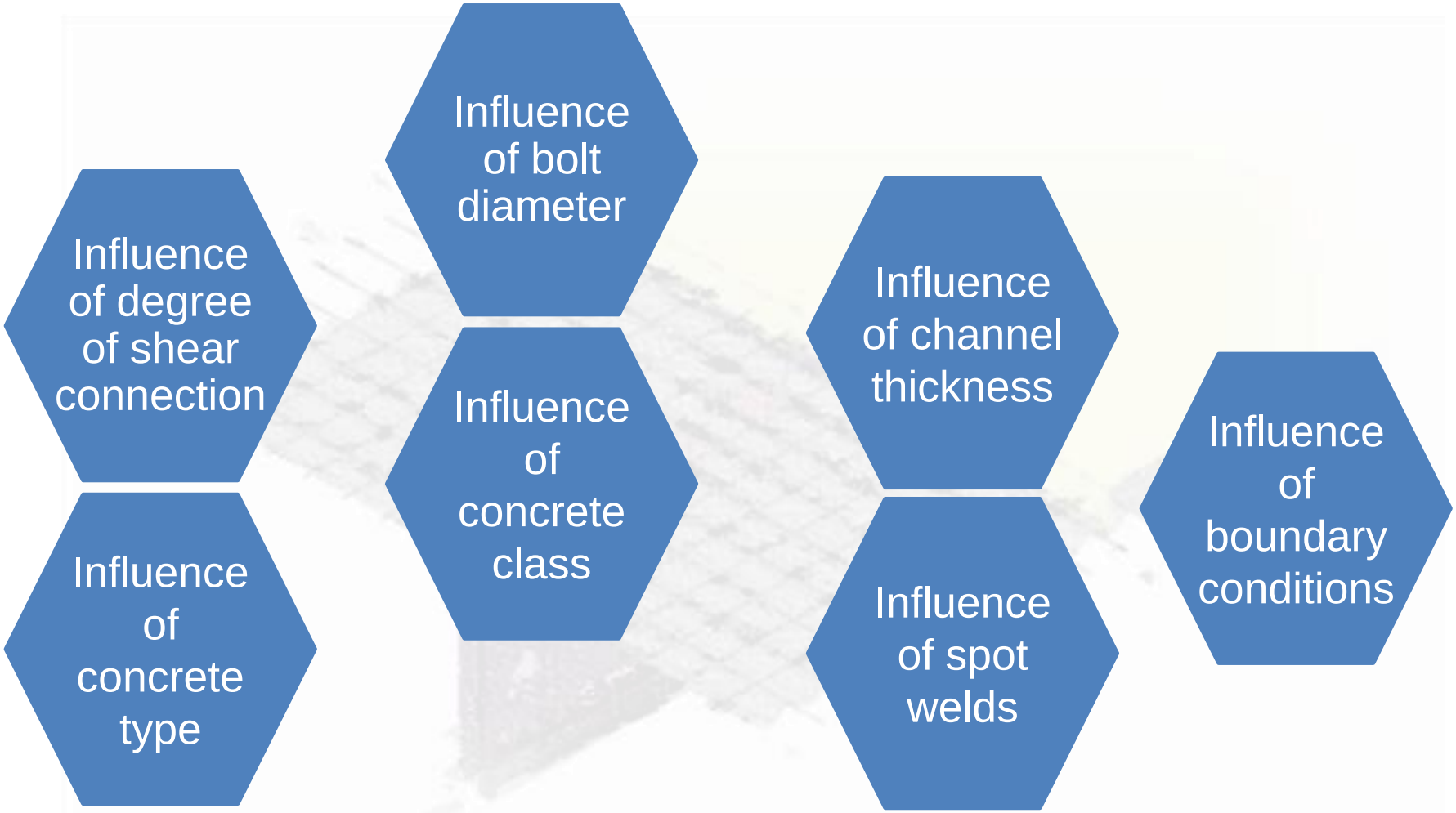


STEEL ELEMENTS			
MESH/MODE	1	2	3
15	21.81	64.58	73.17
10	21.60	63.70	72.45
7	21.60	63.81	72.37
5	21.51	63.42	71.96
2	21.51	63.38	71.98

