VISUAL PROGRAMMING ALGORITHMS AS AN EDUCATIONAL RESOURCE FOR CIVIL ENGINEERING

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1- Introduction

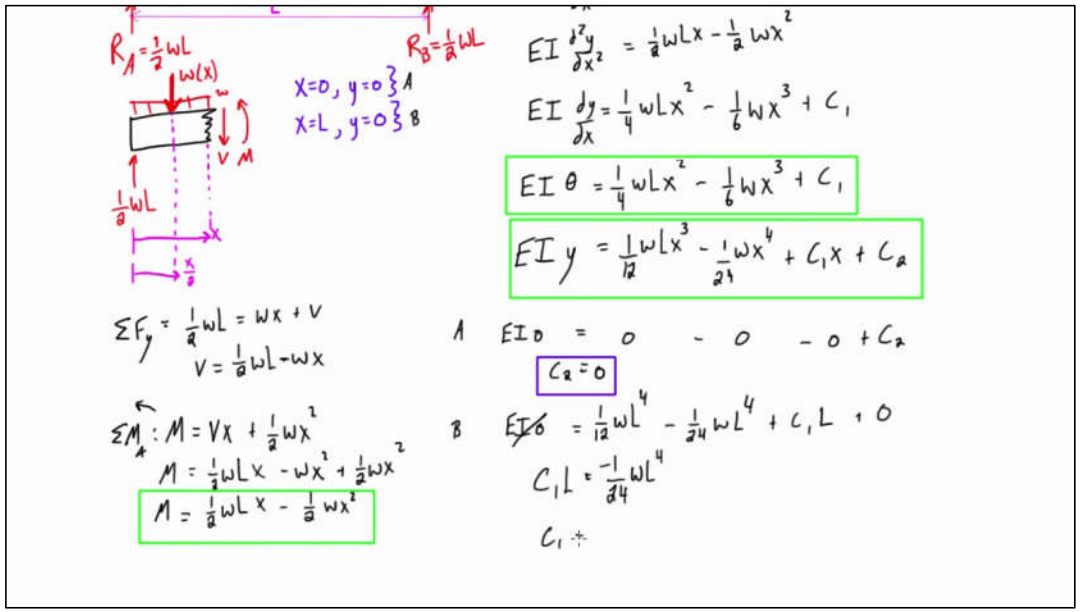
2- Visual Programming Application

