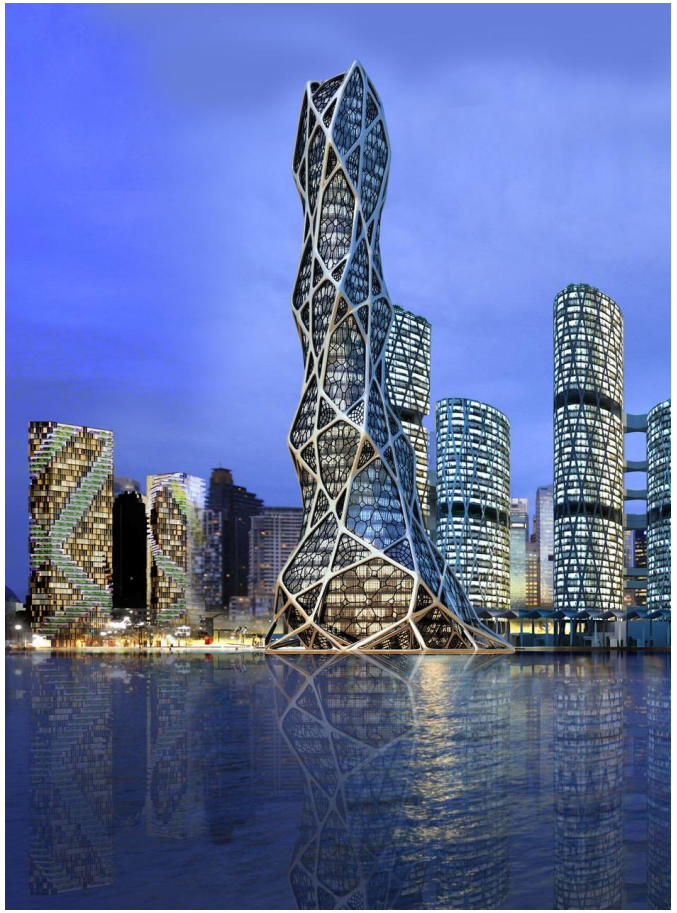
CO227 PROJECT MID EVALUATION

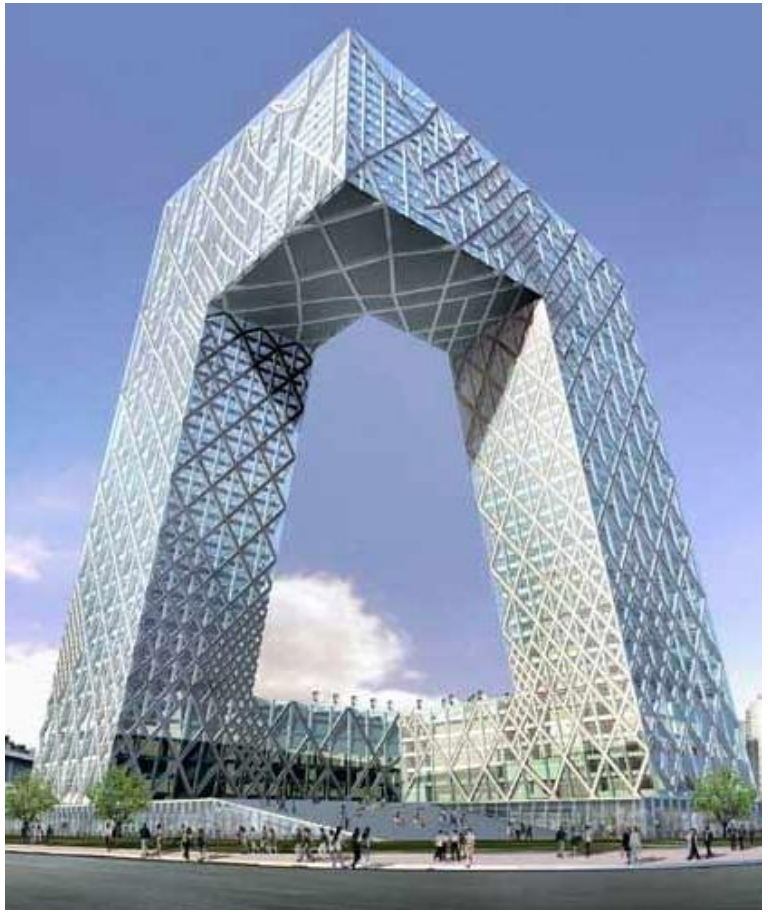
FINITE ELEMENT BASED STRUCTURAL ANALYSIS