CONCRETE SLAB			
MESH/MODE	1	2	3
30	21.73	64.24	68.69
15	21.81	64.58	73.17
10	21.82	64.67	74.27
7	21.82	64.70	75.0

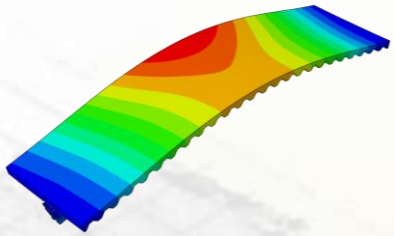
MODELS


BOUNDARY CONDITIONS
SIMPLE
RIGID
CONCRETE TYPE
LIGHTWEIGHT
NORMAL
CONNECTION BETWEEN STEEL ELEMENTS
TIE
SPOT WELDS
2
3
SHEAR CONNECTION
TIE
PAIRS M12/M16
STAGGERED M12/M16
CHANNEL THICKNESS
0.8
1.0
2.5
3.0

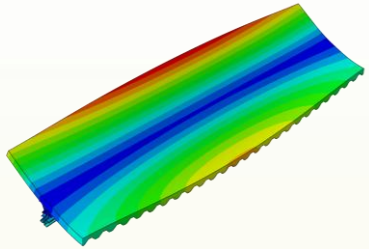

Influence of degree of shear connection
Influence of bolt diameter
Influence of channel thickness
Influence of boundary conditions
Influence of concrete type
Influence of concrete class
Influence of spot welds

Influence of degree of shear connection

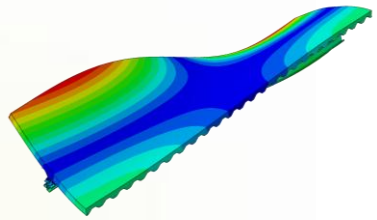
MODE 1

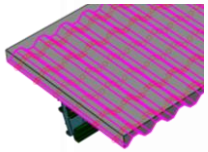


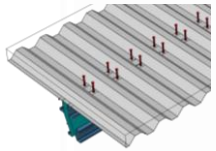
MODE 2

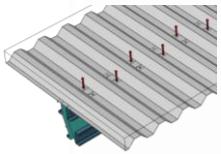


MODE 3



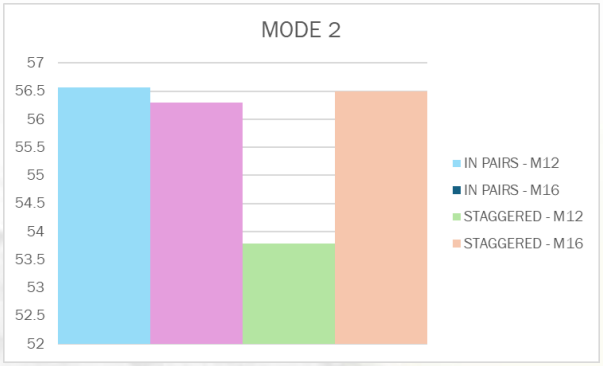


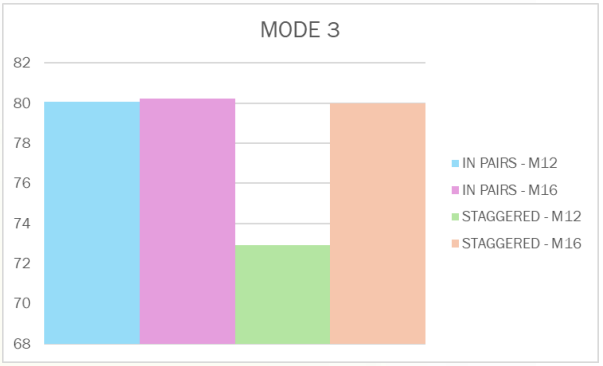


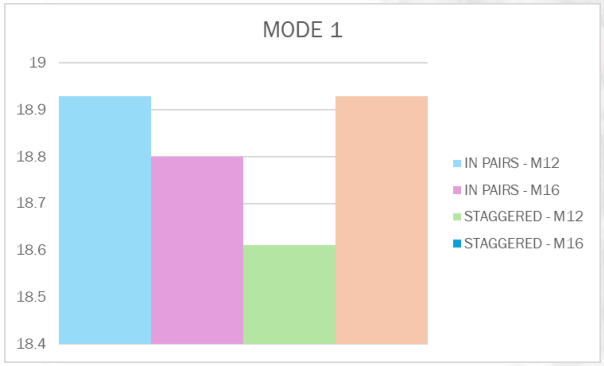


SHEAR CONNECTION	CONCRETE	MODE 1	MODE 2	MODE 3
TIE	LC	21.60	63.70	72.45
	NC	19.00	57.06	80.89
IN PAIRS	LC	21.52	63.17	71.77
	NC	18.93	56.57	80.09
STAGGERED	LC	21.20	60.39	67.55
	NC	18.61	53.78	72.92