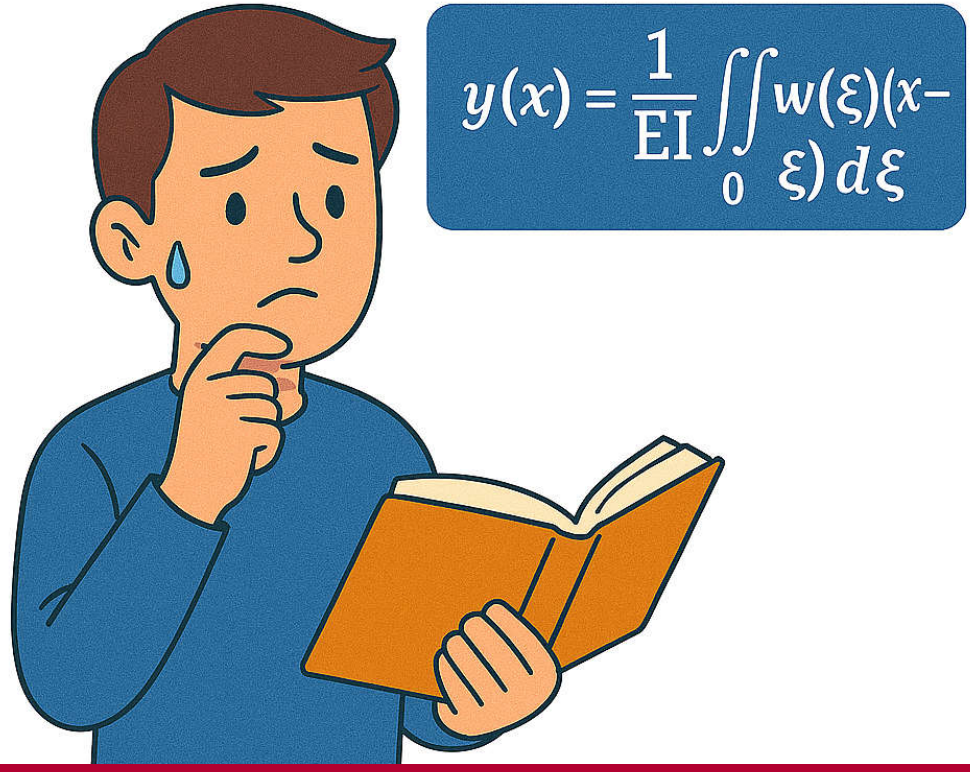
3- Results

4- Conclusions

Introduction: *Key challenges to undestand abstract concepts*

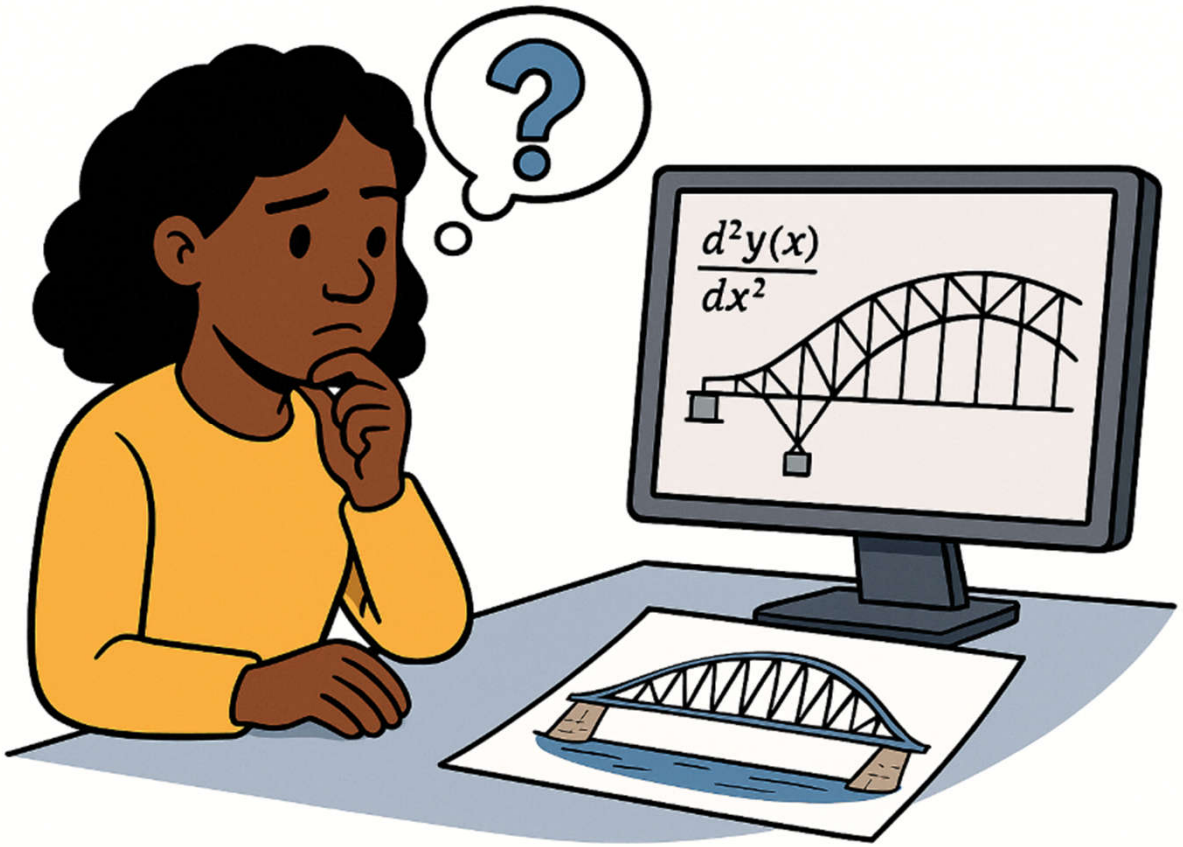
1. Heavy reliance on mathematical formulations and equations.





