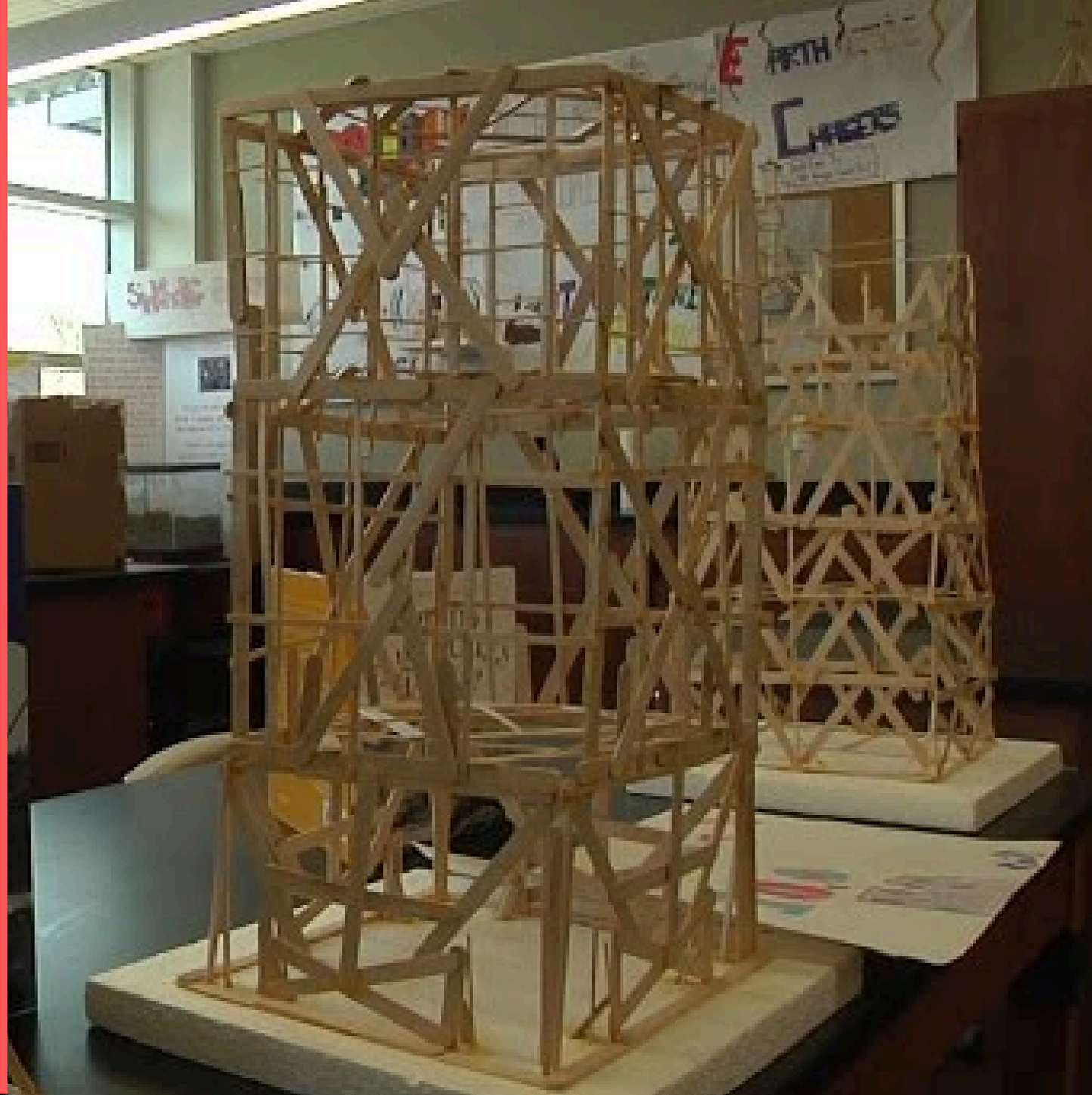
# MATERIALS AND STRUCTURAL TEST

GROUP 4

**INVERTED V-BRACING**
BUILDING



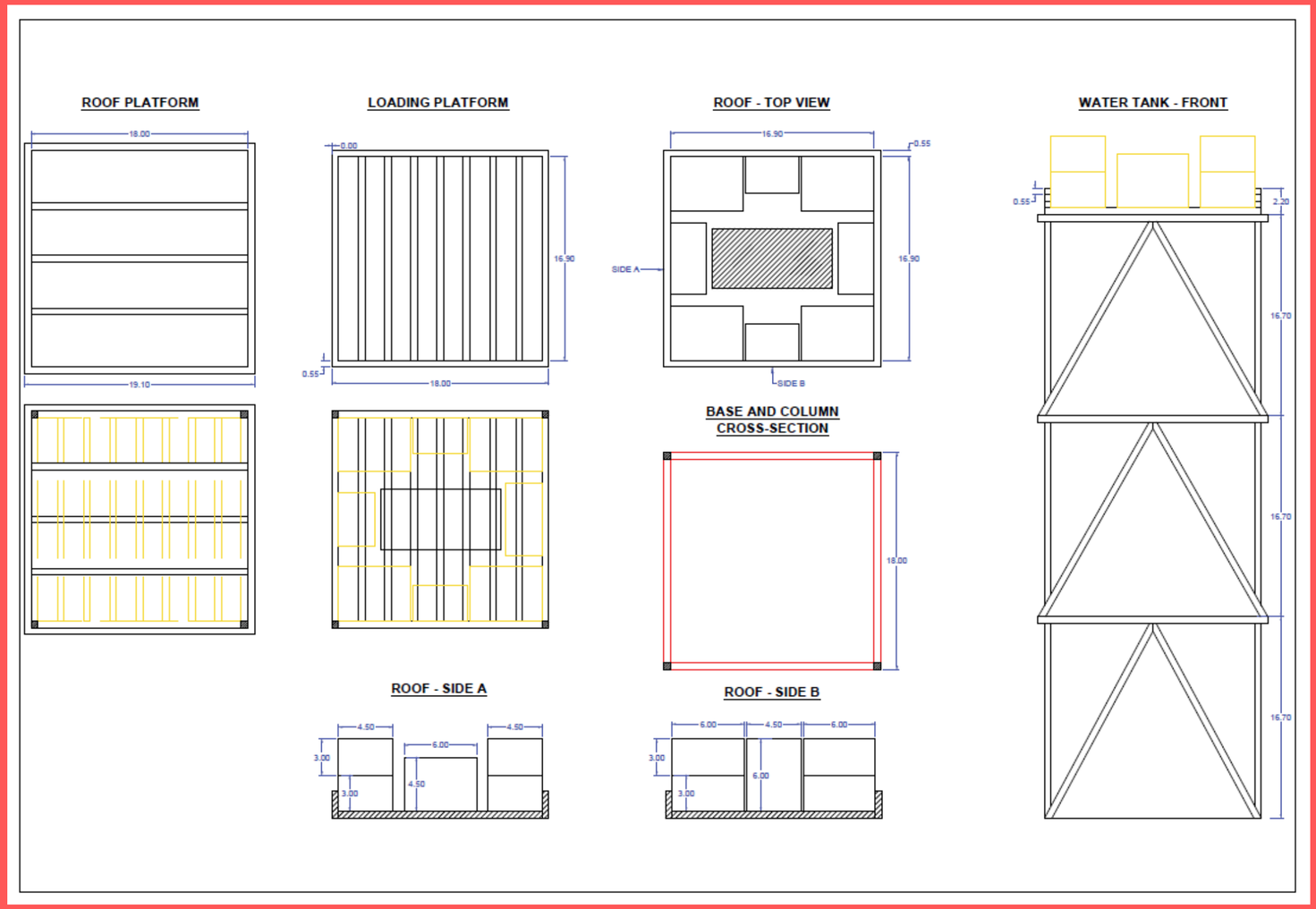
# GROUP 4

GROUP MEMBERS:

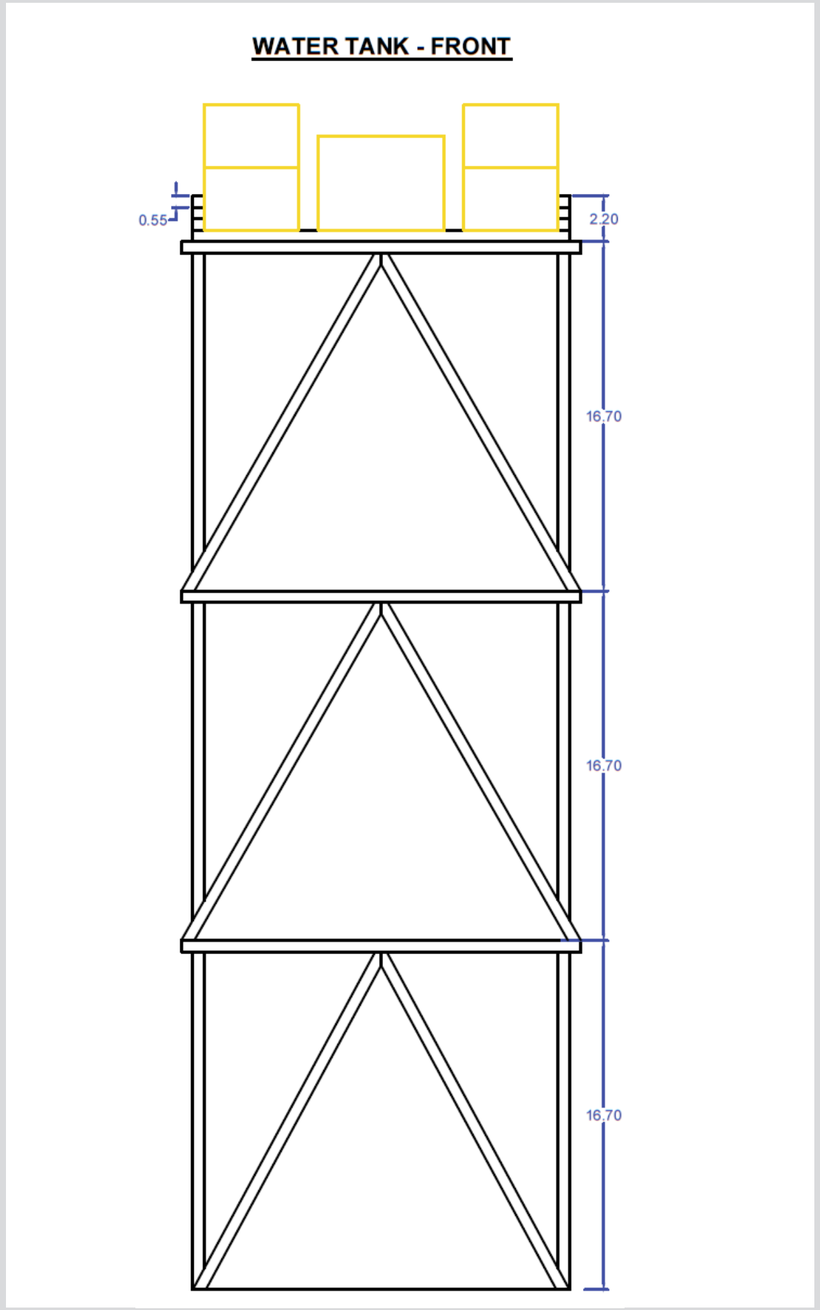
| | |
|---|---|
| SHEREAN DUNCAN | B11135027 |
| ANA AQUINO | B11035012 |
| ARACELI AYALA | F11205102 |
| JUAN PABLO BENITEZ | F11205105 |
| BIANCA CESPEDES | F11205109 |
| ALEJANDRO LOPEZ | F11205115 |
| JULIO OVIEDO | F11205118 |