WHAT YOU SEE



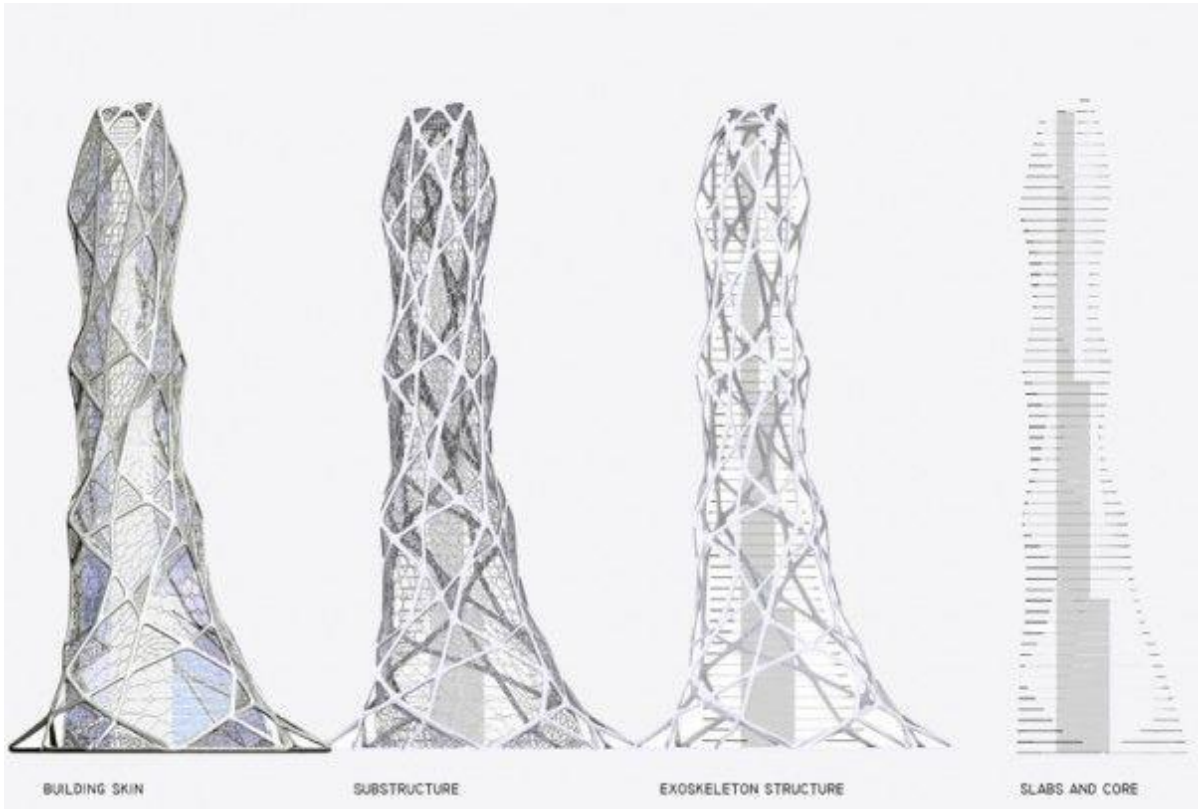
Bionic tower, Abu Dhabi

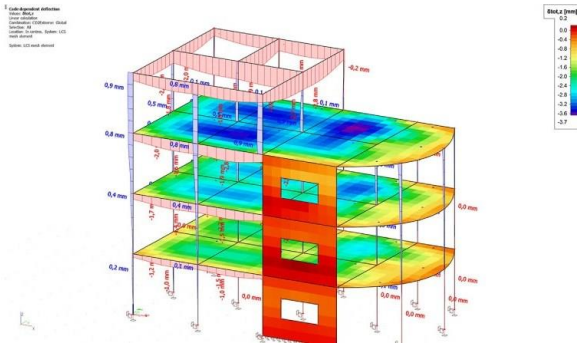
Cobra tower, Kuwait

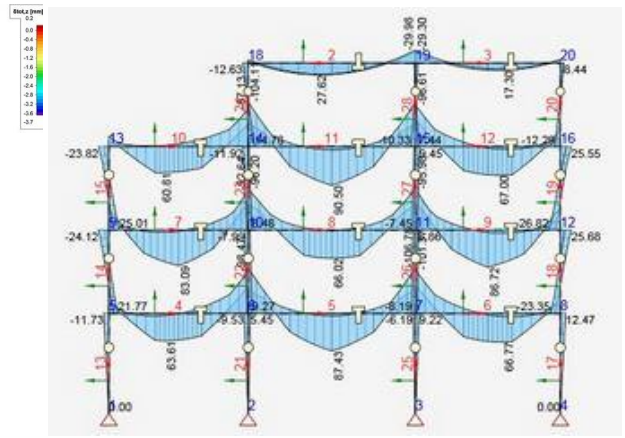


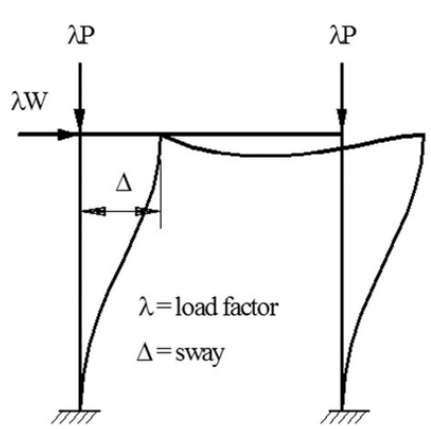
CCTV Headquarters, China

WHAT STRUCTURAL ENGINEERS SEE

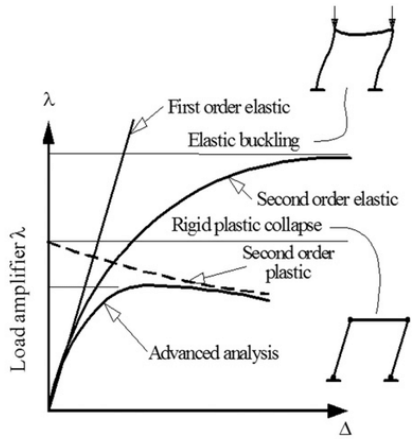








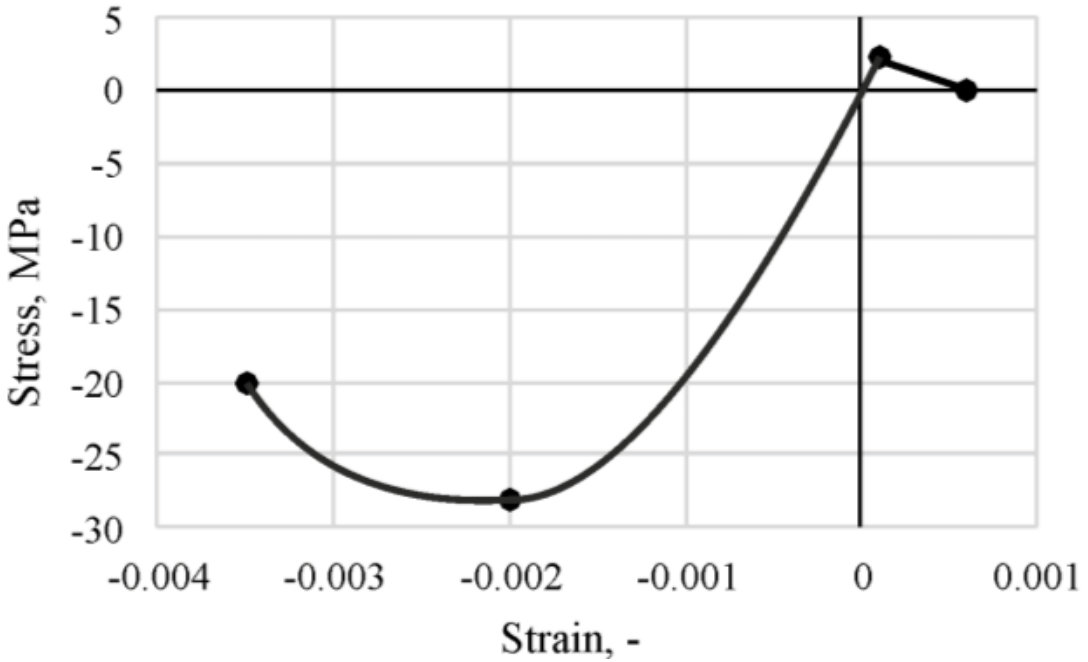
(a) Rigid joint sway frame



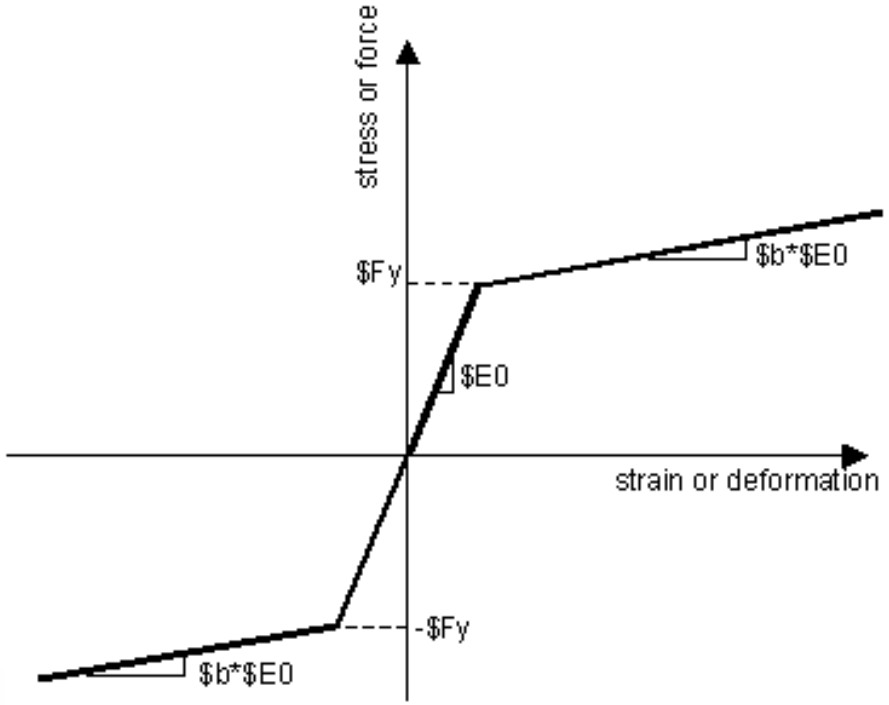
(b) Load deflection response

HOW COMPLEX ?