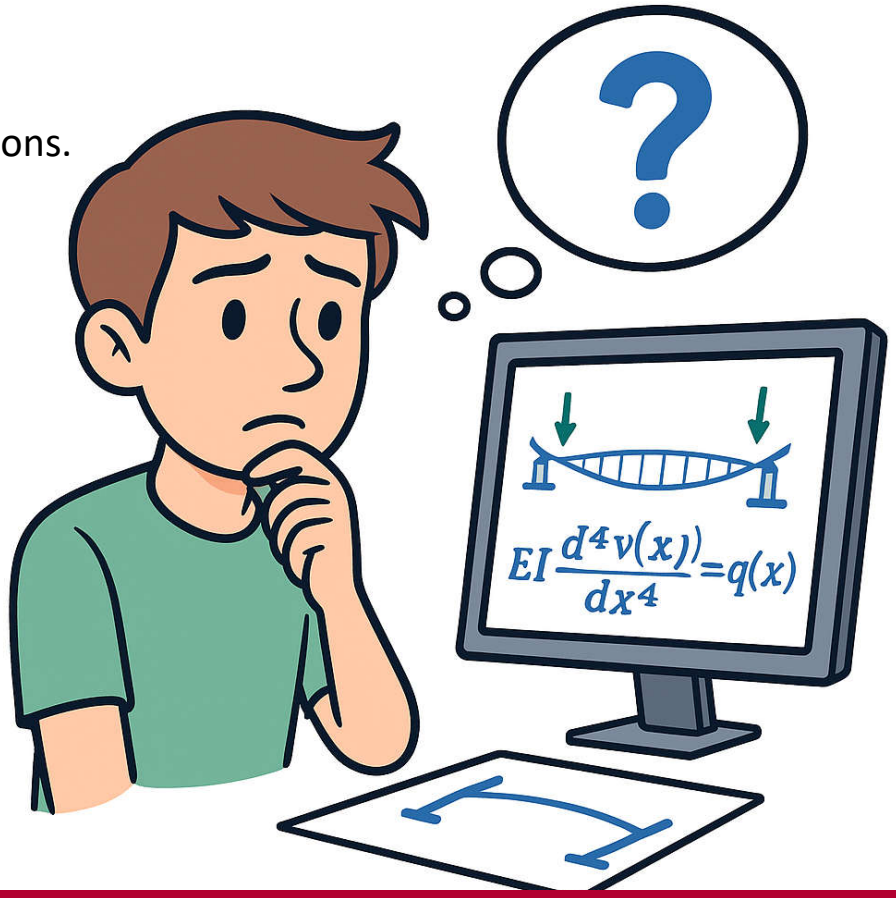
Introduction: *Key challenges to undestand abstract concepts*

2. Apparent lack of connection between theoretical models and real-world applications.



Introduction: *Key challenges to undestand abstract concepts*

3. Difficulty visualizing physical behavior from abstract representations.

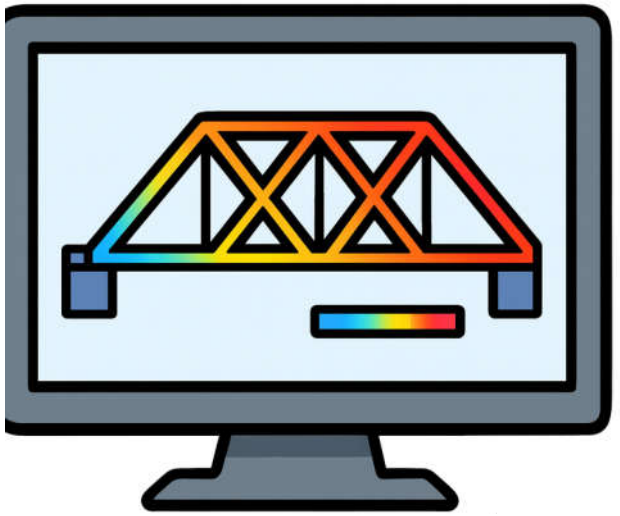


Introduction: *Key challenges to undestand abstract concepts*

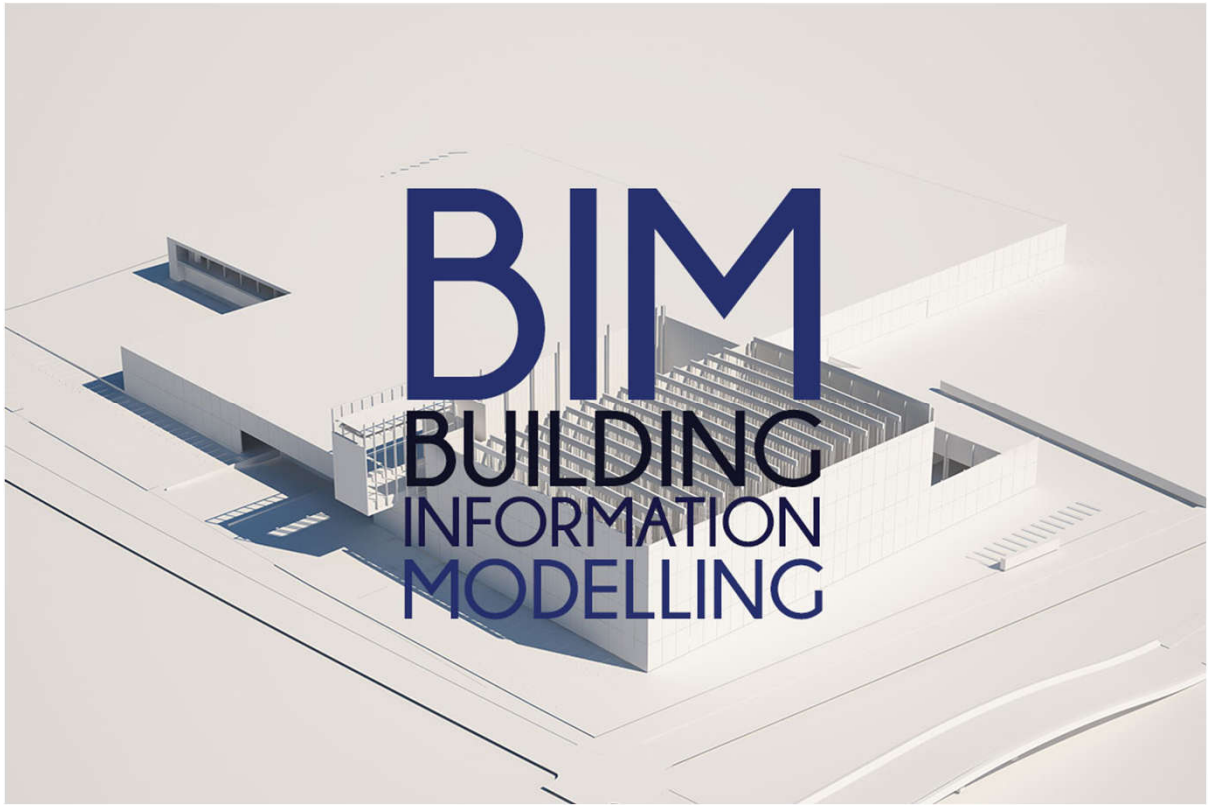
4. Limited exposure to interactive or experimental learning tools.