# DESIGN CONCEPT

A inverted-v bracing design



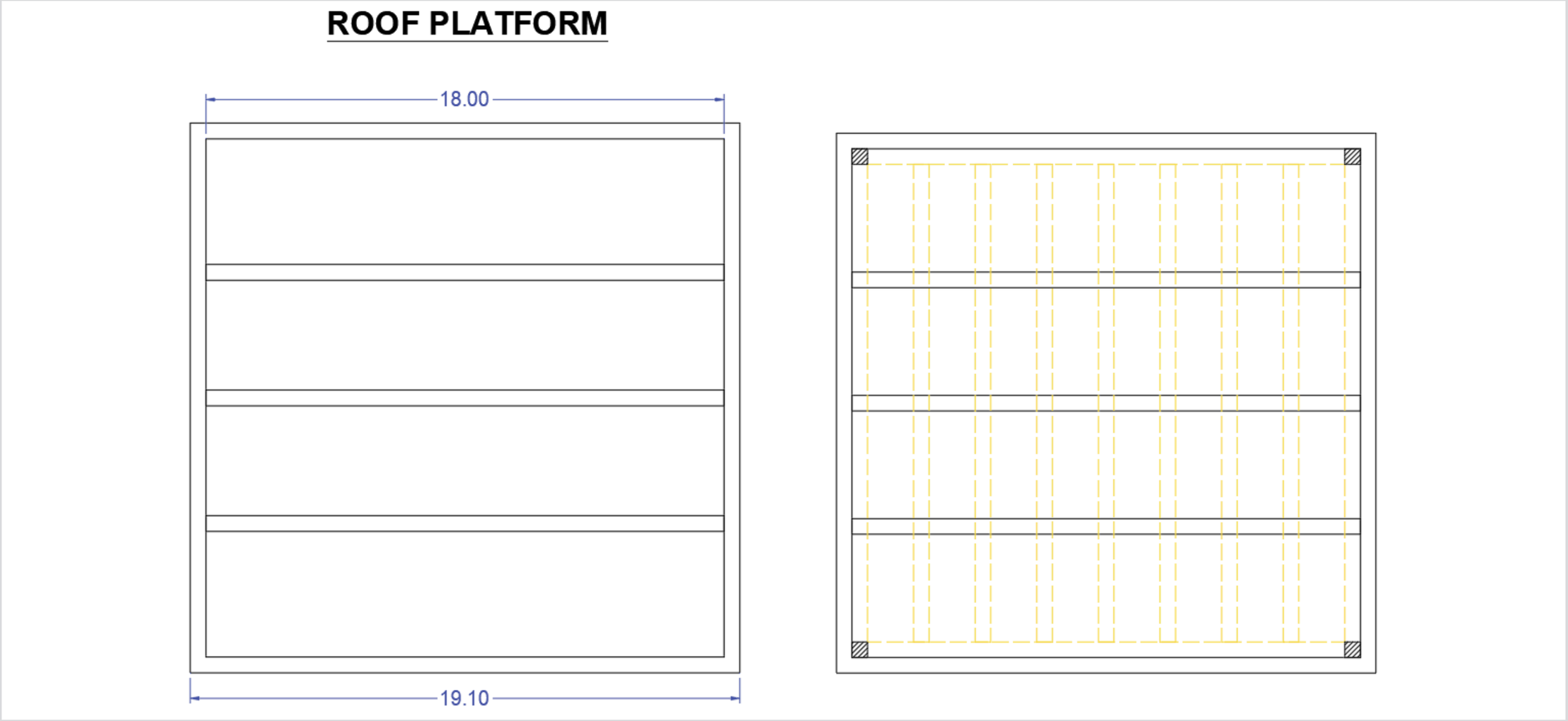

**Planes designed in AutoCAD 2D**




# Type of frames

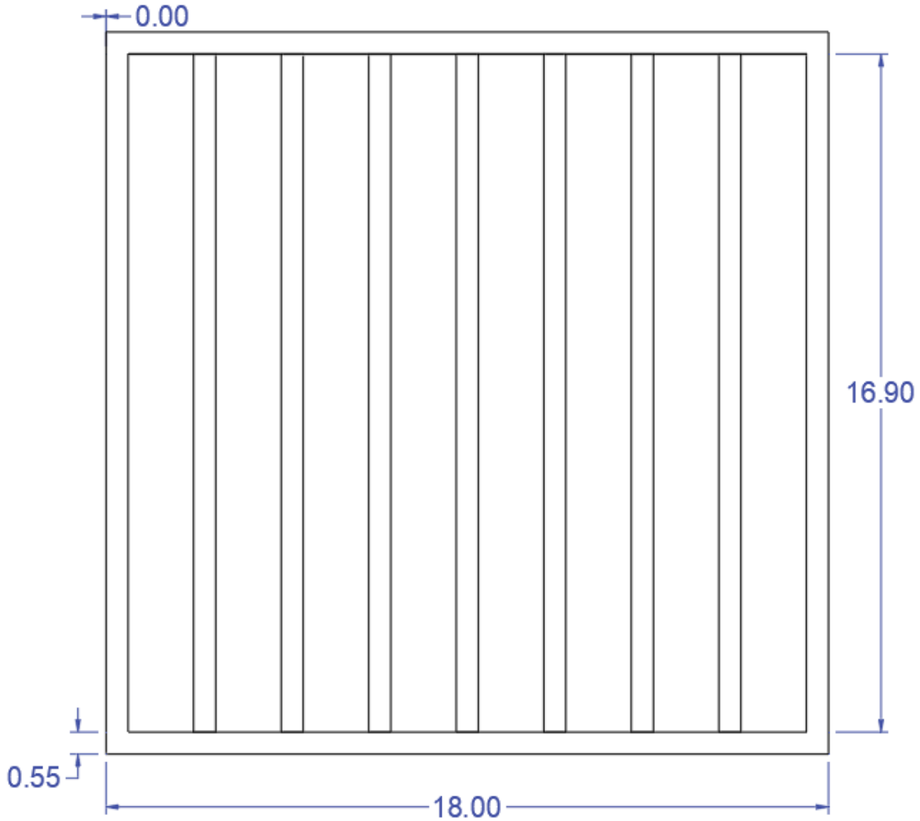
- **Inverted V-braces**
  - This design includes inverted V-brace trusses. These trusses enhances the tower's lateral stability, ensuring it can withstand various forces and maintain structural integrity.