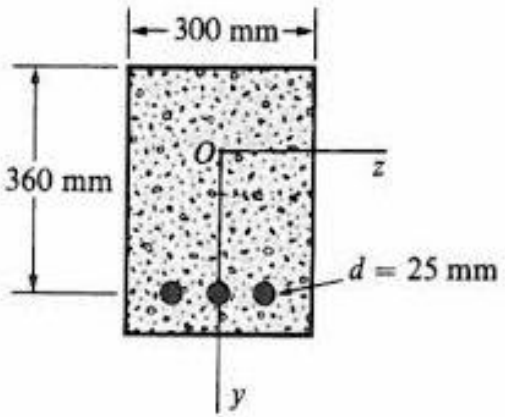
Concrete material model



Steel material model



Reinforced concrete
Cross section



LINEAR

$F = K e$

K is Constant
Small loading conditions

Widely used software : SAP 2000

NON-LINEAR

K Varies
Extreme loading conditions

Widely used software : Opensees

Developed in Berkeley,
University of California

Interaction of

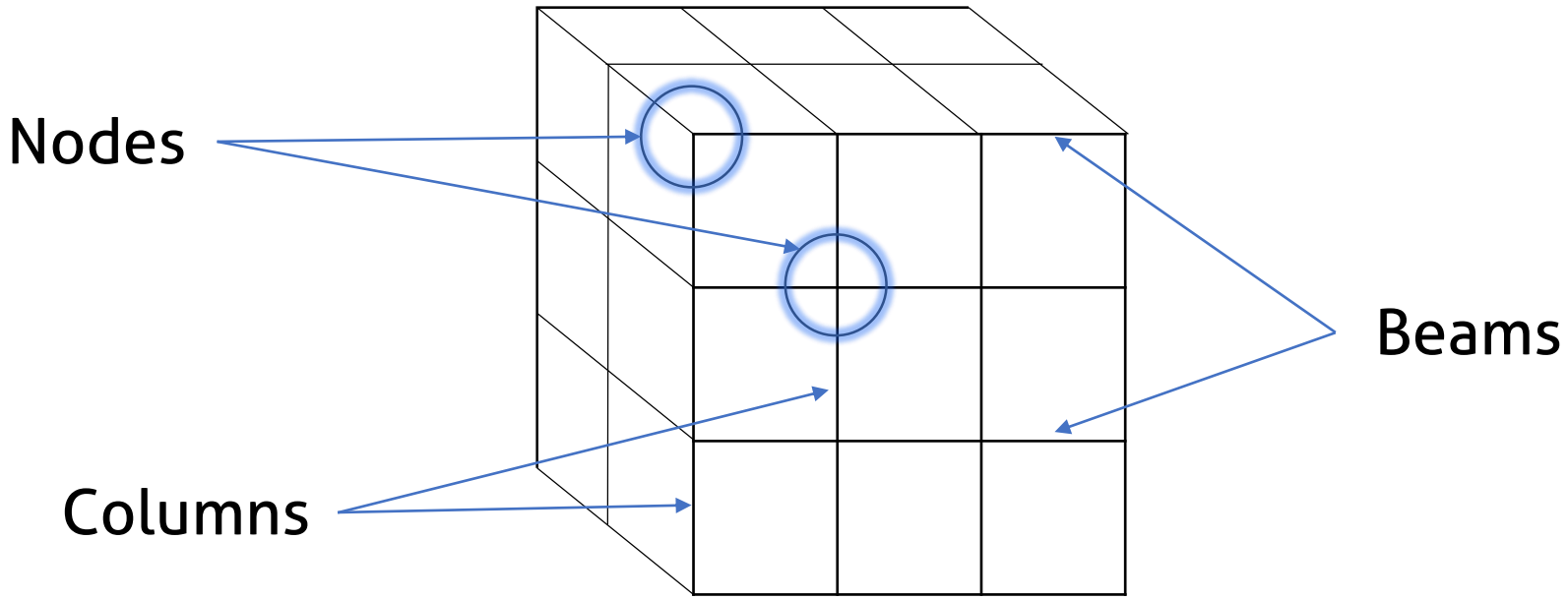
