

## II Foro de Tecnología para la Consultoría de Ingeniería de FEPAC



# MODELADO PARAMÉTRICO Y CÁLCULO DE PUENTES CON ALLPLAN BRIDGE

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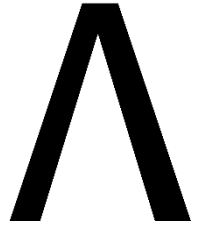
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# AGENDA

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- 1. GRUPO NEMETSCHKE**
- 2. SOLUCIONES ALLPLAN**
- 3. FLUJO DE TRABAJO CON ALLPLAN BRIDGE**
- 4. MODELADO PARAMÉTRICO**
- 5. CÁLCULO DE PUENTES**



# 1. GRUPO NEMETSCHKEK

# ALLPLAN ES PARTE DEL GRUPO NEMETSCHKE



Tanto las marcas del grupo Nemetschek como sus soluciones están estableciendo nuevos estándares para el sector AEC.

- Más de 60 años de innovación
- Pionero y proveedor de 5D
- 13 marcas consolidadas
- 4 millones de usuarios en todo el mundo
- IPO 1999, cotiza en el TecDax
- €802 millones ventas (2022)
- Más de 3.400 empleados
- 18% crecimiento ventas (2021)
- €5.508 millones capital mercado

**NEMETSCHKEK GROUP**

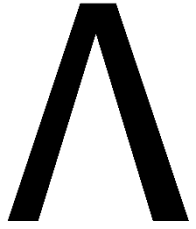
# Mission

Be the Preferred and Most Trusted Software Provider and Partner for the AEC/O and 3D Animation Industries.

**NEMETSCHKEK GROUP**

# Vision

Shape the World in all Dimensions.



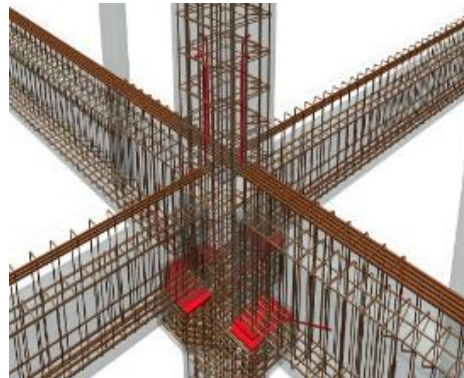
## 2. SOLUCIONES ALLPLAN

# SOLUCIONES ALLPLAN



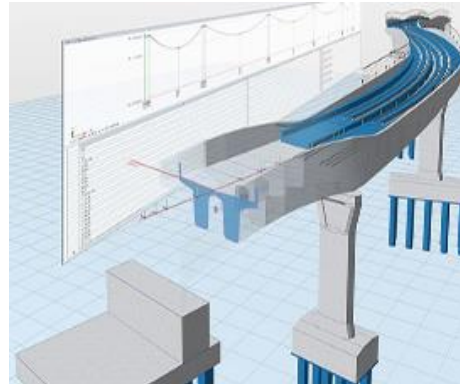
## ARQUITECTURA

Solución para arquitectos desde el diseño conceptual hasta el diseño muy detallado



## INGENIERIA

Diseño y detalles de estructuras con múltiples materiales (hormigón, acero, madera, mixtas)



## INFRAESTRUCTURAS

Modelado, cálculo, diseño y detalles de puentes, modelado y trazado de carreteras, modelado de estructuras de ingeniería civil



## PREFABRICADO

Herramienta para el modelado, detalles y fabricación de elementos prefabricados de hormigón



## CONSTRUCCIÓN

Solución para preparación y organización de obra

ALLPLAN – Solución para todo el sector AEC

# BIMPLUS – OPEN BIM

**Dashboard**

The BIMplus dashboard offers a quick overview on your projects, models, documents and much more. In addition, you have easy access to administer your Common Data Environment. The dashboard splits into different functional areas:

- the navigation area
- the central information board
- the central Project workspace
- the news banner

**Current project:** Tower  
**Company:** Allplan GmbH

**Country:** USA  
**City:** New York

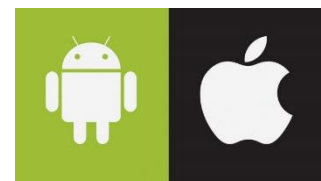
**Next appointment:** 10:00  
**Date:** April 30, 2018  
**Time:** 1h  
**Contact:** Munich

**Tasks:**

|         |           |           |
|---------|-----------|-----------|
| Open: 7 | Solved: 5 | Closed: 2 |
|---------|-----------|-----------|

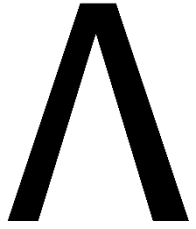
**Start:** January 24, 2023  
**End:** July 24, 2018

**Contact:** Allplan GmbH  
Name: 0049 89 92793 1155  
Telephone: 0049 172 216 8505  
Mobile phone:  
E-mail: rzellner@allplan.com