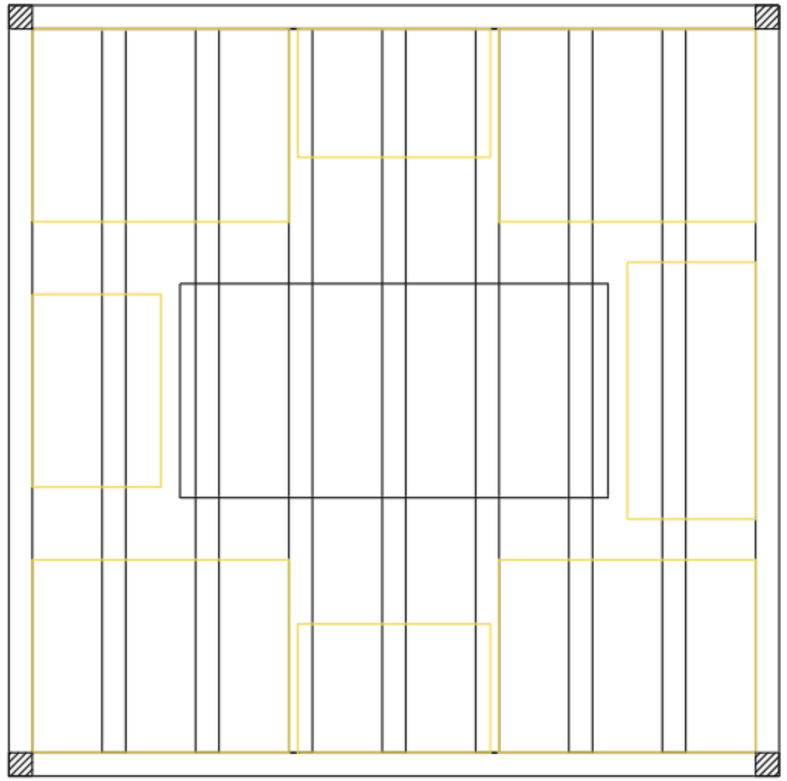
# DESIGN DETAILS



# DESIGN DETAILS

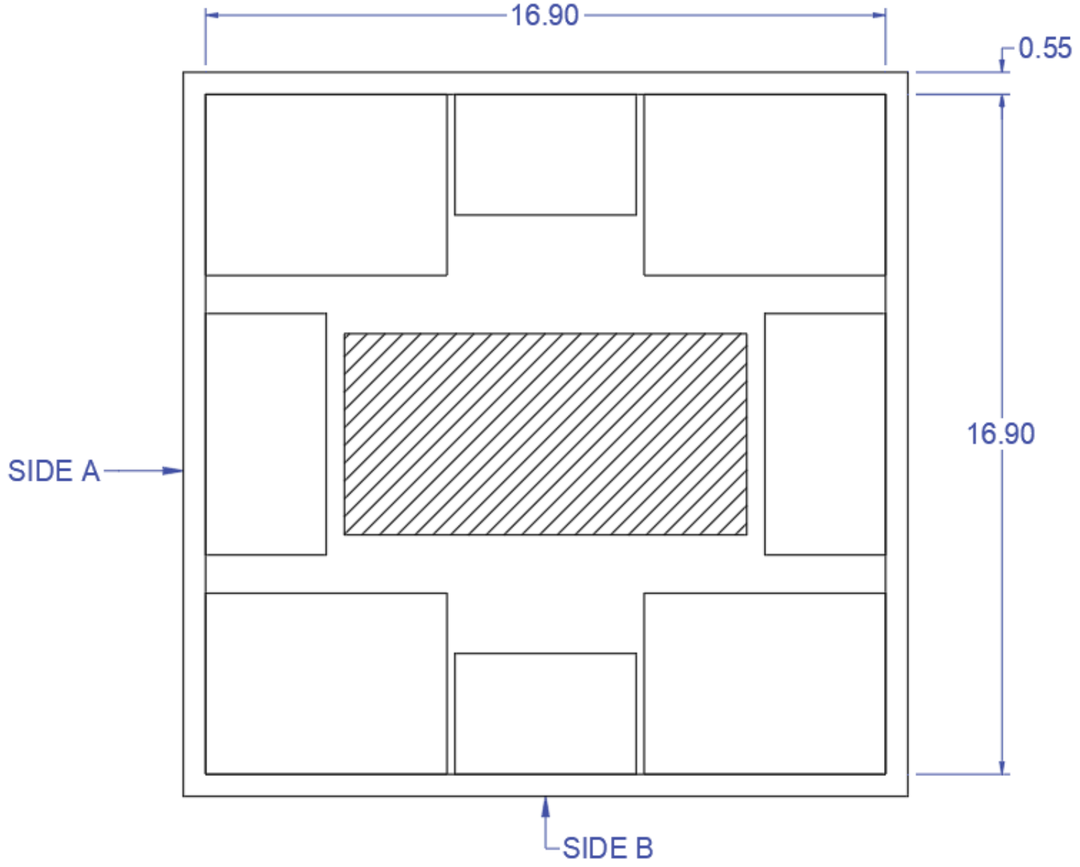
## LOADING PLATFORM



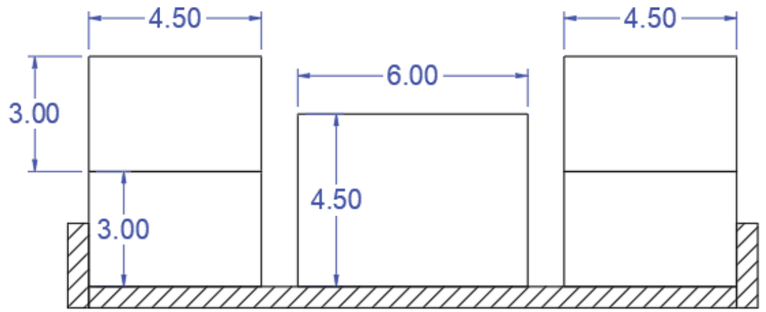



# DESIGN DETAILS - LOAD PLACEMENT

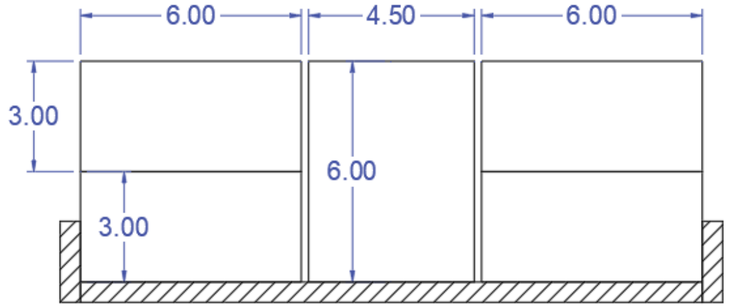
## ROOF - TOP VIEW




## ROOF - SIDE A




## ROOF - SIDE B



# STRUCTURE DETAILS

**UNIT**: N/mm

**NUMBER OF STORIES**: 3

**NUMBER OF NODES**: 60

**MATERIAL PROPERTIES**

**MATERIAL**: Medium Density Fiberboard (MDF)

**ELASTIC MODULUS**: 4000 MPA

**POISSON'S RATIO**: 0.25

# TRANSMISION OF FORCES

First we calculate the **forces generated in members** because of the *12 blocks* carried on the top support, in order to analyze the reactions and how they are distributed throught the structure.

- *We use the two-way slab because of the surface dimensions.*

### Calculations for distributed load

Mass of each block: $0.635\ kg$

Weight of each block: $(0.635\ kg)(9.81\ kg/m^2) = 6.229\ N$

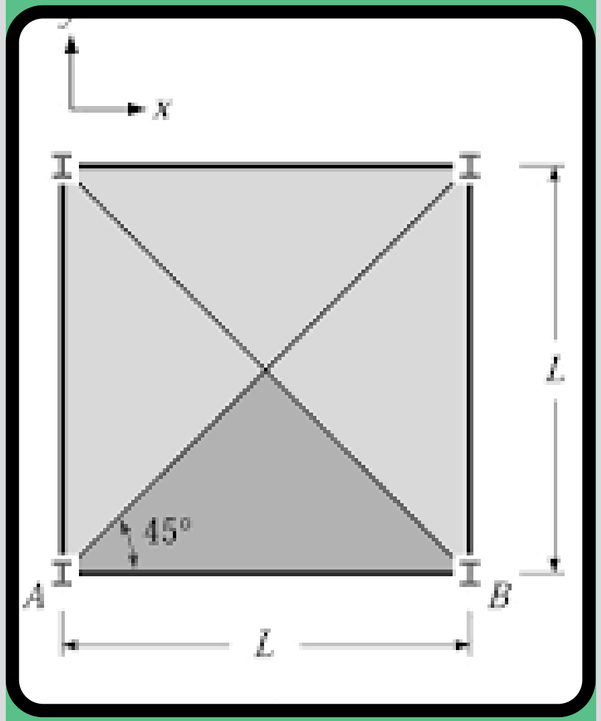
Supporting area: $(18\ cm)(18\ cm) = 324\ cm^2$

Distributed loading: $\frac{6.229\ N}{324\ cm^2} = 0.01923\ N/cm^2$

Tributary load: $(0.01923\ N/cm^2)(9\ cm) = 0.17302\ N/cm$

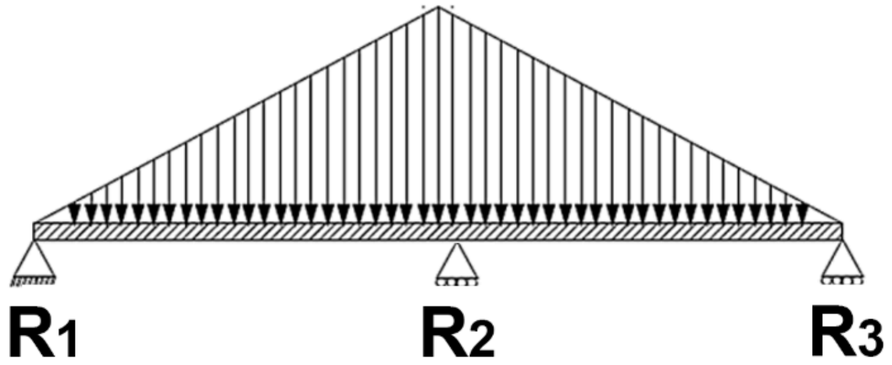
## Two-way slab

Because *length = width*




**Load will be distributed in two perpendicular directions.**

# IDEALIZED MODEL




Reactions at the supports:

$$+\uparrow \sum Fy = 0$$

$$R1 + R2 + R3 - Tributary\ Load = 0$$
$$R1 + R2 + R3 = (0.17302\ x\ 18\ x\ 0.5)\ /\ 3$$
$$R1 = R2 = R3 = 0.51906\ N$$