Introduction: *Tools to enhance understanding*

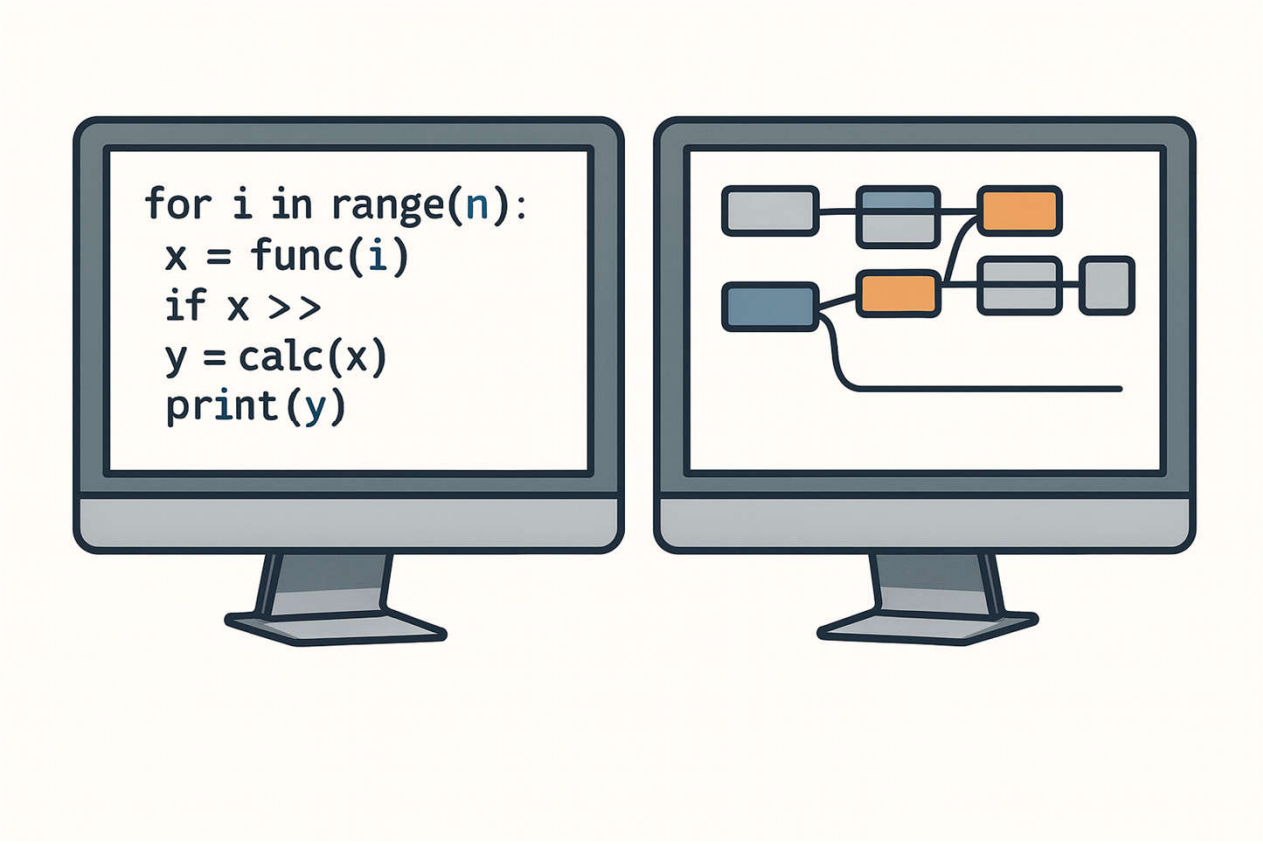
- Small scale models
- Sensor monitoring
- Computer simulations
- Digital twins (BIM)