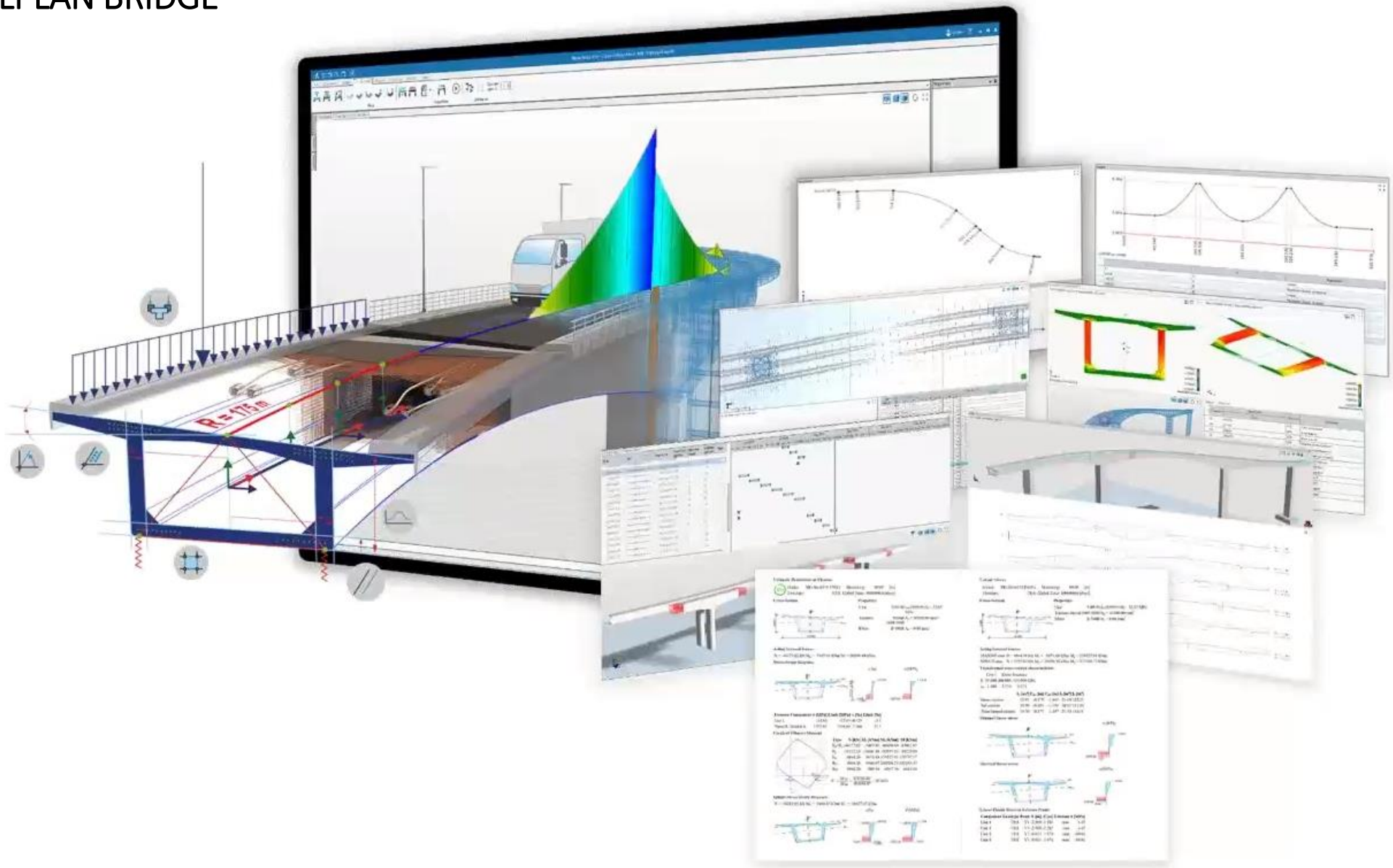
$$2x + 2y = 20$$





### 3. FLUJO DE TRABAJO CON ALLPLAN BRIDGE

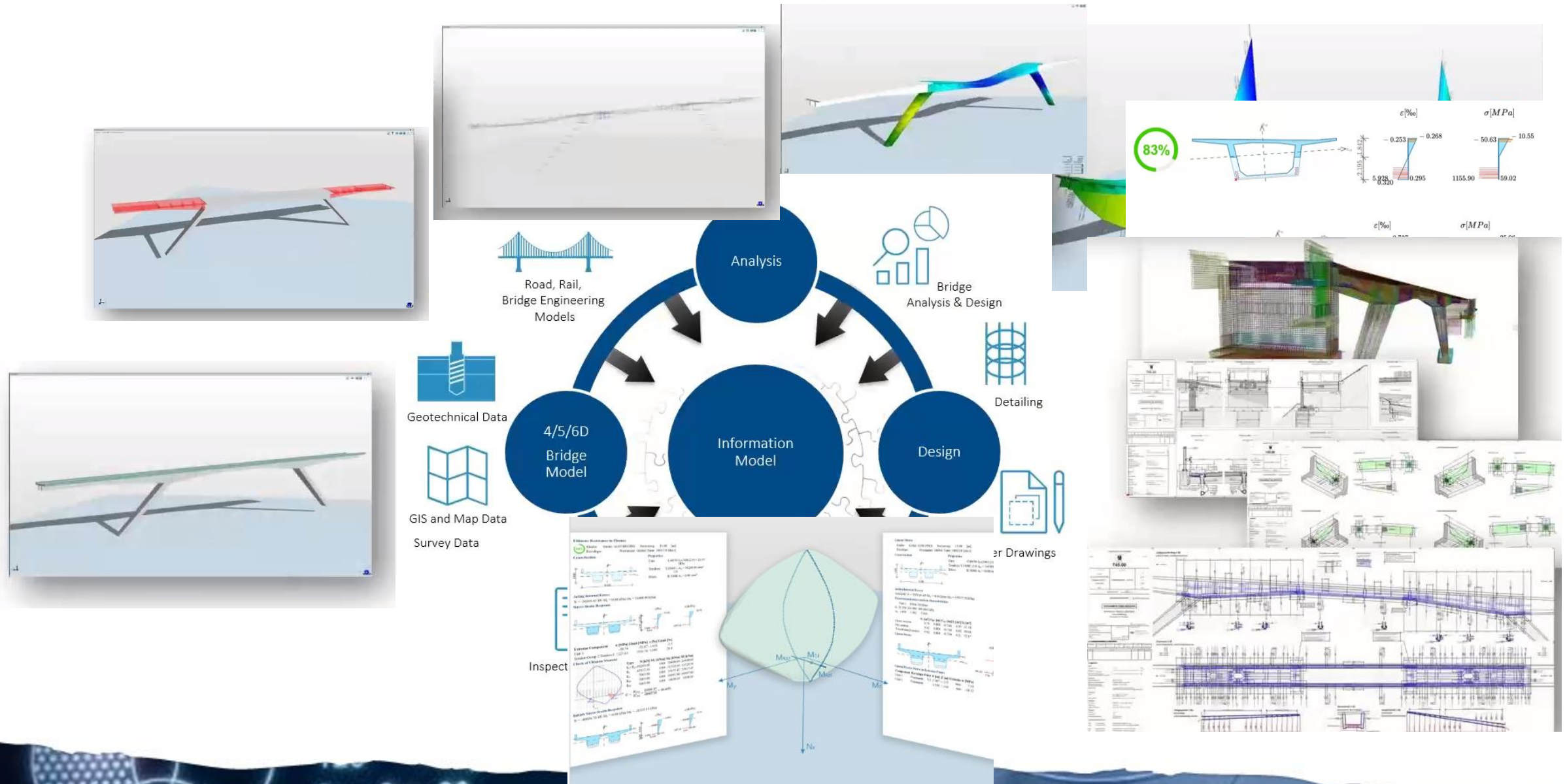