Influence of bolt diameter



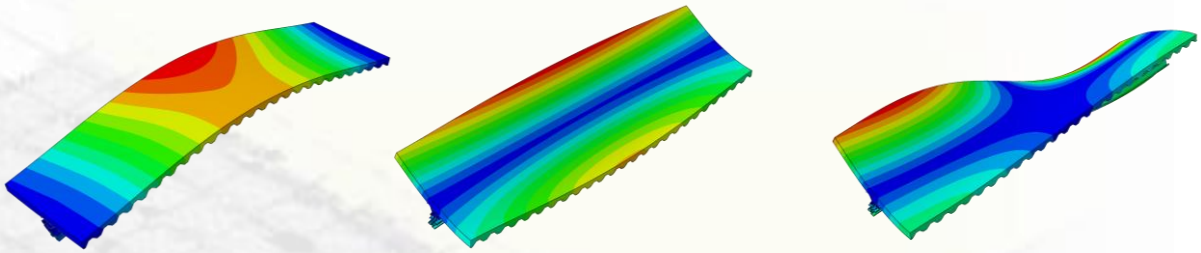


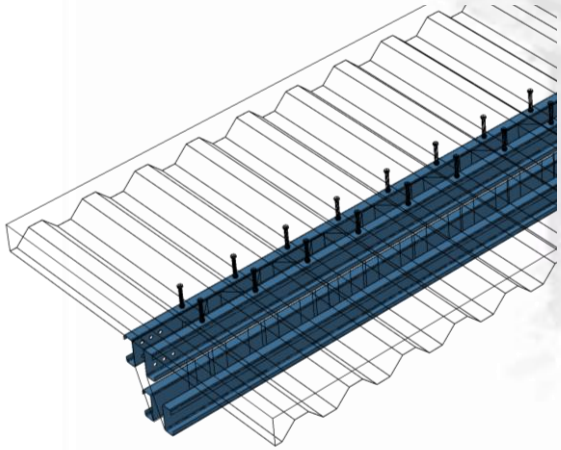


		DIAMETER	MODE 1	MODE 2	MODE 3
NC	IN PAIRS	12	18.93	56.57	80.09
		16	18.80	56.30	80.21
	STAGGERED	12	18.61	53.78	72.92
		16	18.93	56.49	80.00

Influence of channel thickness

MODE 1 MODE 2 MODE 3

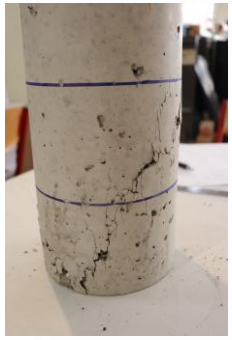




THICKNESS [mm]	CONCRETE	MODE 1	MODE 2	MODE 3
0.8	LC	12.60	38.74	69.79
	NC	10.83	33.96	63.06
1.0	LC	15.92	49.01	73.06
	NC	13.68	42.91	75.56
2.5	LC	21.60	63.70	72.45
	NC	19.00	57.06	80.89
3.0	LC	23.36	67.56	72.24
	NC	20.77	61.06	80.77