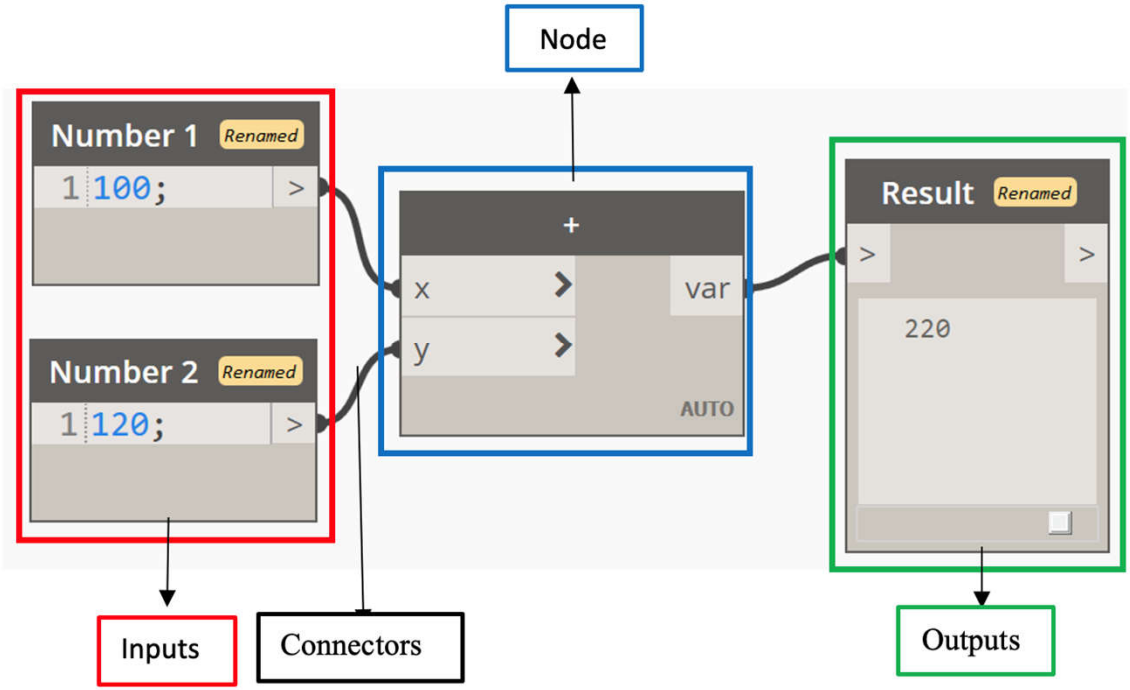
Introduction: *Building information modelling (BIM)*