Axial force - Bending moment

Using a novel formulation developed by
the Department of Civil Engineering

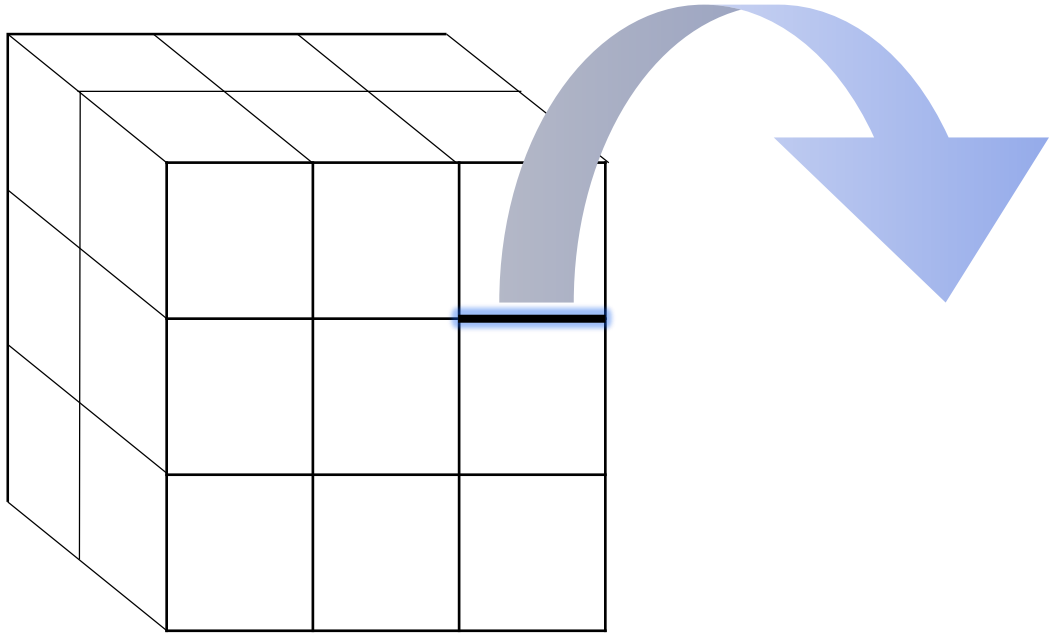
Interaction of

Axial force - Bending moment - Shear force

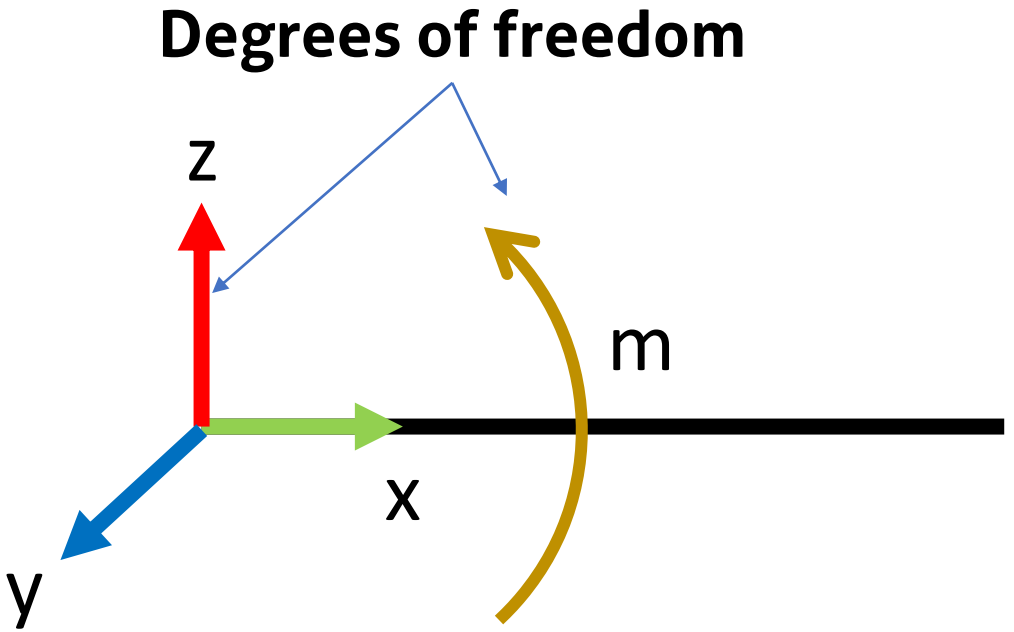
A SIMPLE OVERVIEW OF THE SOFTWARE



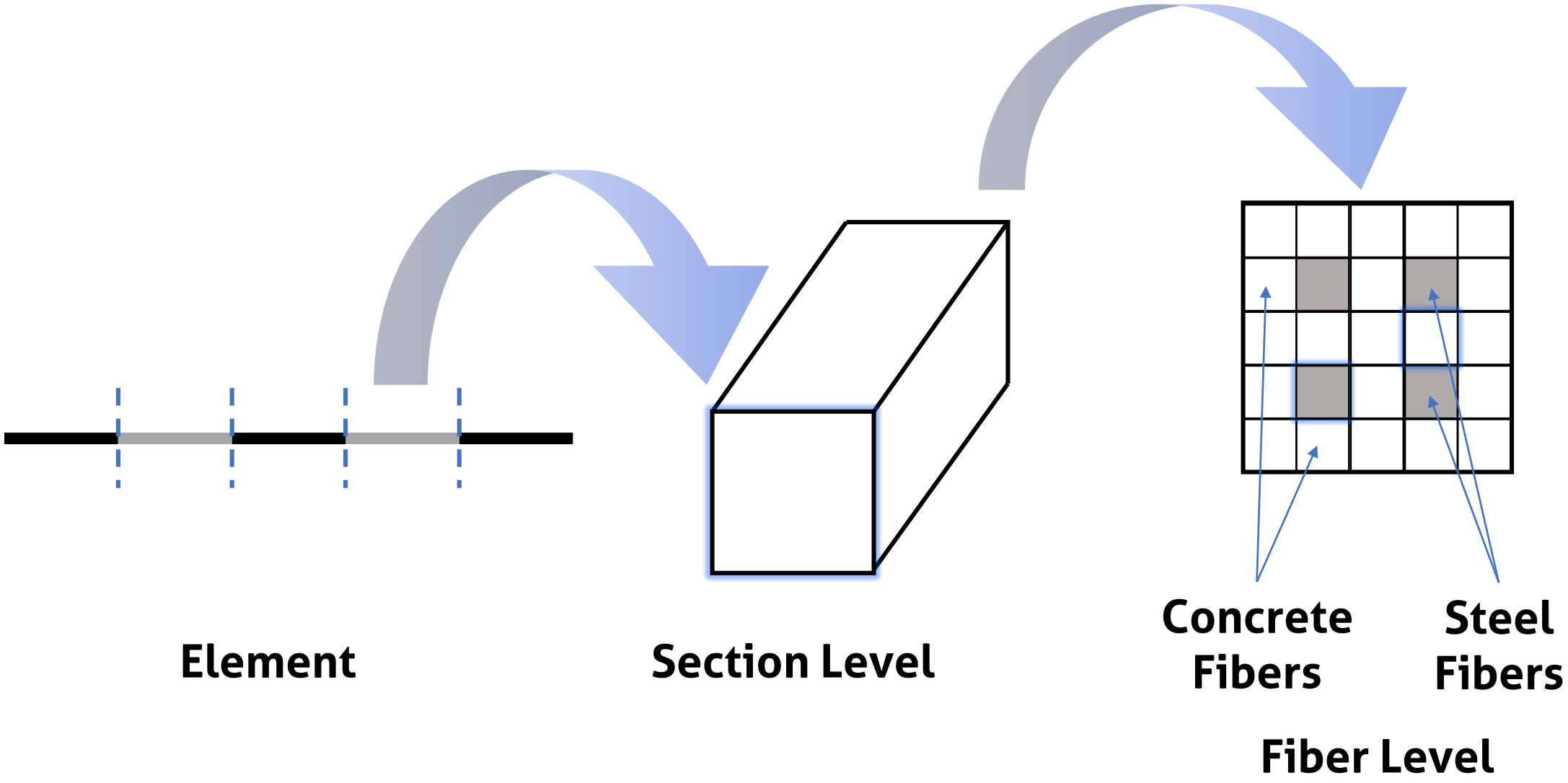
Simple 3 story building using reinforced concrete frames