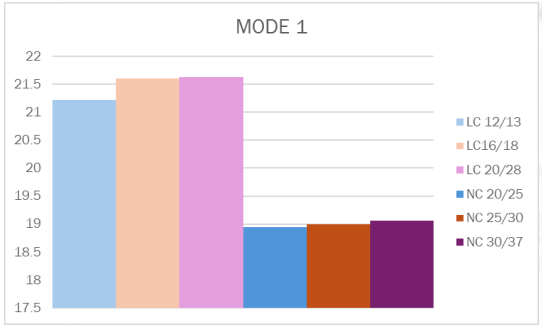
Influence of concrete type

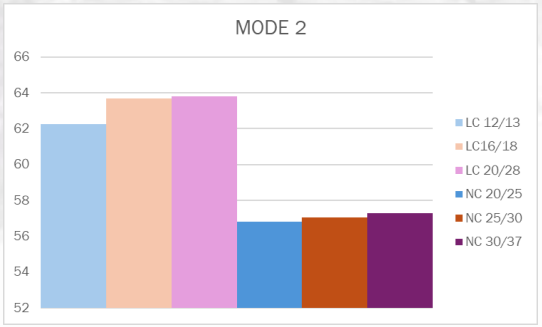
MODELS	CONCRETE	MODE 1	MODE 2	MODE 3
1	LC	21.60	63.70	72.45
	NC	19.00	57.06	80.89
2	LC	21.52	63.17	71.77
	NC	18.93	56.57	80.09
3	LC	21.20	60.39	67.55
	NC	18.61	53.78	72.92
4	LC	21.37	62.92	71.93
	NC	18.80	56.30	80.21
5	LC	21.51	63.11	71.72
	NC	18.93	56.49	80.00
8	LC	21.22	62.26	67.51
	NC	18.94	56.81	79.30
9	LC	21.63	63.81	72.86
	NC	19.06	57.28	82.28
10	LC	23.36	67.56	72.24
	NC	20.77	61.06	80.77
11	LC	15.92	49.01	73.06
	NC	13.68	42.91	75.56
12	LC	12.60	38.74	69.79
	NC	10.83	33.96	63.06
13	LC	31.50	68.60	73.81
	NC	28.60	60.97	82.35

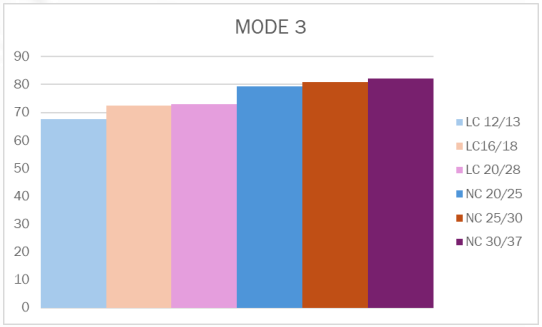


Influence of concrete class

	CONCRETE	MODE 1	MODE 2	MODE 3
MODEL 1	LC 16/18	21.60	63.70	72.45
	NC 25/30	19.00	57.06	80.89
MODEL 8	LC 12/13	21.22	62.26	67.51
	NC 20/25	18.94	56.81	79.30
MODEL 9	LC 20/28	21.63	63.81	72.86
	NC 30/37	19.06	57.28	82.28