# \ ALLPLAN BRIDGE



$$2x + 2y = 20$$

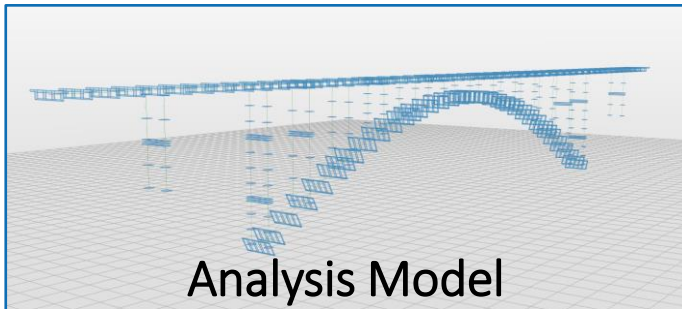
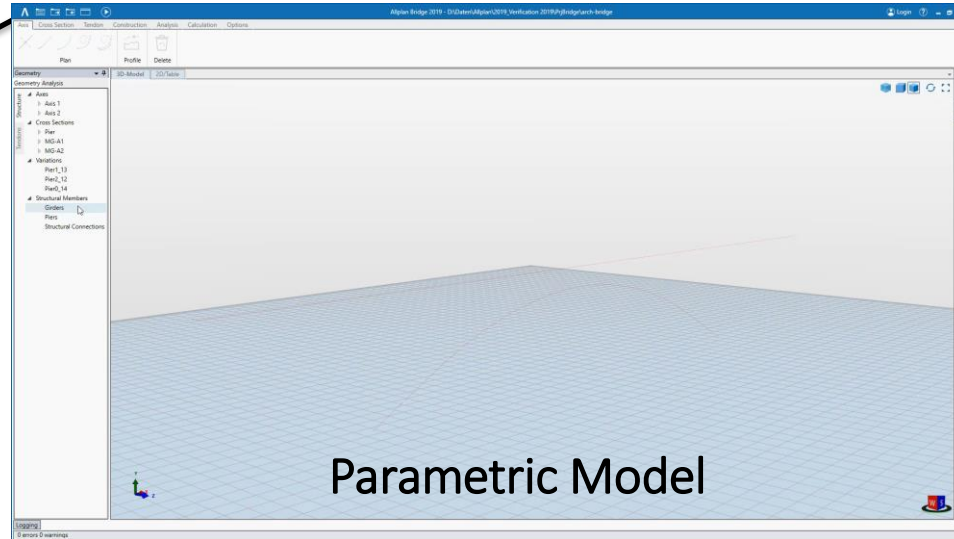
2"