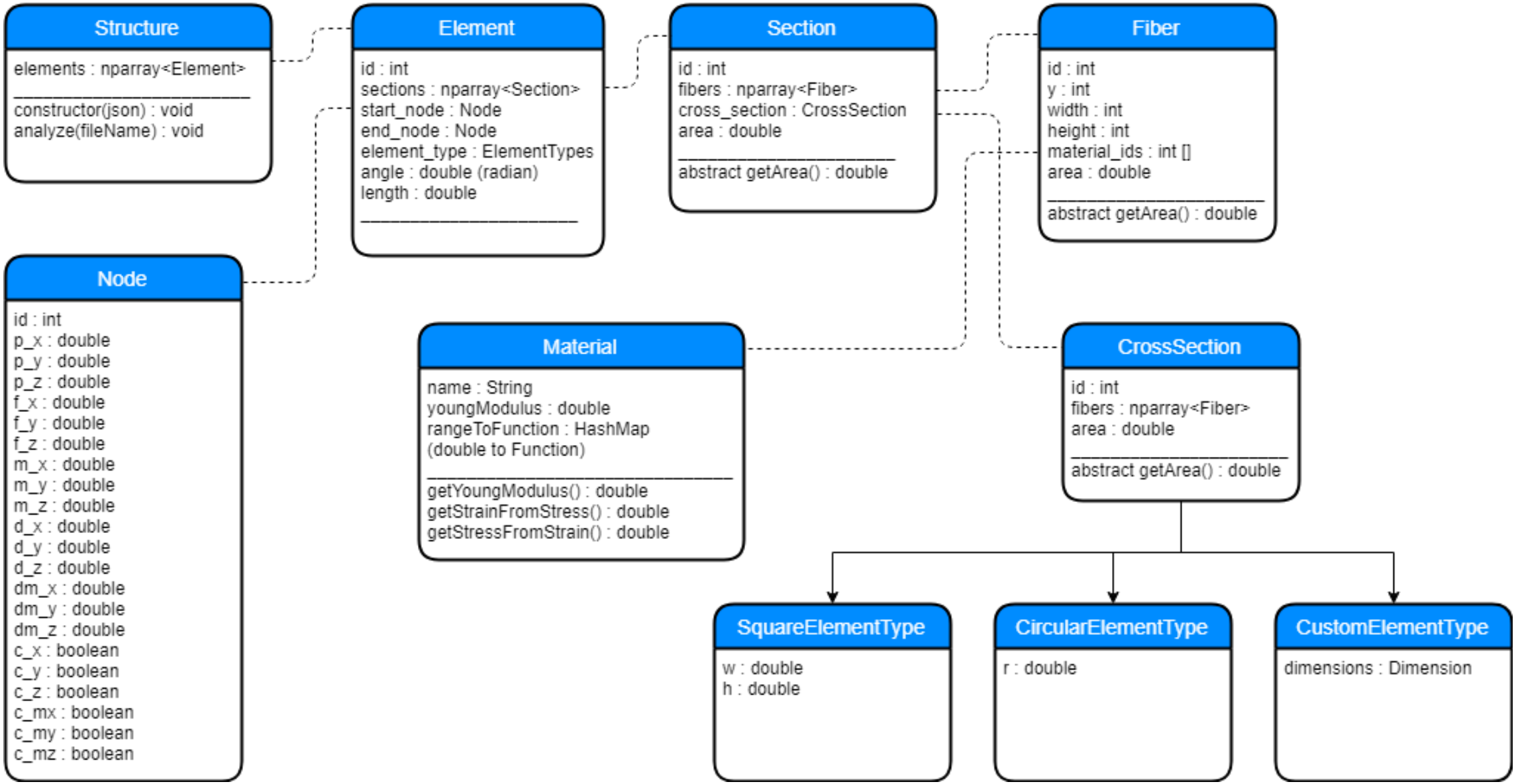
Structure Level



Element Level


Element
Section Level
Concrete Fibers
Steel Fibers
Fiber Level

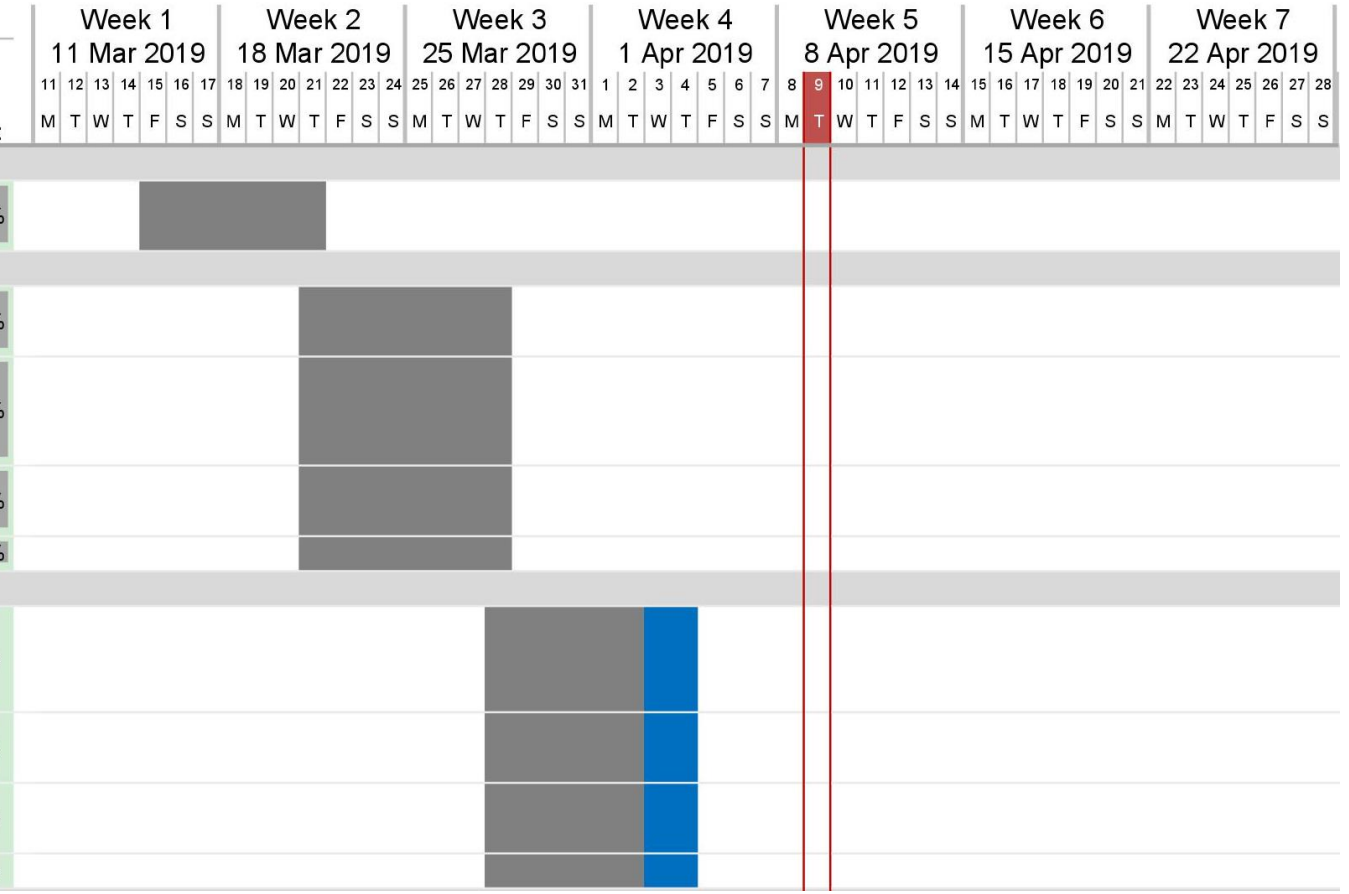
CLASS DIAGRAM



PROJECT PLAN AND PROGRESS

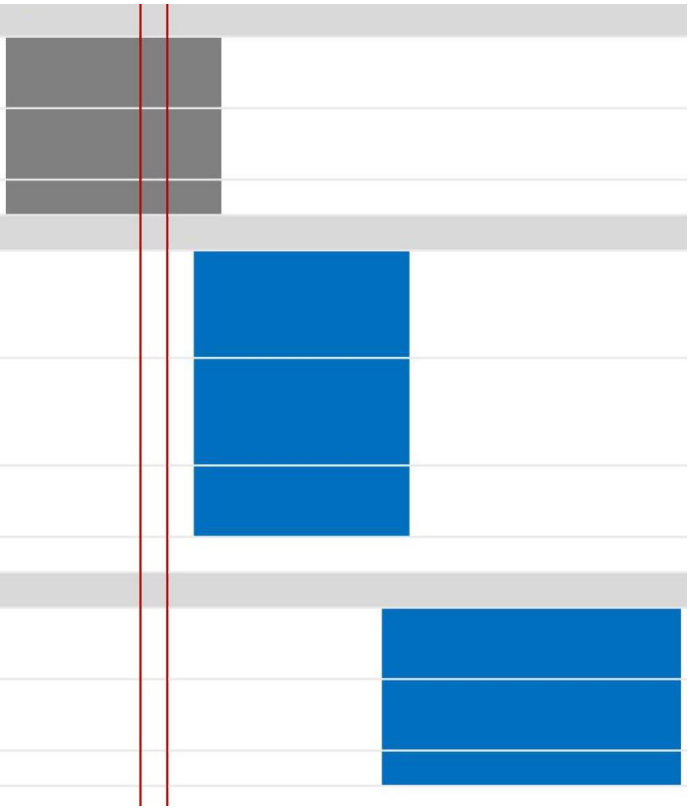
Project Start Date: 3/15/2019 (Friday)
Project Lead: Dr.Kushan Wijesundara
Display Week: 1

WBS	TASK	START	END	DAYS	% DONE
1	**Milestone 1**		-		
1.1	Discussion with the civil department	Fri 3/15/19	Thu 3/21/19	7	100%
2	**Milestone 2**		-		
2.1	Structure level(Assembling the Matrix)	Thu 3/21/19	Thu 3/28/19	8	100%
2.2	Element level (Per element: section resisting force & updated section stiffness)	Thu 3/21/19	Thu 3/28/19	8	100%
2.3	Section level(Material Model Structure)	Thu 3/21/19	Thu 3/28/19	8	100%
2.4	Learning Algorithem	Thu 3/21/19	Thu 3/28/19	8	100%
3	**Milestone 3**		-		
3.1	Structure level (Making newton rapson for force increment)	Thu 3/28/19	Thu 4/04/19	8	75%
3.2	Element level(Calculate Updated element stiffness)	Thu 3/28/19	Thu 4/04/19	8	75%
3.3	Section level(Defining standard material models)	Thu 3/28/19	Thu 4/04/19	8	75%
3.4	Learning Algorithem	Thu 3/28/19	Thu 4/04/19	8	75%