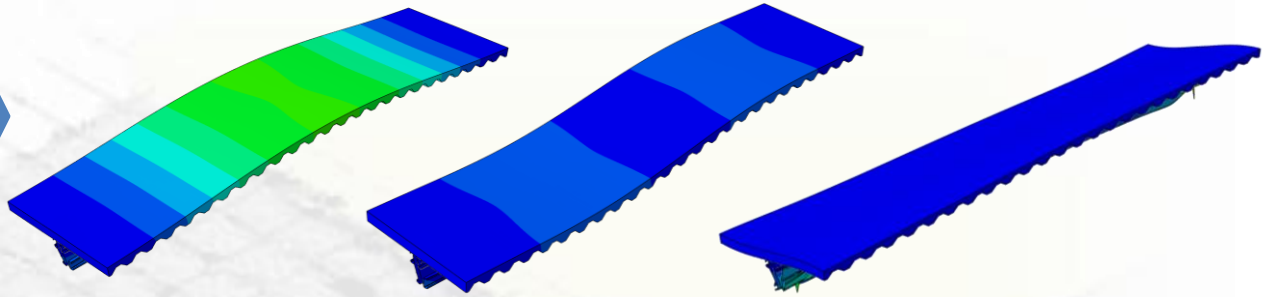






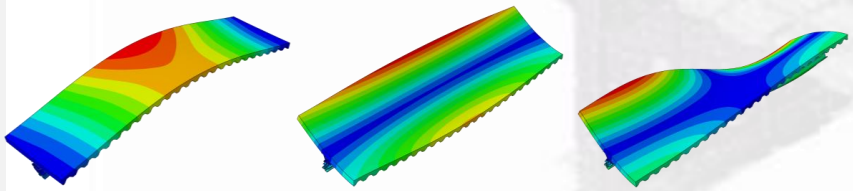
Influence of spot welds

MODE 1 MODE 4 MODE 7



Reminder: tied elements

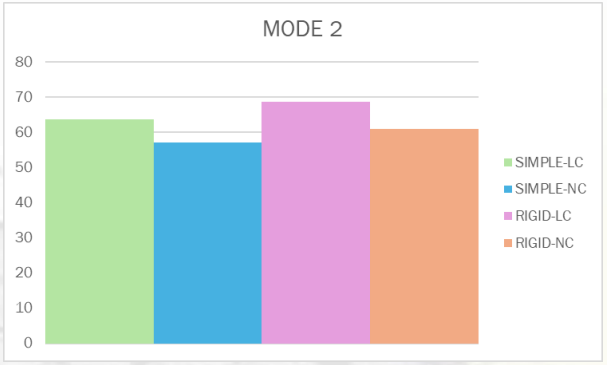
MODE 1 MODE 2 MODE 3

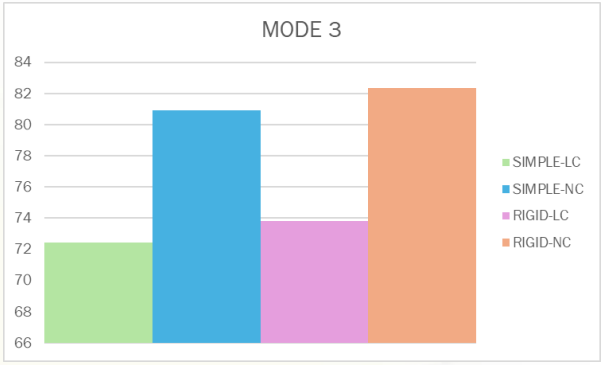


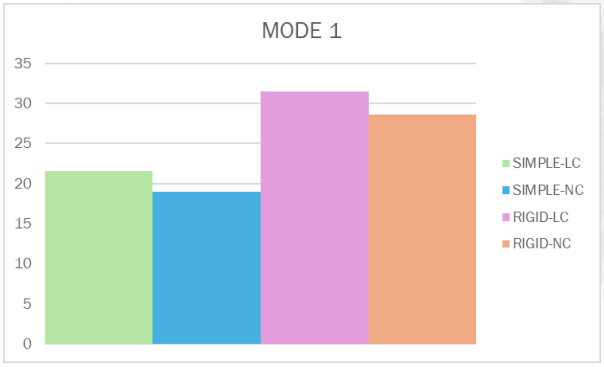
	CONCRETE	MODE 1	MODE 4	MODE 7
2 SW	LC	17.66	43.32	64.02
	NC	15.64	38.96	65.57
3 SW	LC	17.69	43.38	64.73
	NC	15.67	39.00	66.38