# \ MODELADO, ANÁLISIS Y PLANOS (DETALLES) EN UNA SOLA SOLUCIÓN BIM



$$2x + 2y = 20$$

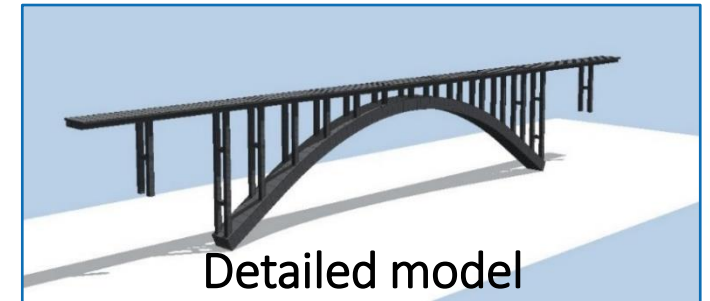
# ALLPLAN BRIDGE UN SOLO MODELO



Analysis Model

Structural Analysis

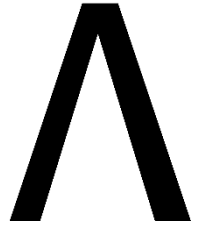
Parametric Model



Detailed model

Detailing, Drafting, Deliverables<sup>2D</sup>





## 4. MODELADO PARAMÉTRICO

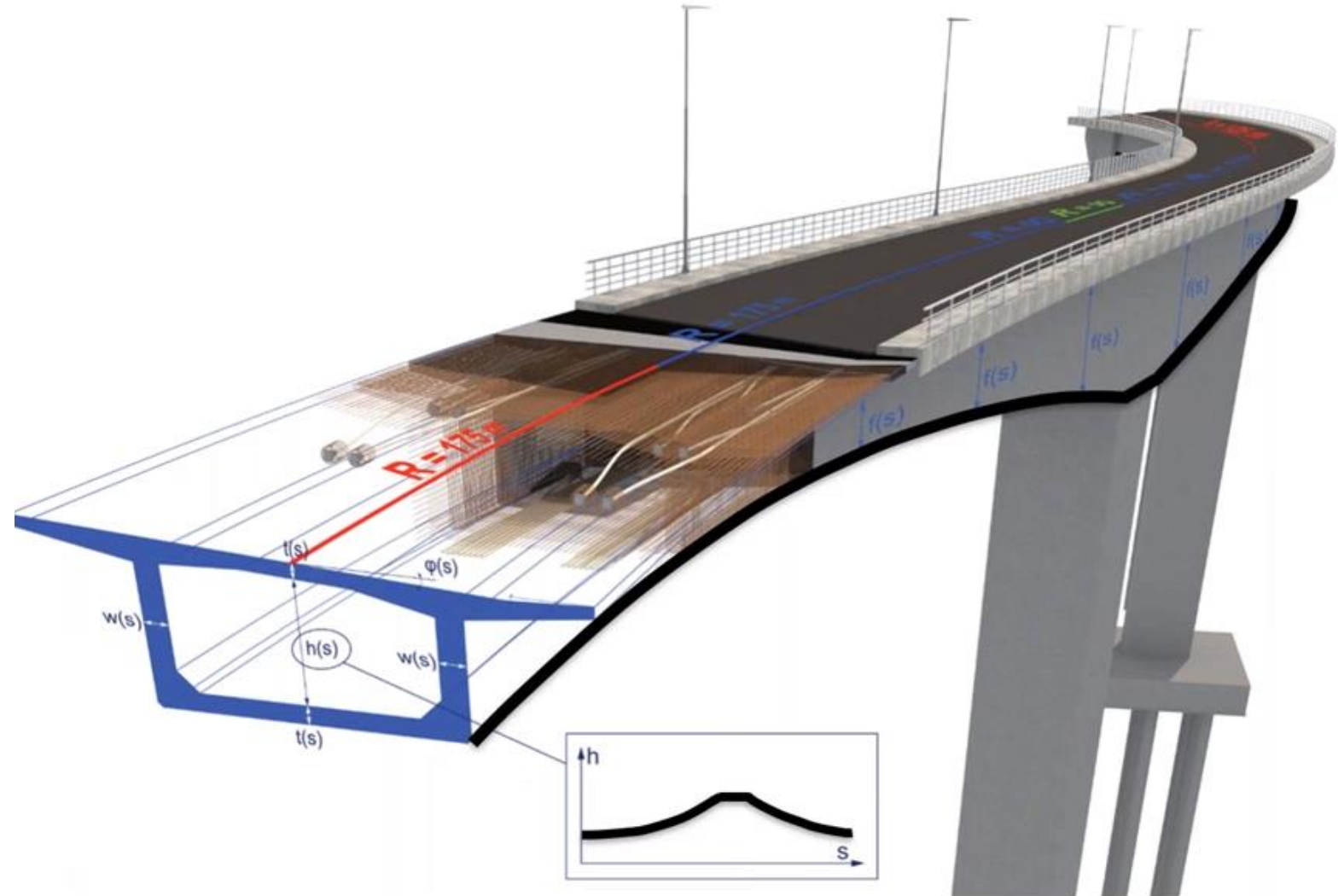