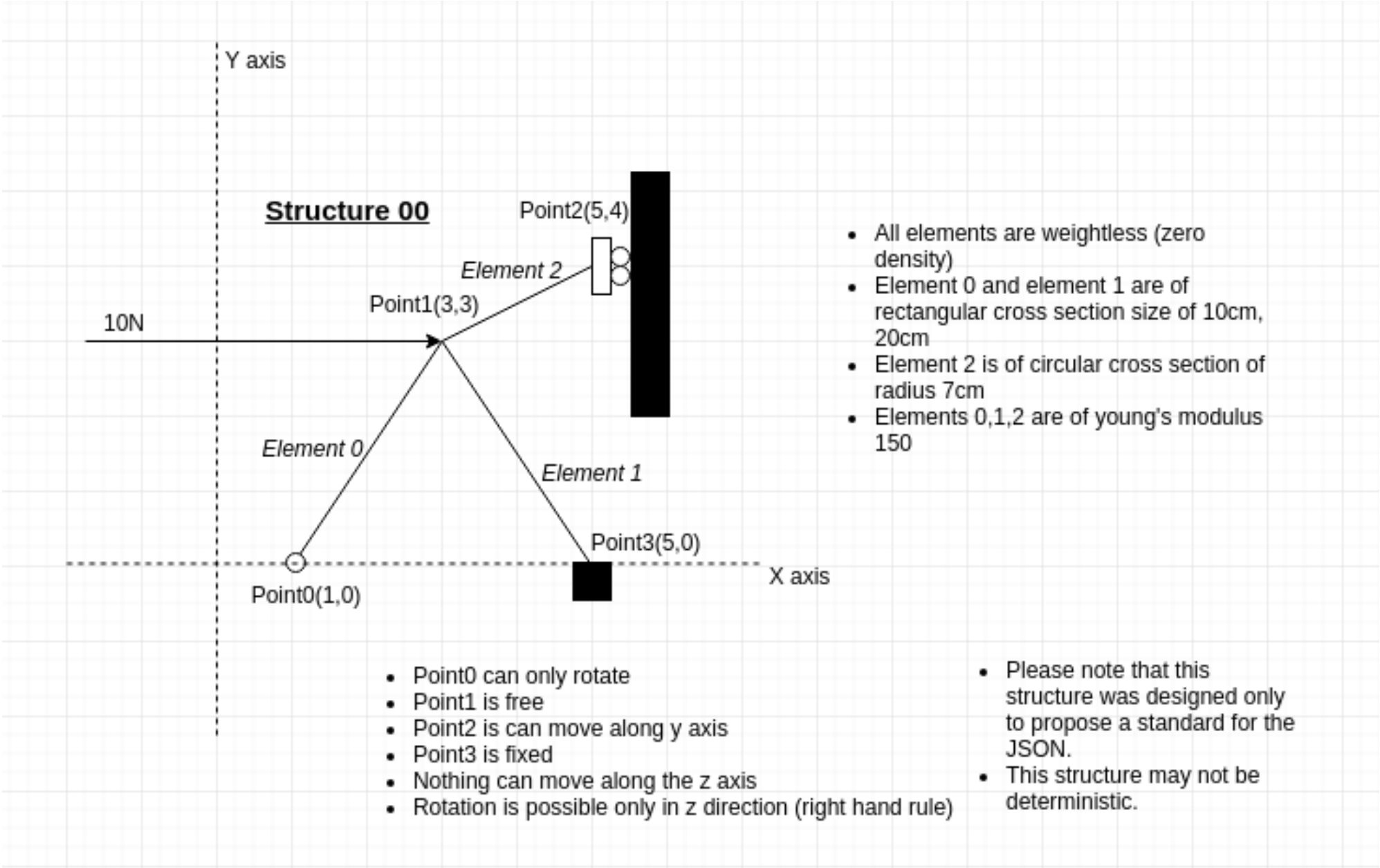
PROJECT PLAN AND PROGRESS

4	**Milestone 4**		-		
4.1	Structure level : Linear Analysis	Thu 4/04/19	Thu 4/11/19	8	100%
4.2	Section level: Linear Analysis	Thu 4/04/19	Thu 4/11/19	8	100%
4.3	Fiber level: Linear Analysis	Thu 4/04/19	Thu 4/11/19	8	100%
5	**Milestone 5**		-		
5.1	Structure level(merging all inputs,outputs and process)	Thu 4/11/19	Thu 4/18/19	8	0%
5.2	Element level (assemble and execute section level algorithem)	Thu 4/11/19	Thu 4/18/19	8	0%
5.3	Section level(assemble and final execution)	Thu 4/11/19	Thu 4/18/19	8	0%
6	**Milestone 6**		-		
6.1	Optimization of Structure level	Thu 4/18/19	Fri 5/31/19	44	0%
6.2	Optimization of Section level	Thu 4/18/19	Fri 5/31/19	44	0%
6.3	Optimization of Fiber level	Thu 4/18/19	Fri 5/31/19	44	0%