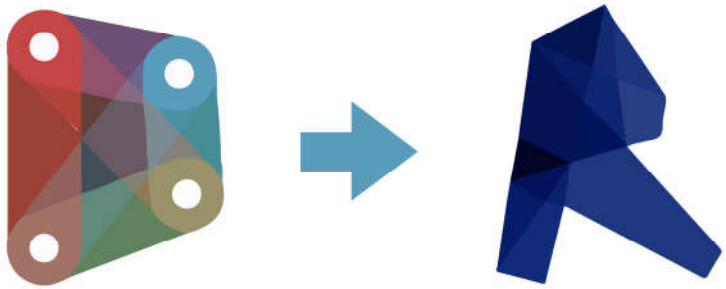


Introduction: *Visual programming tools*

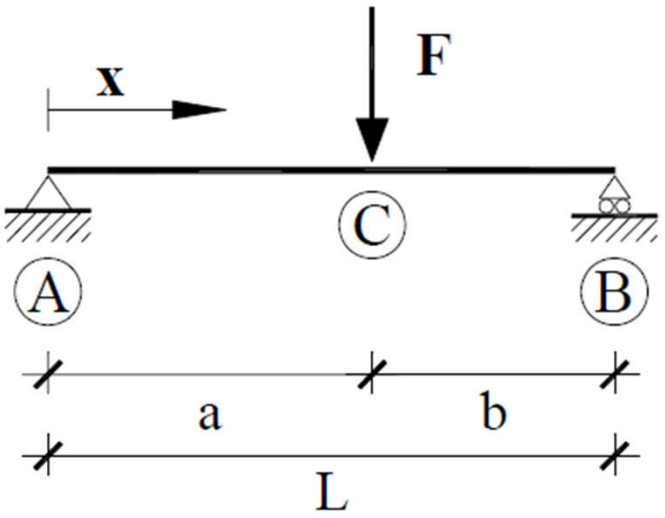


Visual programming tool: *Dynamo*





Beam structural response: *Equations*

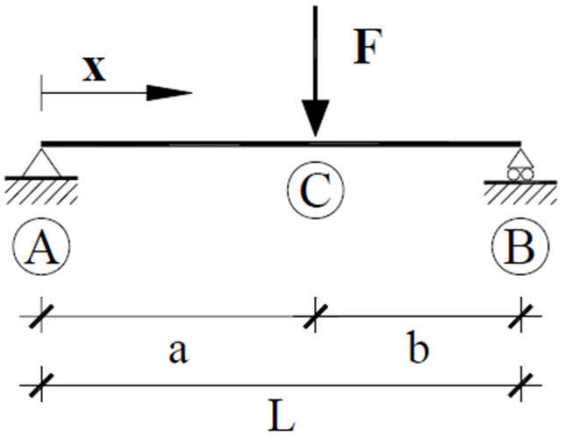


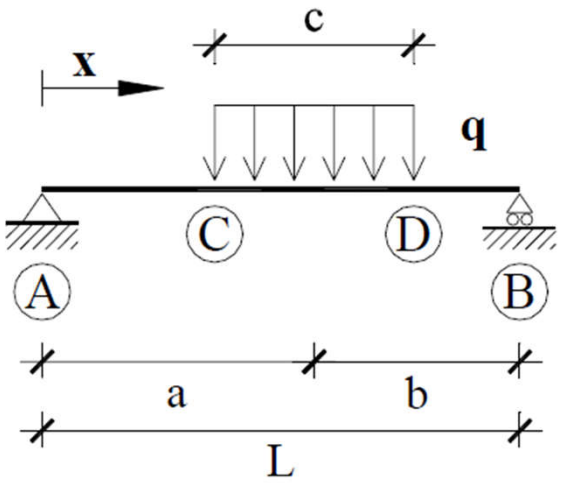
$$Y_{ac} = \frac{F \cdot L \cdot b \cdot x}{6EI}\left(1 - \frac{b^2}{L^2} - \frac{x^2}{L^2}\right), \qquad Y_{cb} = \frac{F \cdot L \cdot a \cdot (L - x)}{6EI}\left(1 - \frac{a^2}{L^2} - \frac{(L - x)^2}{L^2}\right)$$

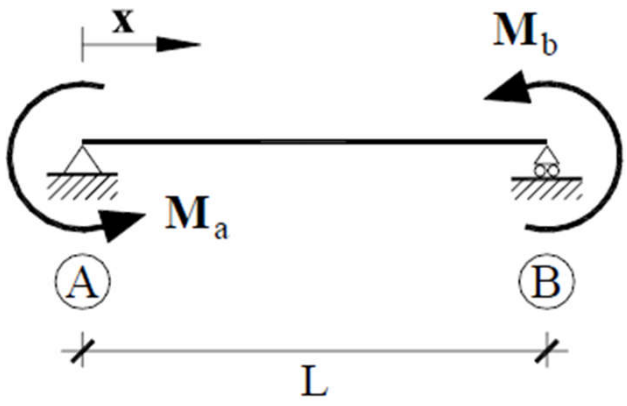
$$V_{ac} = \frac{F \cdot b}{L}, \quad V_{cb} = -\frac{F \cdot a}{L}$$

$$M_{ac} = \frac{F \cdot b}{L} \cdot x, \quad M_{cb} = \frac{F \cdot a}{L} \cdot (L - x)$$

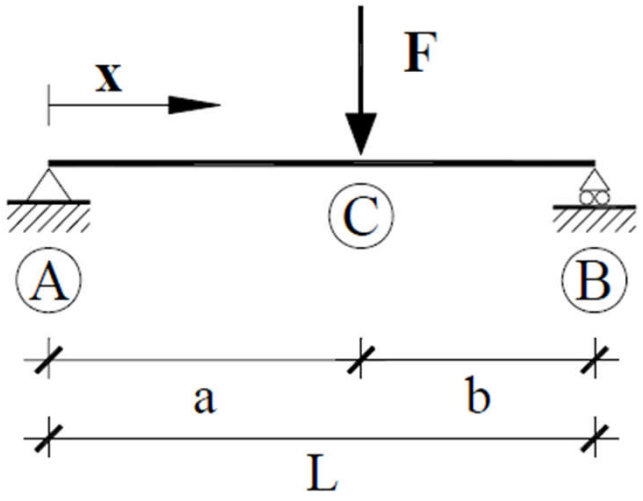
Beam structural response: *Loading cases*