$$2x + 2y = 20$$

2

## \ ALLPLAN BRIDGE MODELER



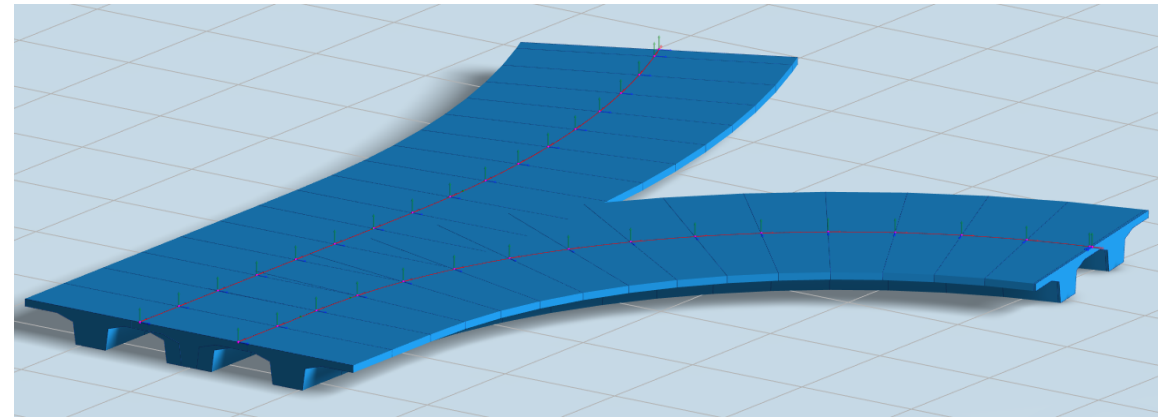
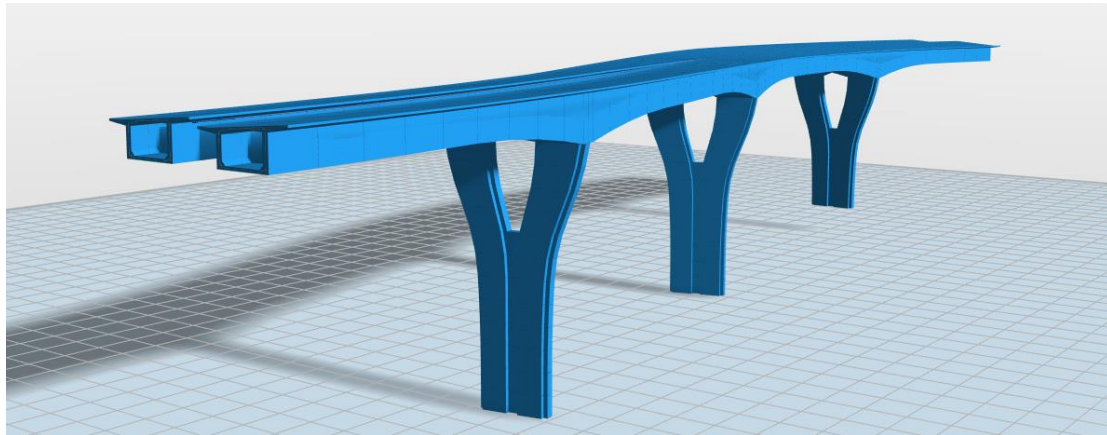
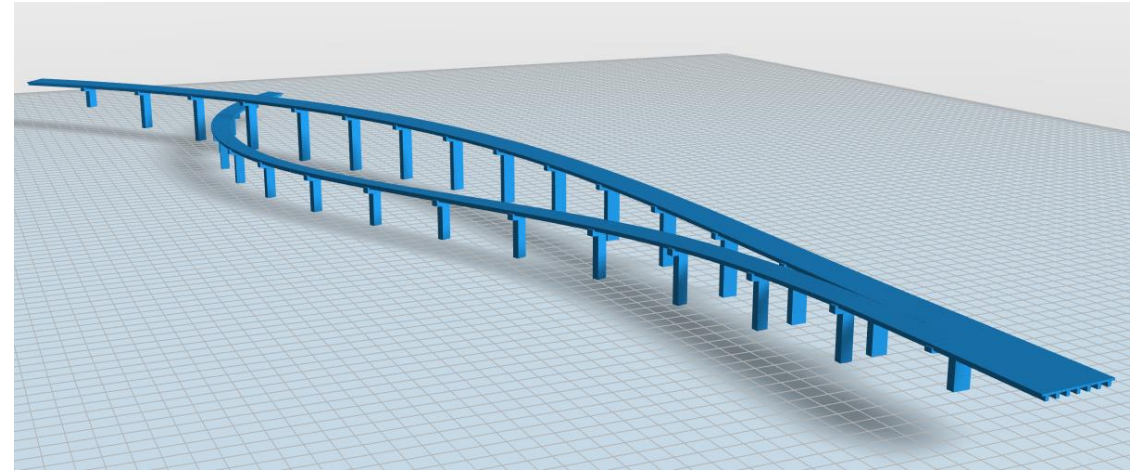
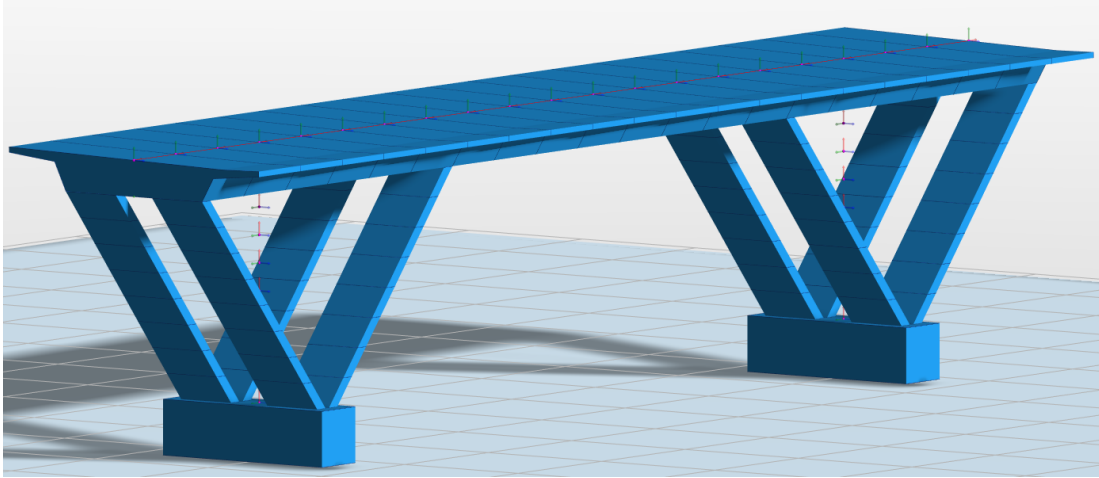
- › Modificaciones posibles en cualquier momento, incluso con el modelo geométrico acabado
- › Elementos paramétricos:
  - › **EJES**
  - › **SECCIONES TRANSVERSALES**
  - › **VARIACIONES**