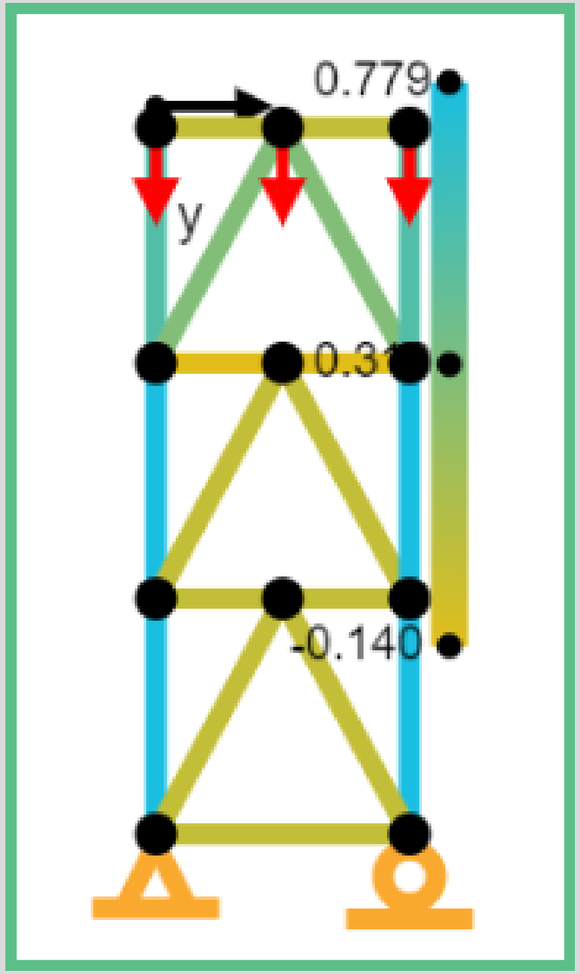
# FORCES DISTRIBUTED TO THE STRUCTURE

- We distribute the load thorught the **three nodes** located at the top support.

- **By symmetry** we can analyze one side, and its magnitude will represent the other ones.

**As more:**

- Blue: Greater force magnitude.
- Green: No magnitude.



# RESULTS OBTAINED

| Member ID | Start -> End Node | Length (mm) | Axial Force (N) |
|---|---|---|---|
| 0 | 0 → 2 | 167 | 0.7786 |
| 1 | 0 → 4 | 189.7 | 0 |
| 2 | 2 → 4 | 90 | 0 |
| 3 | 1 → 3 | 167 | 0.7786 |
| 4 | 1 → 4 | 189.7 | 0 |
| 5 | 3 → 4 | 90 | 0 |
| 6 | 2 → 5 | 167 | 0.7786 |
| 7 | 2 → 7 | 189.7 | 0 |
| 8 | 5 → 7 | 90 | -0.1399 |
| 9 | 3 → 7 | 189.7 | 0 |
| 10 | 3 → 6 | 167 | 0.7786 |
| 11 | 6 → 7 | 90 | -0.1399 |
| 12 | 5 → 8 | 167 | 0.5191 |
| 13 | 5 → 9 | 189.7 | 0.2948 |
| 14 | 8 → 9 | 90 | 0 |
| 15 | 6 → 9 | 189.7 | 0.2948 |
| 16 | 6 → 10 | 167 | 0.5191 |
| 17 | 9 → 10 | 90 | 0 |
| 18 | 0 → 1 | 180 | 0 |

# REFLECTIONS

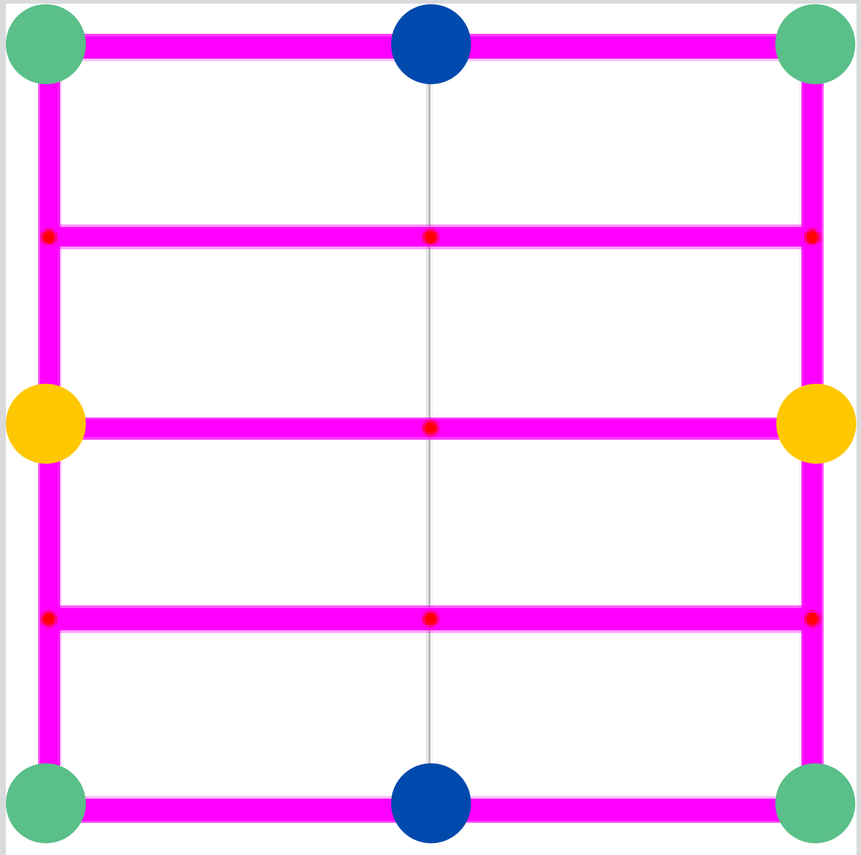
**01** The column members supporting the first and second floor **are the most influenced ones**, meaning that a reinforcement in those will enhance overall load capacity.

**02** **The inverted V-Brace Members** distribute effectively the loadings. Meaning that it´s inclusion and location are correct decisions.