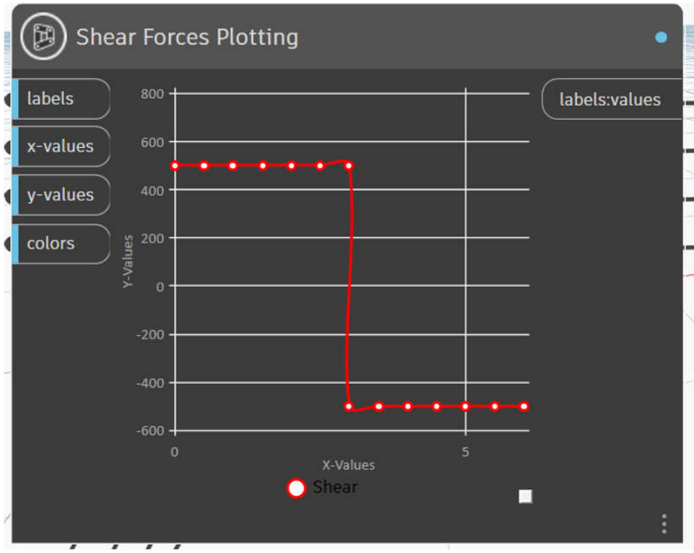


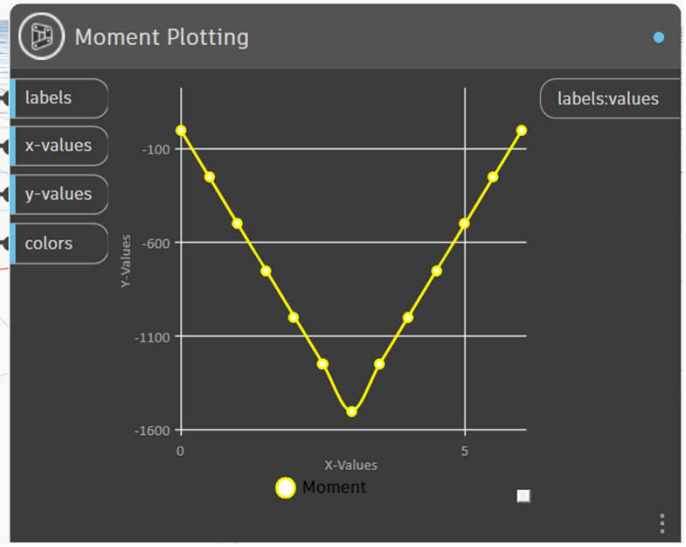




Beam structural response: *Results in Dynamo*







Results: *Course*

- Construction Engineering Degree
- “Structural Engineering” Course
- 25 students

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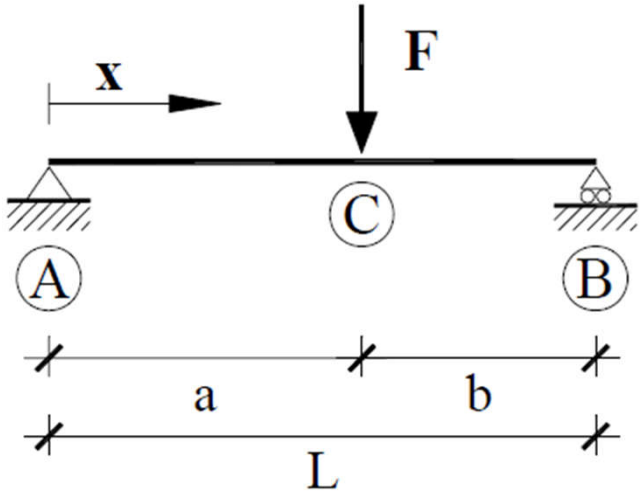


Results: *Seminar organization*

Block	Name	Description	Time [min]
1	Introduction	The concepts and main elements of visual programming in BIM projects are presented.	20
2	Virtual Model application	Explanation of the virtual model proposed in section 2: inputs, operations and outputs are presented and explained.	35
3	Case analysis	Load cases are developed and analyzed.	25
4	Conclusions	The main ideas of the experience are delivered and the public answers the perception survey.	10

Results: *Survey*

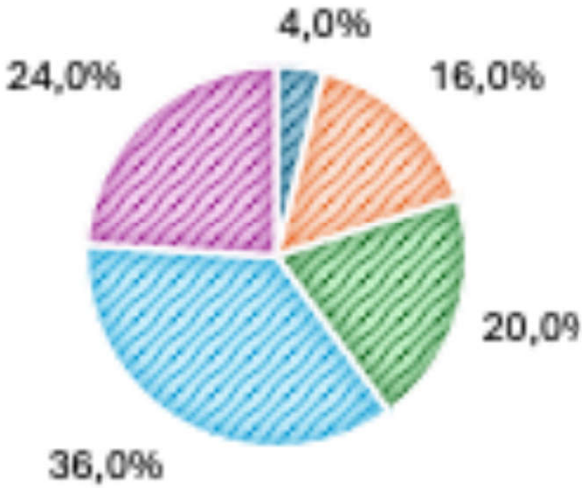
- TOPICS:
  - Undestanding of structural concepts
  - Visualization
  - Problem solving
  - çStructural engineering education