# \ ALLPLAN BRIDGE MODELER



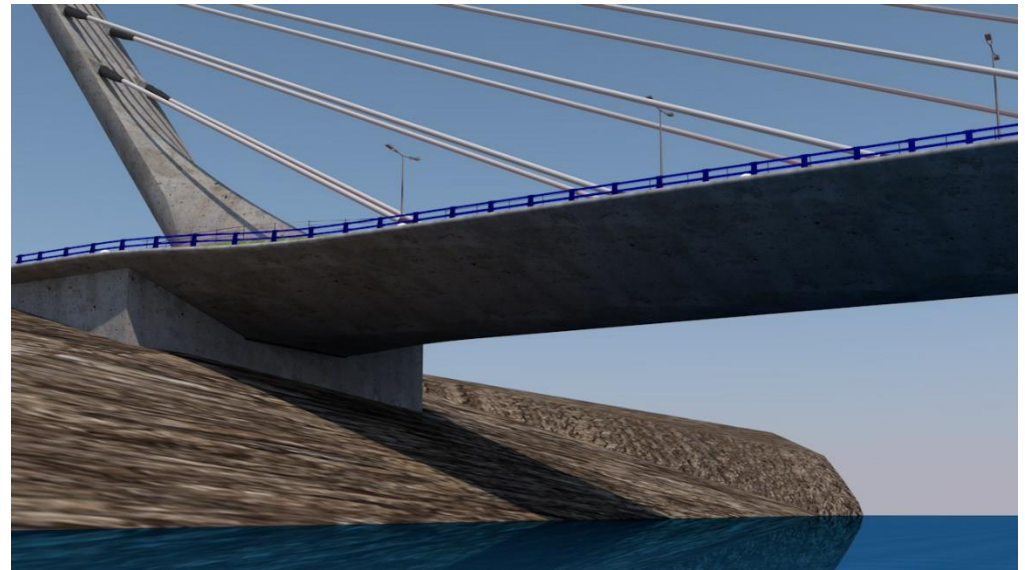
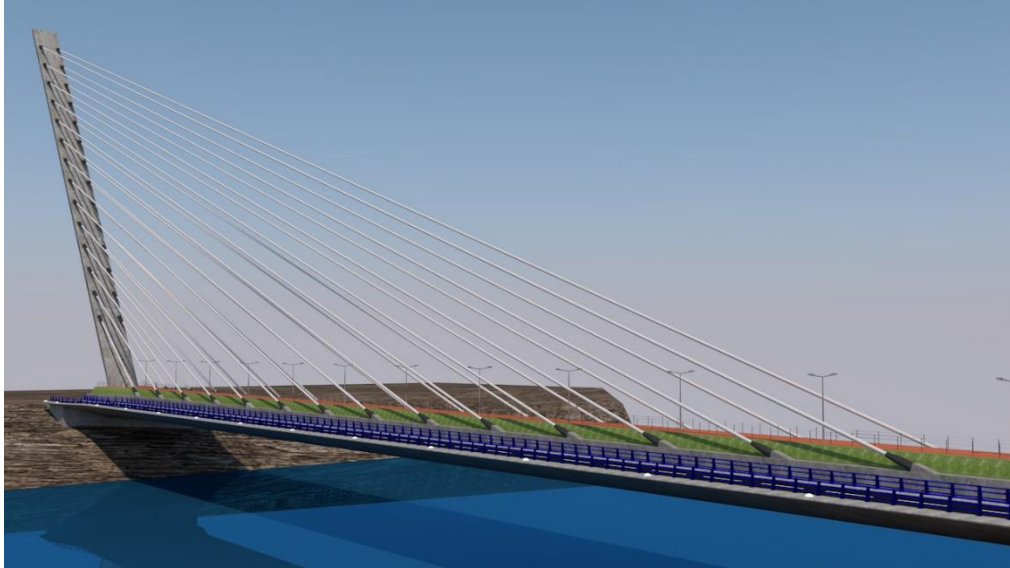
CUALQUIER TIPOLOGÍA Y FORMA