**03** Because of the magnitudes, **the loads doesn´t represent a threat** for the structure integrity.

# LOAD TESTING

## NODAL MASS DISTRIBUTION ON 3F



0.5 column + 1 beam + 2 mass blocks

**$1.255768931 \times 10^{-3}$ N-s²/mm**

1.5 beam + 1 brace + 1 mass block

**$6.350645989 \times 10^{-4}$ N-s²/mm**

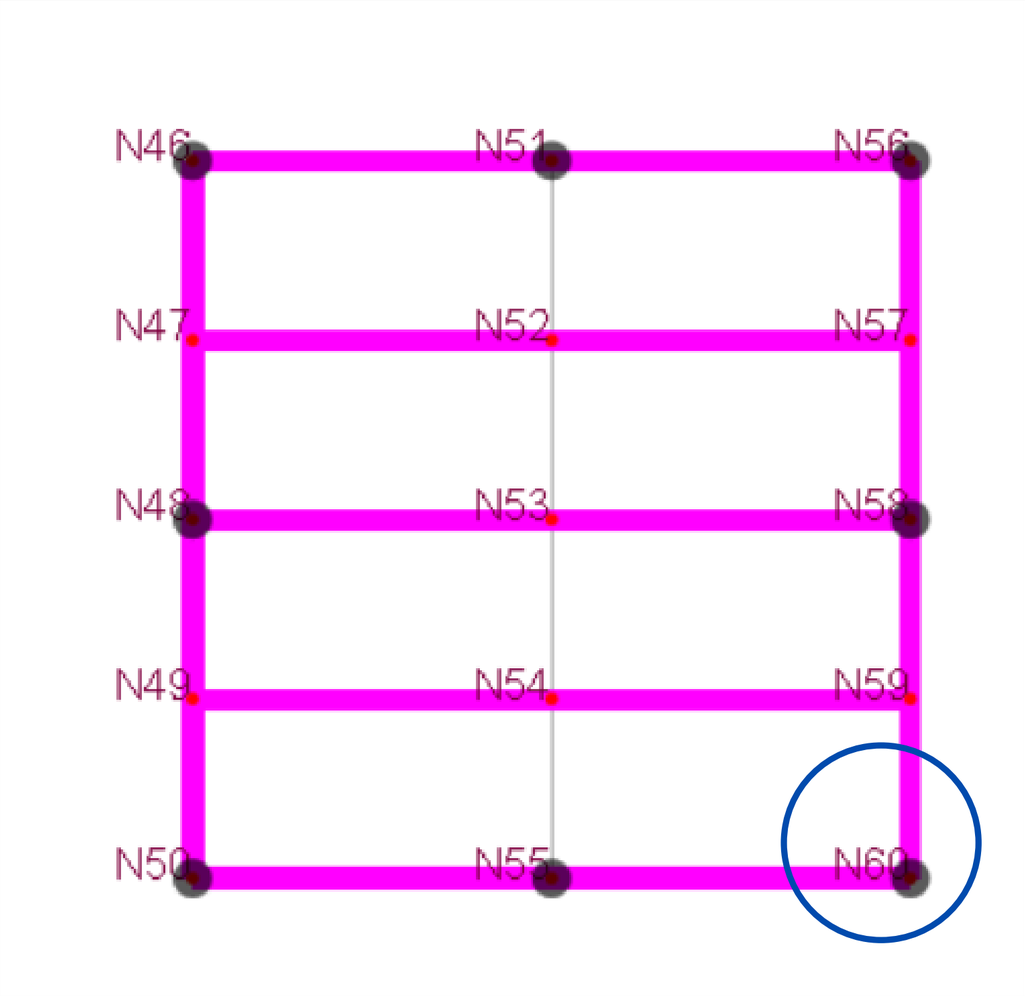
1 beam + 1 brace + 1 mass block

**$6.33094186 \times 10^{-4}$ N-s²/mm**

## TOTAL OF 12 MASS BLOCKS ON LOADING PLATFORM

# MODAL ANALYSIS

## FREQUENCY MEASURED IN TOP FLOOR




**THE ANALYSIS WAS BASED ON THE NODE N60**

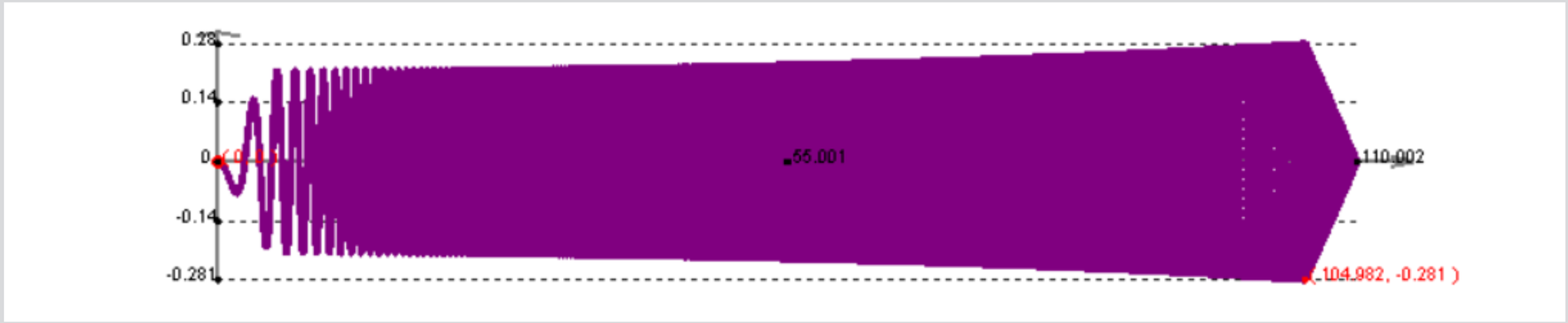
**NATURAL PERIOD: 0.069 SEC**
**FREQUENCY: 14.5 HZ**