Results: *Survey*

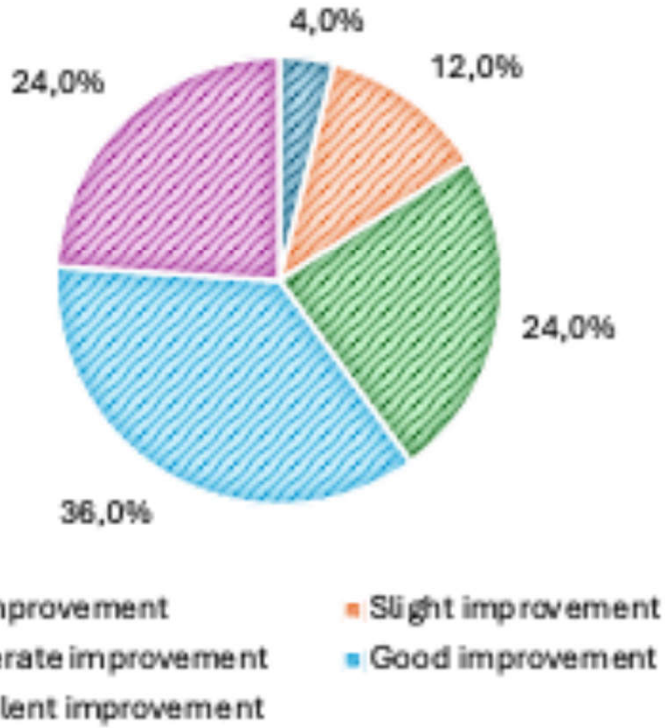
- ANSWERS:
  - (1) no improvement
  - (2) slight improvement
  - (3) moderate improvement
  - (4) significant improvement
  - (5) excellent improvement

Results: *Survey*

Understanding structural concepts

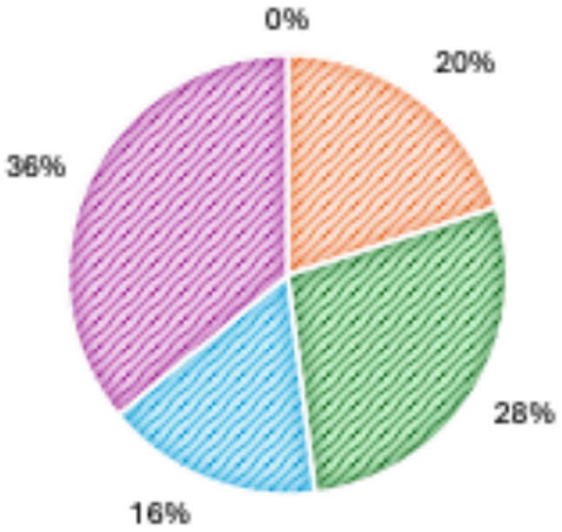


Visualization



Results: *Survey*

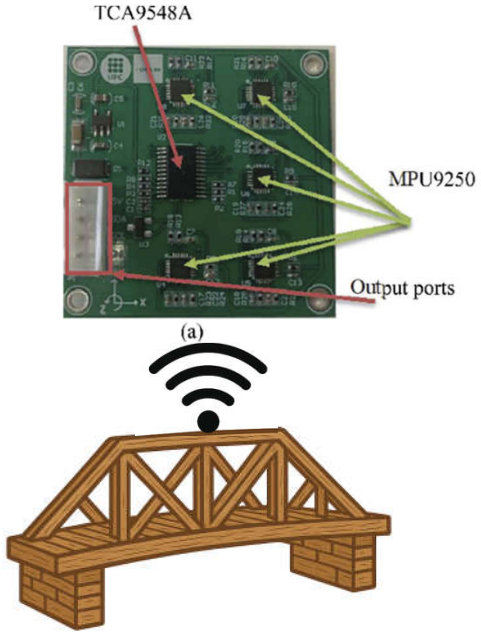
Problem solving

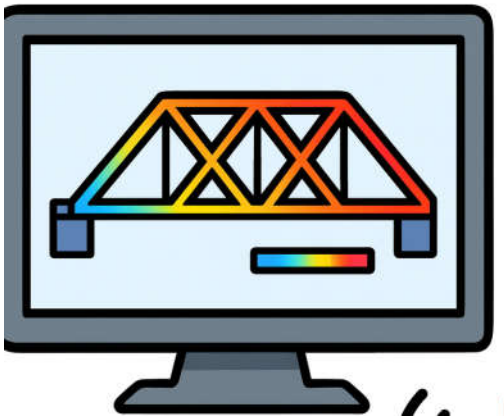


Structural Engineering education

Conclusions

- V-P tools
- Visualization of beam response
- Possitive Students perception
- Future: Digital twin connecting with sensos





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