		MODE 1	MODE 2	MODE 3
MODEL 1	LC 16/18	21.60	63.70	72.45
	NC 25/30	19.00	57.06	80.89

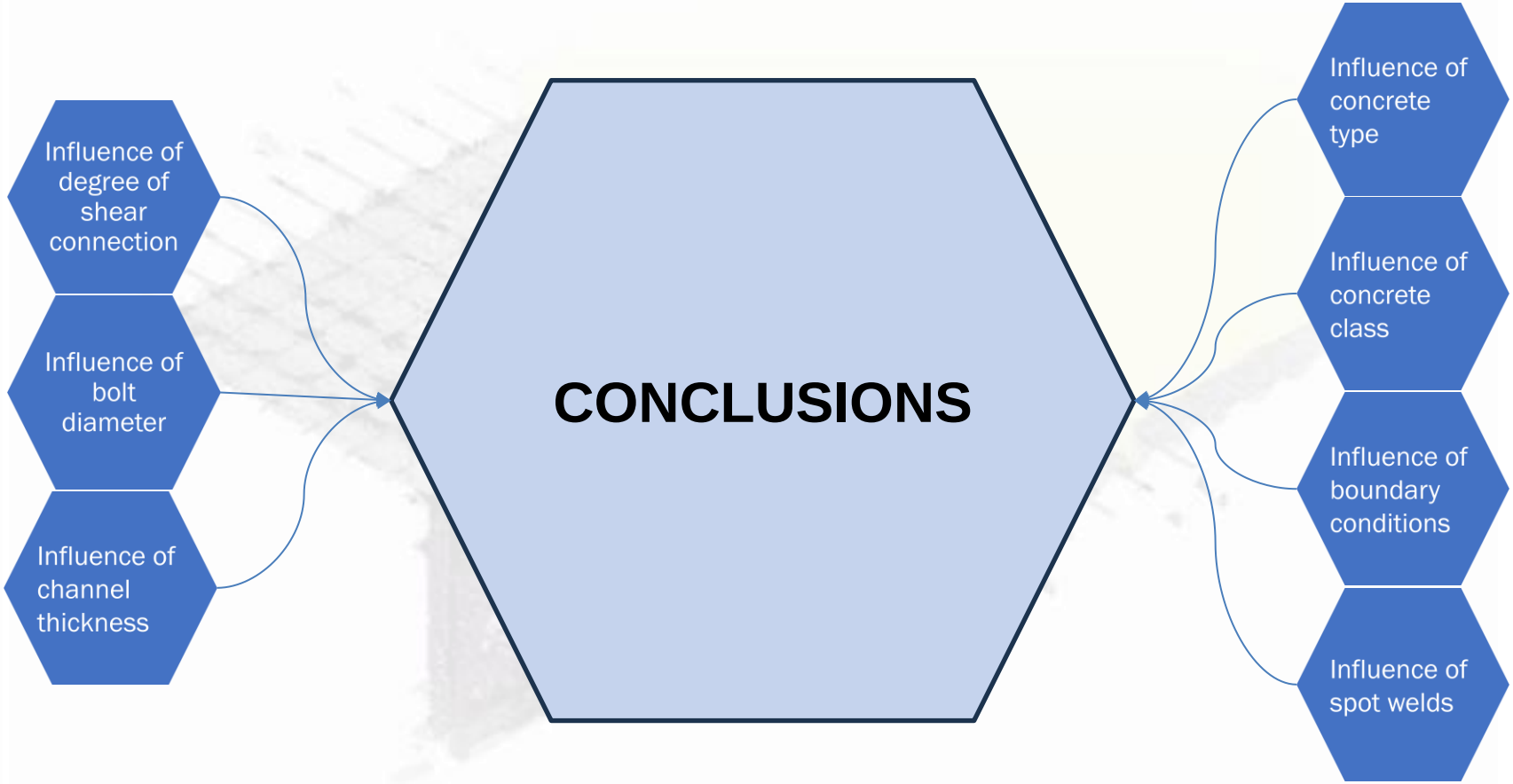
Influence of boundary conditions







	CONCRETE	MODE 1	MODE 2	MODE 3
SIMPLE	LC	21.60	63.70	72.45
	NC	19.00	57.06	80.89
RIGID	LC	31.50	68.60	73.81
	NC	28.60	60.97	82.35


Influence of degree of shear connection
Influence of bolt diameter
Influence of channel thickness
CONCLUSIONS
Influence of concrete type
Influence of concrete class
Influence of boundary conditions
Influence of spot welds

Influence of degree of shear connection

The value of natural frequency decreases by decreasing the degree of shear connection.

Influence of bolt diameter

By increasing the diameter of the shear connector, the natural frequencies decrease for the first two modes, but in the third mode, the frequency for models with larger shear connector diameters achieves a higher value.

Influence of channel thickness

The level of frequency increases in the first two modes when increasing the thickness of the channel section

Influence of concrete type

Influence of concrete class

Influence of boundary conditions

Influence of spot welds

Influence of degree of shear connection

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Influence of concrete type

Influence of concrete class

Influence of boundary conditions

Influence of spot welds

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Influence of bolt diameter

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Influence of channel thickness

The level of frequency increases in the first two modes when increasing the thickness of the channel section

Influence of concrete type

Influence of concrete class

Influence of boundary conditions

Influence of spot welds

Models with normal concrete have lower frequency levels than those with lightweight concrete (for modes 1 and 2).

Influence of concrete type

Changing concrete classes shows that by increasing concrete class, the value of natural frequency increases as well.

Influence of concrete class

By changing boundary conditions from nominally pinned to nominally rigid, the natural frequency is increased.

Influence of boundary conditions

A larger number of spot welds cause a higher natural frequency of the system. This is expected due to the increased stiffness of the system.

Influence of spot welds

Influence of degree of shear connection

Influence of bolt diameter

Influence of channel thickness

Influence of degree of shear connection

Influence of bolt diameter

Influence of channel thickness

Models with normal concrete have lower frequency levels than those with lightweight concrete (for modes 1 and 2).