# MODAL ANALYSIS

## 2500 mm/s²

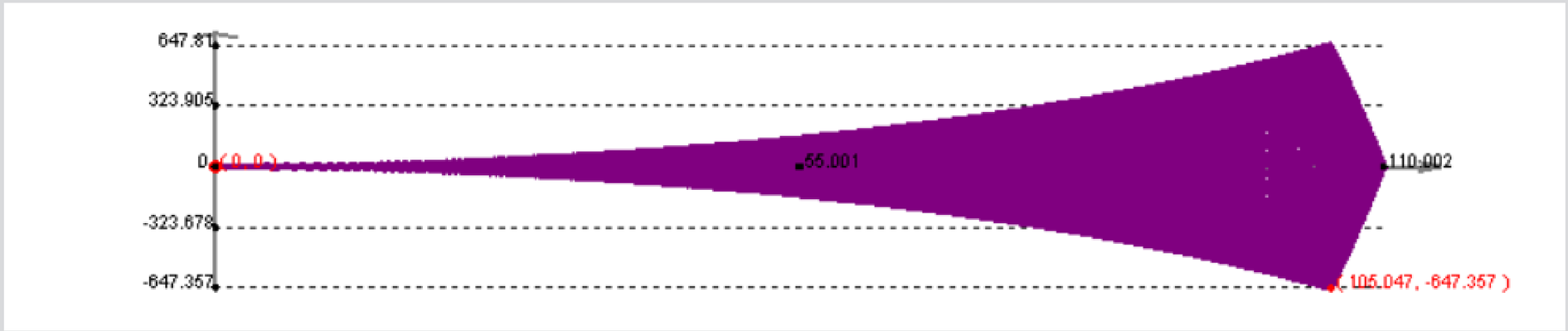
## DISPLACEMENT

**0.281 mm**




## ACCELERATION

**647.357 mm/s²**



# MODAL ANALYSIS

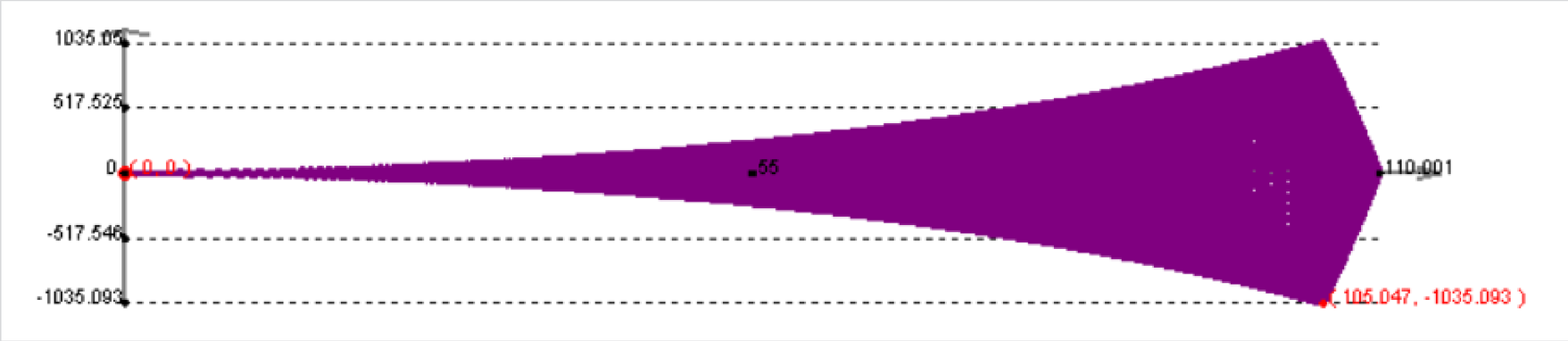
## 4000 mm/s²

### DISPLACEMENT

0.449 mm


### ACCELERATION

1035.093 mm/s²



# MODAL ANALYSIS

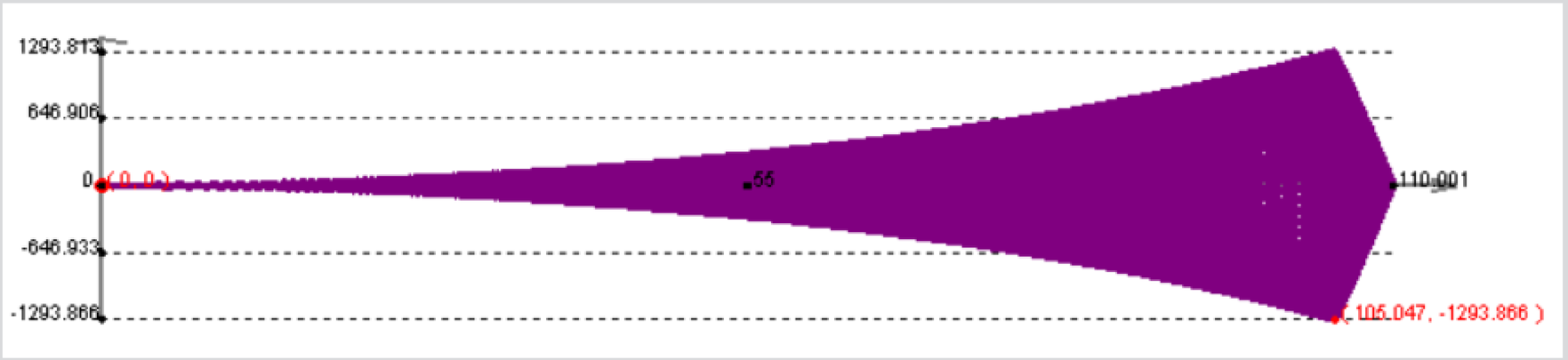
## 5000 mm/s²

### DISPLACEMENT

0.561 mm


### ACCELERATION

1293.866 mm/s²

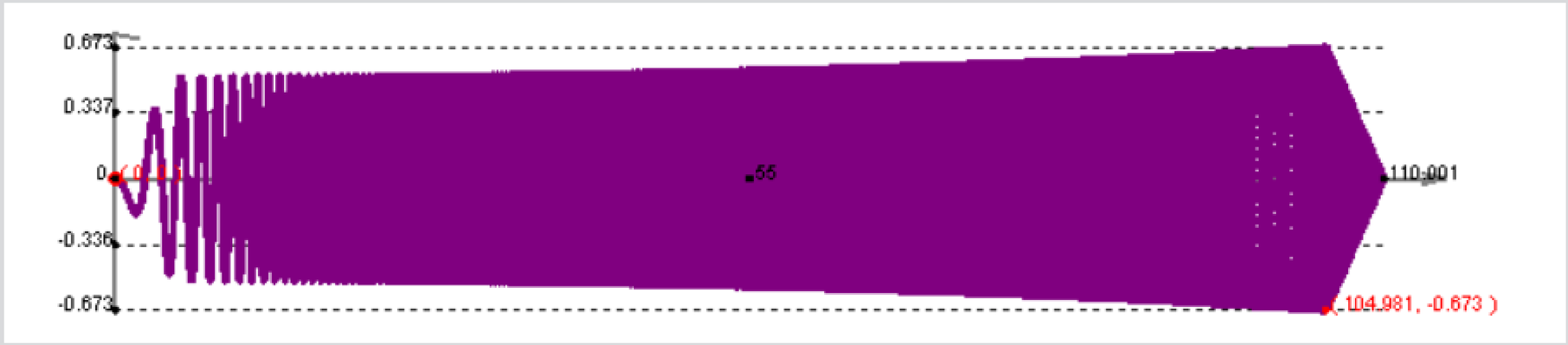