$$2x + 2y = 20$$

$$2''$$

# \ ALLPLAN BRIDGE

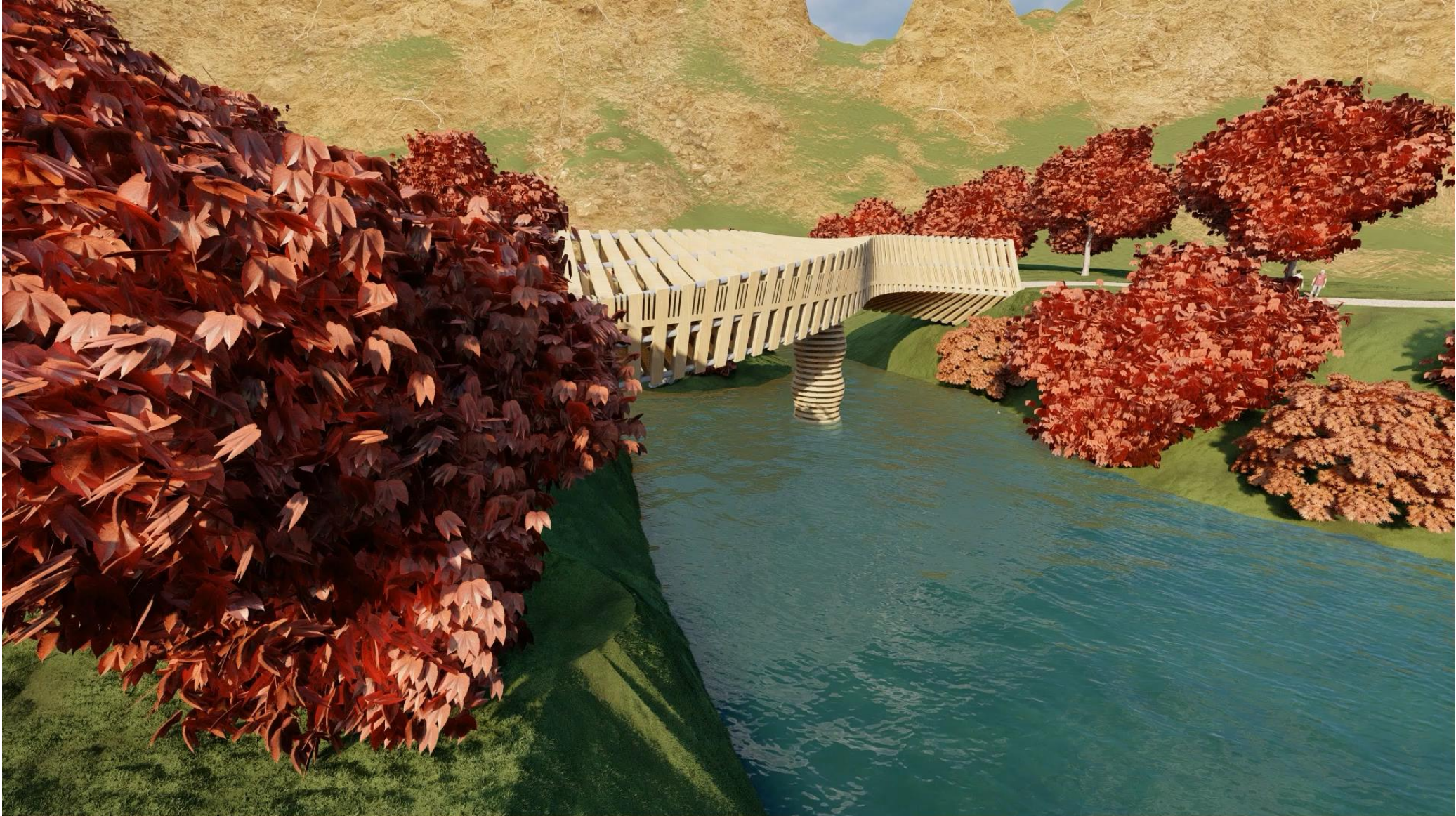


$$2x + 2y = 20$$





# \ BRIDGE: MODELADO DE ALTA CALIDAD





## FÁCIL MANEJO DE CAMBIOS - EJES

Allplan Bridge 2019 - \\AIMLE0001\allplan\_2019\PrjBridge\Double curved

Axis | Cross section | Tendon | Analysis | Calculation | Options

Plan | Profile | Delete

Project Navigation

- Structure
  - Axis
    - Axis Plan
    - Profile
  - Cross Sections
    - Pier
      - Variables
        - wpier
        - hpier
    - MG
      - Variables
        - hsection
        - webwidth
        - bthickness
        - incl
        - inclLeft
        - inclRight
        - webwidth\_half
        - bthickness\_half
  - Variations
    - hsection
    - bthickness
    - webwidth
    - incl
    - wpier
    - inclLeft
    - inclRight
  - Structural Members
    - Girders
      - MG
    - Piers
      - Pier 1-1
      - Pier 1-2
      - Pier 1-3
      - Pier 2-1
      - Pier 2-2
      - Pier 2-3
    - Structural Connections

3D-Model

Properties

- General
  - Name: Axis
  - Profiles: Profile
- Station
  - Station Start: 0 [m]
  - Station End: 220 [m]
  - Stationing: Ascending
- Bimplus
  - Bimplus Name:

Axis

Axis

E=109.941 [m] N=16.148 [m]

Logging

0 errors 0 warnings



## FÁCIL MANEJO DE CAMBIOS EN GEOMETRÍA

Allplan Bridge 2019 - \\AIMLE0001\allplan\_2019\PrgBridge\Double curved

Axis | Cross section | Tendon | Analysis | Calculation | Options

Plan | Profile | Delete

Project Navigation: 3D-Model

Structure:
 

- Axis
  - Axis Plan
  - Profile
- Cross Sections
  - Pier
    - Variables
      - wpier
      - hpier
    - MG
      - Variables
        - hsection
        - webwidth
        - bthickness
        - incl
        - inclLeft
        - inclRight
        - webwidth\_half
        - bthickness\_half
  - Variations
    - hsection
    - bthickness
    - webwidth
    - incl
    - wpier
    - inclLeft
    - inclRight
  - Structural Members
    - Girders
      - MG
    - Piers
      - Pier 1
      - Pier 2
      - Pier 3
      - Pier 4
      - Pier 5
      - Pier 6
    - Structural Connections

Properties:
 

- General
  - Name: hsection
  - Description: Section height
  - Type: Table
- Table
  - X constant:
  - Y constant:

hsection

x=85.041 y=-14.669

|   | X   | Y   | Transition                  |
|---|-----|-----|-----------------------------|
| > | 0   | 3.5 | Linear                      |
|   | 24  | 3.5 | Parabolic (horiz. at begin) |
|   | 44  | 3.5 | Linear                      |
|   | 46  | 3.5 | Parabolic (horiz. at end)   |
|   | 66  | 3.5 | Linear                      |
|   | 89  | 3.5 | Parabolic (horiz. at begin) |
|   | 109 | 3.5 | Linear                      |
|   | 111 | 3.5 | Parabolic (horiz. at end)   |

Logging: 0 errors 0 warnings

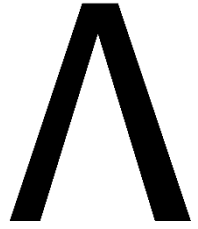


## DISEÑO DE ARMADURAS

The screenshot displays the Allplan Bridge 2018 software interface. The main window shows a 3D model of a curved prestressed concrete bridge with reinforcement bars (rebar) visible. The interface includes a top menu bar with options like Axis, Cross section, Analysis Sets, Calculation, and Options. Below the menu is a toolbar with icons for Plan, Profile, and Delete. On the left, a Project Navigation tree lists various elements such as Axes, Cross Sections, MG-Box, Variations, and Structural Members. The right side of the interface has a Properties panel. At the bottom, a status bar shows '0 errors 0 warnings'.

Project Navigation

- Axis
- Axis(MG)
  - Axis Plan
  - Profile(MG)
- Cross Sections
  - Pier
    - Variables
      - wpier
  - MG-Box
    - Variables
      - webwidth
      - webwidth\_half
      - bthickness
      - bthickness\_half
      - hsection
      - incl
  - Variations
    - hsection
    - bthickness
    - webwidth
    - incl
    - wpier
  - Structural Members
    - Girders
      - MG-Box\_P1
      - MG-Box\_P2
      - MG-Box\_P3
    - Piers
      - Pier 1
      - Pier 2
    - Structural Connections