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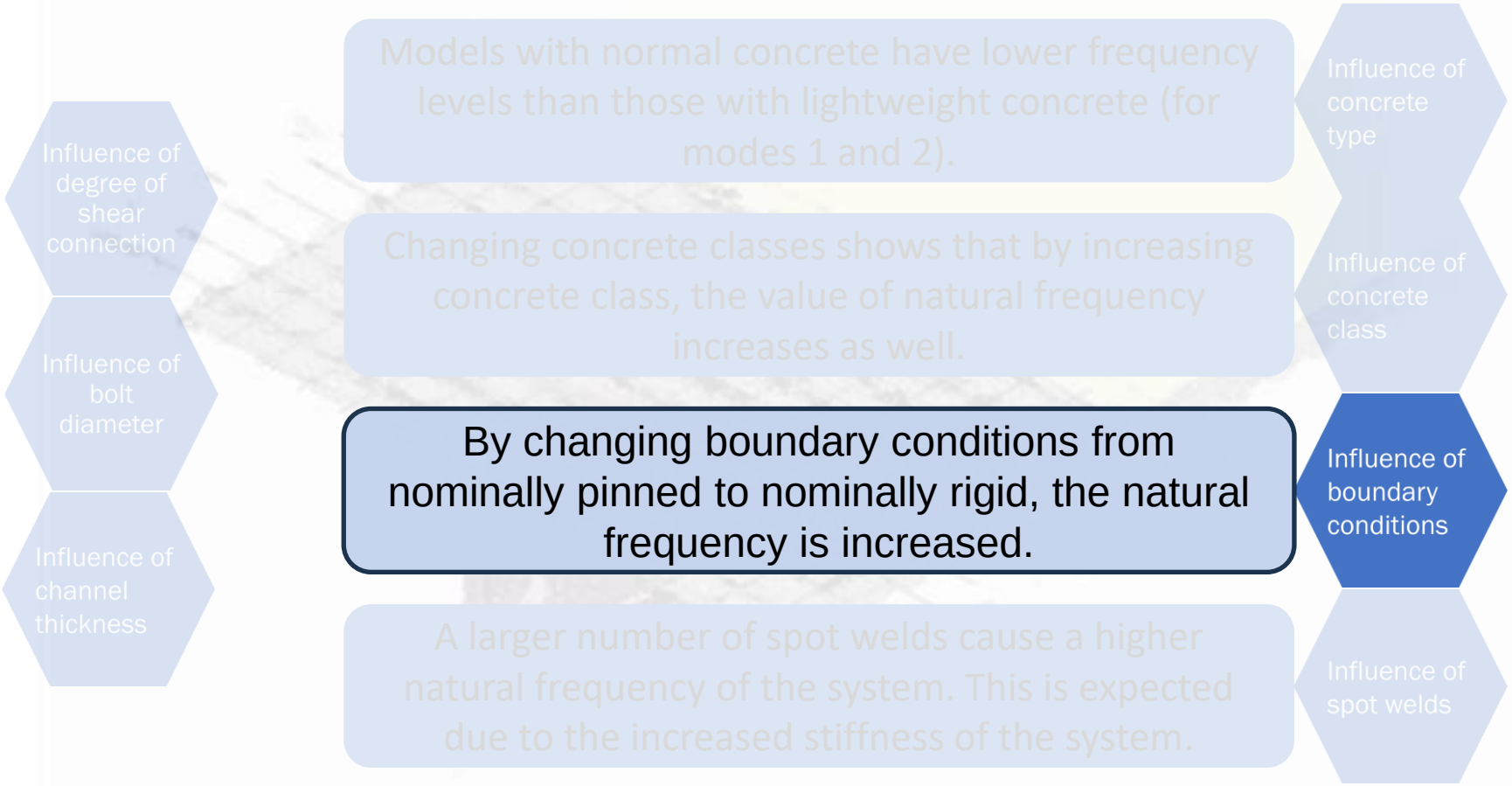
Influence of concrete type

Influence of concrete class

Influence of boundary conditions

Influence of spot welds


Influence of degree of shear connection
Influence of bolt diameter
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Influence of concrete type

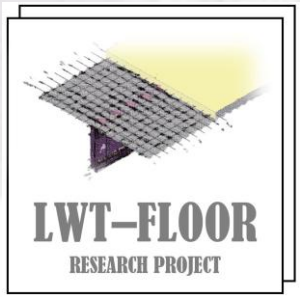
Influence of concrete class

Influence of boundary conditions

Influence of spot welds

Influence of shear connection and end supports onto self-vibrations of cold-formed steel concrete composite floor

Andrea Rajić, Ivan Lukačević, Ivan Ćurković, Vlaho Žuvelek



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