# MODAL ANALYSIS

## 6000 mm/s²

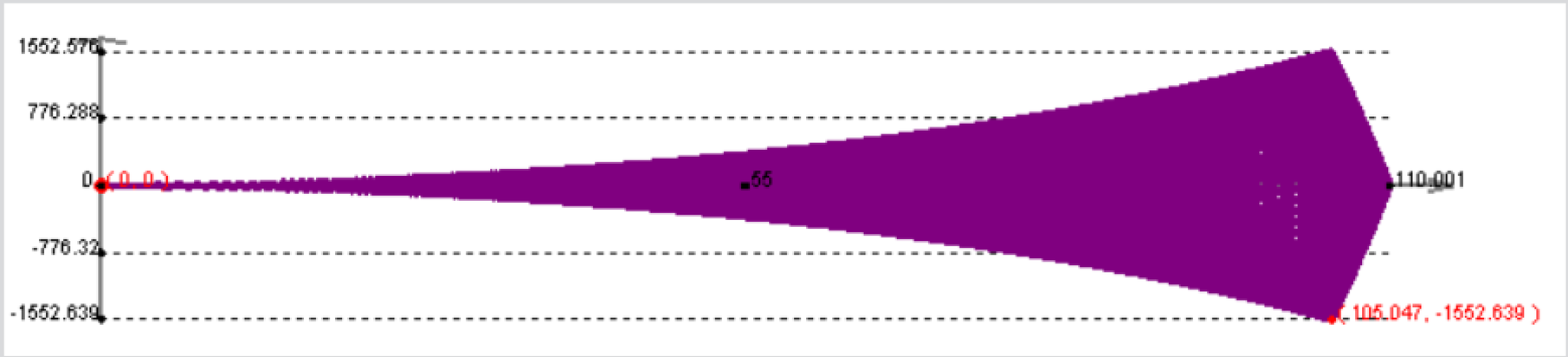
### DISPLACEMENT

0.673 mm




### ACCELERATION

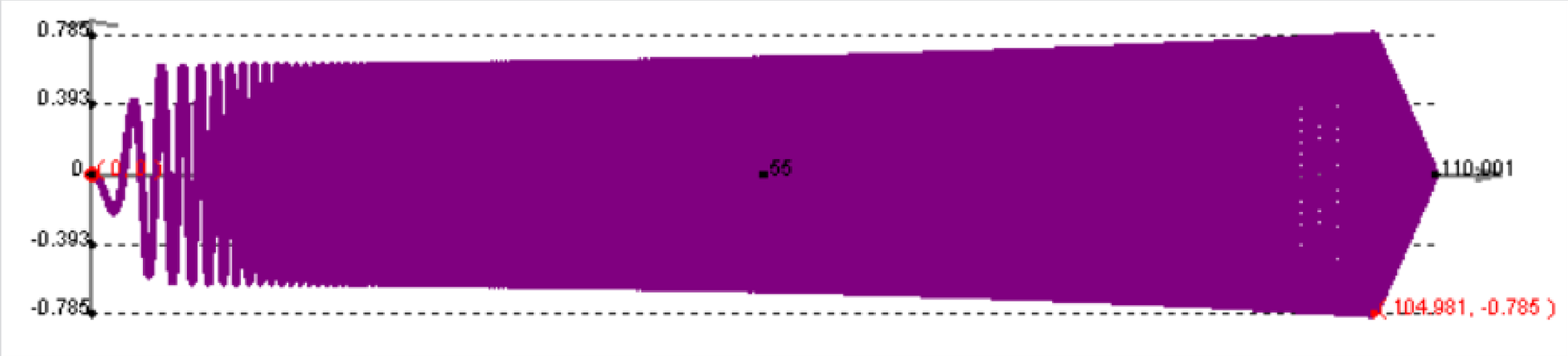
1552.639 mm/s²



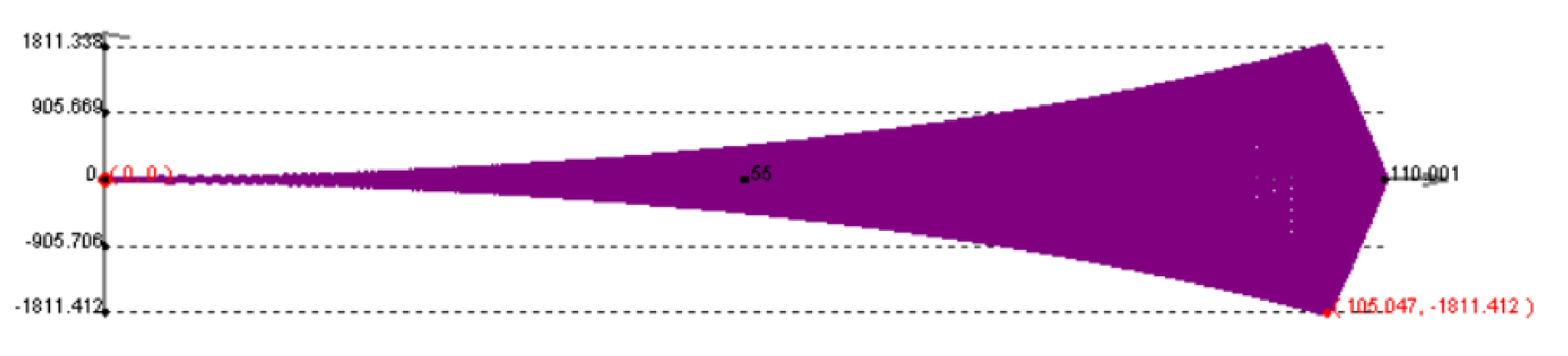
# MODAL ANALYSIS

## 7000 mm/s²

### DISPLACEMENT 0.785 mm




### ACCELERATION 1811.412 mm/s²

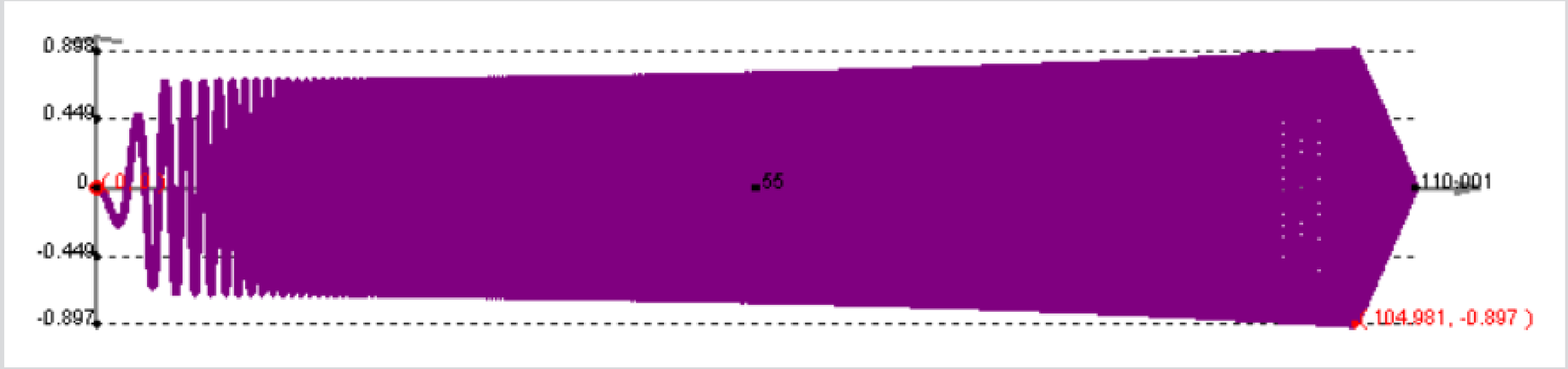


# MODAL ANALYSIS

## 8000 mm/s²

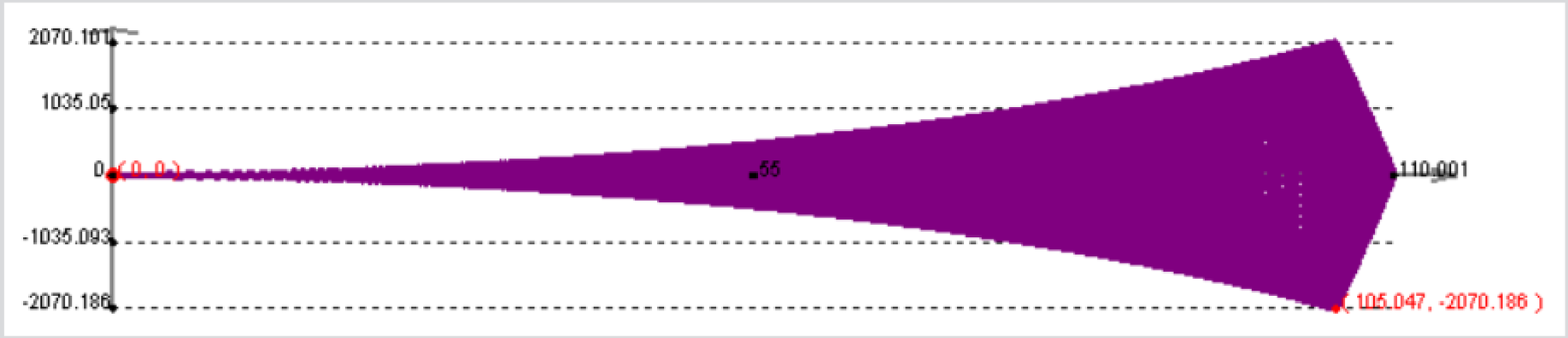
### DISPLACEMENT

0.897 mm/s²




### ACCELERATION

2070.186 mm/s²



# THANK YOU