DEMONSTRATION

STRUCTURE WE ARE GOING TO ANALYZE

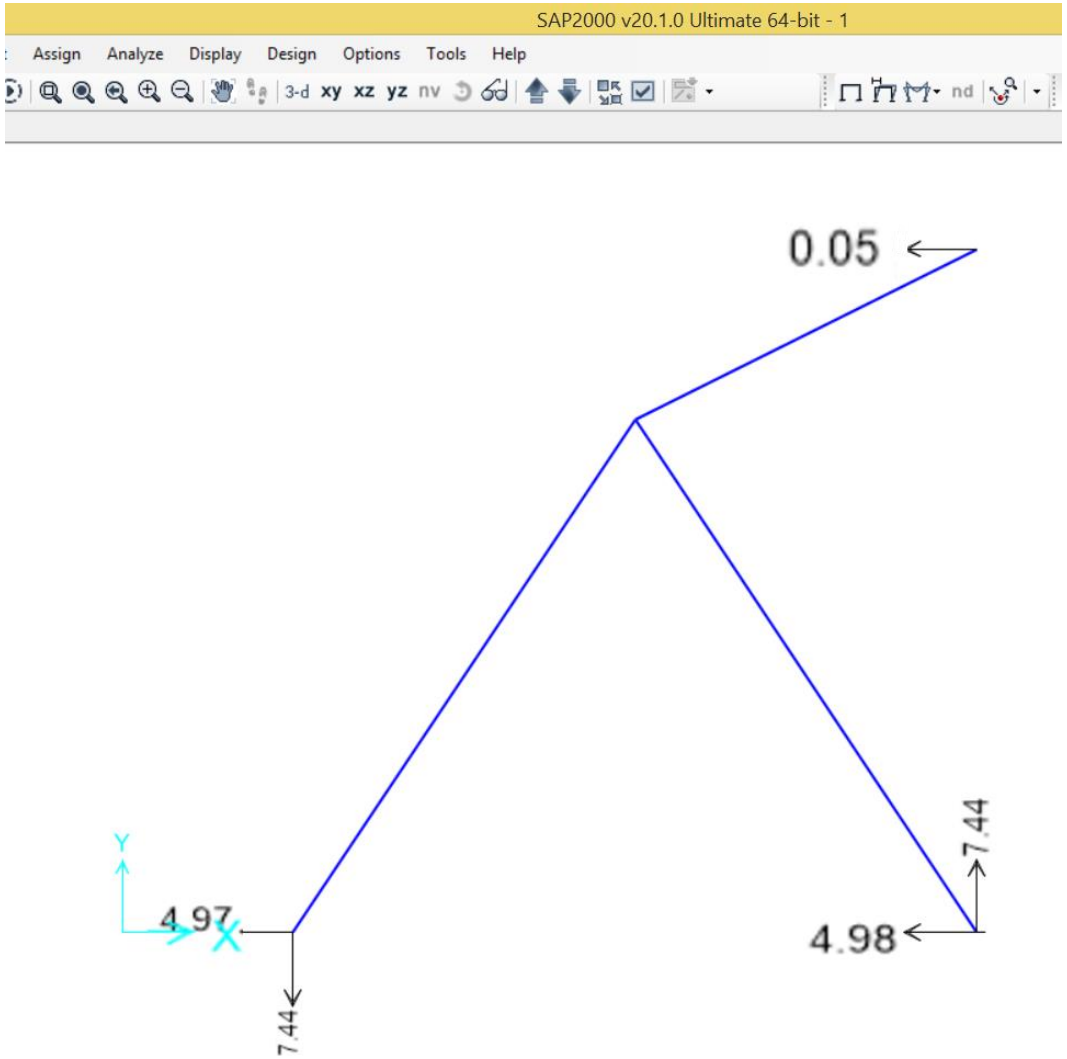


- All elements are weightless (zero density)
- Element 0 and element 1 are of rectangular cross section size of 10cm, 20cm
- Element 2 is of circular cross section of radius 7cm
- Elements 0,1,2 are of young's modulus 150

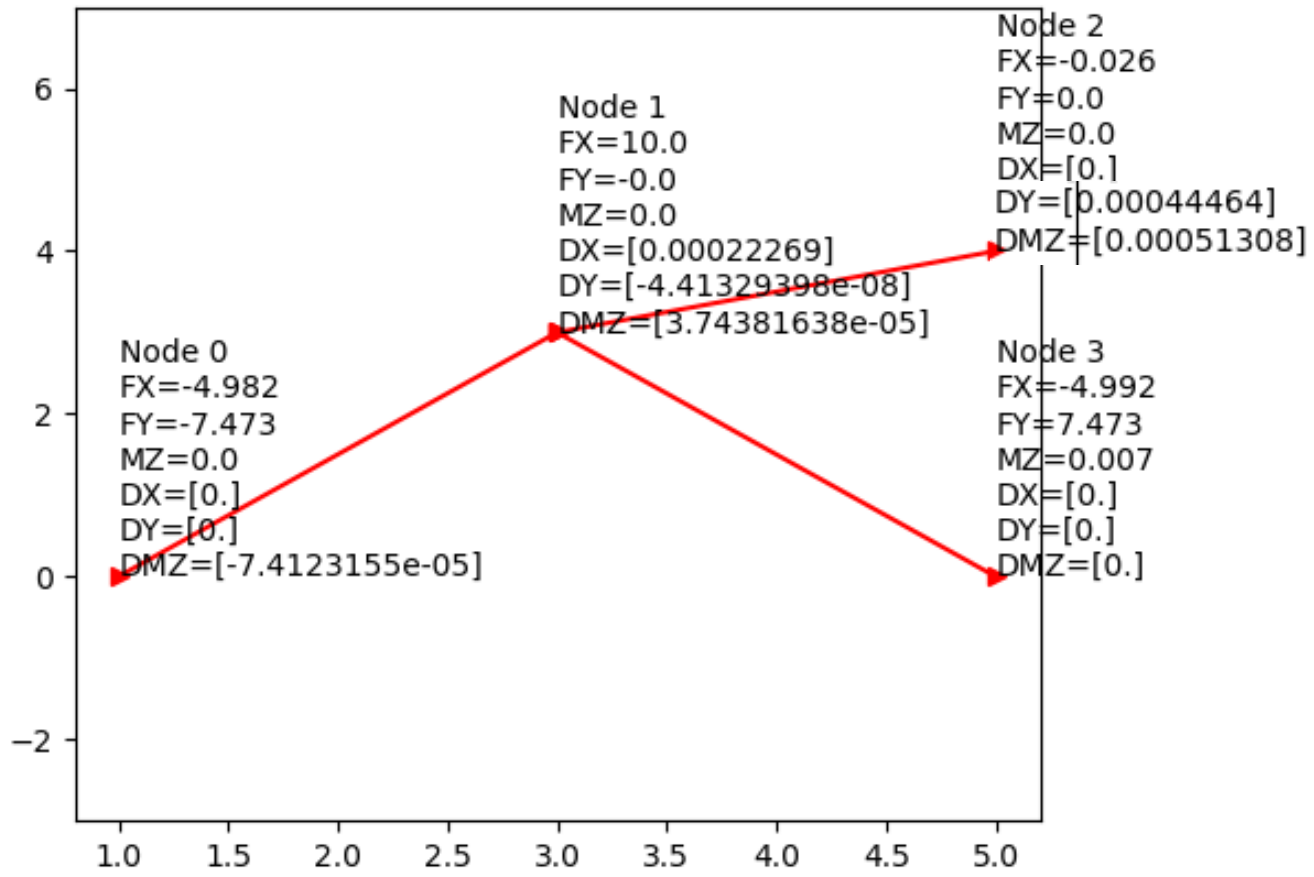
- Point0 can only rotate
- Point1 is free
- Point2 is can move along y axis
- Point3 is fixed
- Nothing can move along the z axis
- Rotation is possible only in z direction (right hand rule)

- Please note that this structure was designed only to propose a standard for the JSON.
- This structure may not be deterministic.

RESULTS COMPARISON Forces



SAP2000



Our results

NEXT STEPS

Improvements

- Extending for 3D structures

Optimizations

- Parallelizing calculations
- GPU processing

Q & A