## 5. CÁLCULO DE PUENTES

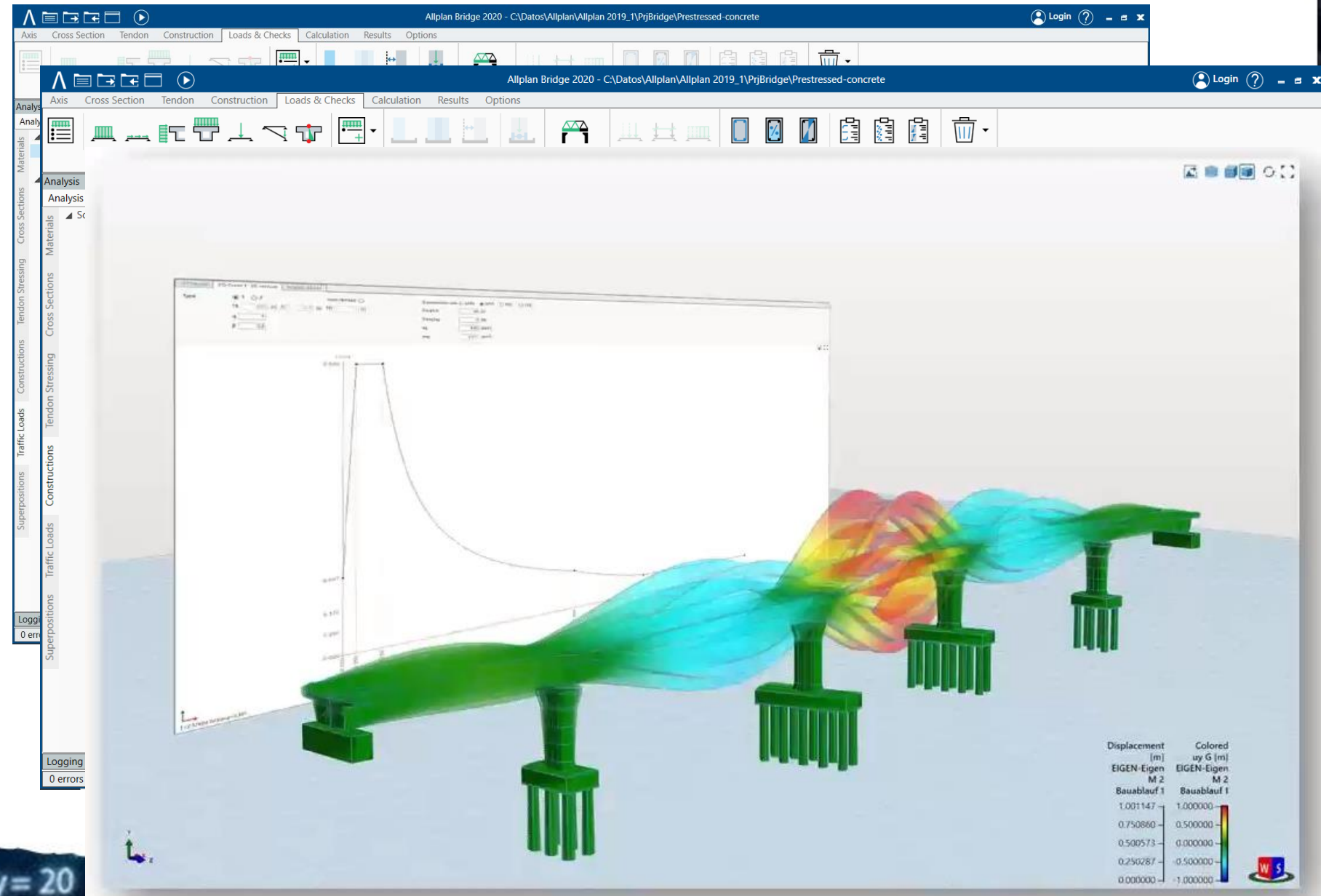
$$2x + 2y = 20$$

2

# \ DEFINICIÓN DE CARGAS



- › TRÁFICO
- › TEMPERATURA
- › ASIENTOS DIFERENCIALES
- › ACCELERACION / FRENADO
- › VIENTO
- › CARGAS PUNTUALES NUDOS
- › CARGAS DISTRIBUIDAS
- › SÍSMICAS



# \ HIPÓTESIS Y COMBINACIONES



- ✓ Grupos
- ✓ Tipos de combinación
- ✓ Filtros

The screenshot displays the 'Analysis Model' window in Allplan Bridge 2021. The main table lists 26 load combinations (C1 to C26) with their respective types and constituent loads. The table is organized into columns for different load categories: Permanent Loads, Pre-stressing, Time Effects, Settlement, and Variable Loads. Each load combination is defined by a set of 'Unfavorable' (Unfav) and 'Favorable' (Favor) coefficients for each constituent load.

| No. | Name    | Type           | SW-SUM |     | SDL-SUM |     | PT-SUM |     | CS-SUM |      | CS-#0 |     | CS-too |     | Settlement |       | LM1_TS |       | LM1_UDL |      | Braking |      | CFG-EuroormWind-with-Traf |     | Temperature |     | Earthquake |     | Name    | Groups  |         |   |   |   |   |  |
|-----|---------|----------------|--------|-----|---------|-----|--------|-----|--------|------|-------|-----|--------|-----|------------|-------|--------|-------|---------|------|---------|------|---------------------------|-----|-------------|-----|------------|-----|---------|---------|---------|---|---|---|---|--|
|     |         |                | Add    | Sub | Add     | Sub | Add    | Sub | Add    | Sub  | Add   | Sub | Add    | Sub | Add        | Sub   | Add    | Sub   | Add     | Sub  | Add     | Sub  | Add                       | Sub | Add         | Sub | Add        | Sub |         | 1       | 2       | 3 | 4 | 5 |   |  |
| 1   | C1_0<d  | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 1     | 1      | 1     | 1       | 1    | 1       | 1    | 1                         | 1   | 1           | 1   | 1          | 1   | 1       | C1_0<d  |         |   |   |   |   |  |
| 2   | C2_t=0  | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 1     | 1      | 1     | 1       | 1    | 1       | 1    | 1                         | 1   | 1           | 1   | 1          | 1   | 1       | C2_t=0  | ✓       |   |   |   |   |  |
| 3   | C3_t=0  | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 1     | 1      | 1     | 1       | 1    | 1       | 1    | 1                         | 1   | 1           | 1   | 1          | 1   | 1       | C3_t=0  | ✓       |   |   |   |   |  |
| 4   | C4_wind | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 1     | 0.75   | 0.75  | 0.4     | 0.4  | 1.5     | 0.6  | 0.6                       | 0.6 | 0.6         | 0.6 | 0.6        | 0.6 | 0.6     | C4_wind |         |   |   |   |   |  |
| 5   | C5_wind | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 1     | 0.75   | 0.75  | 0.4     | 0.4  | 1.5     | 0.6  | 0.6                       | 0.6 | 0.6         | 0.6 | 0.6        | 0.6 | 0.6     | C5_wind |         |   |   |   |   |  |
| 6   | C6_tem  | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 0.75  | 0.75   | 0.4   | 0.4     | 0.6  | 1.5     | 0.6  | 0.6                       | 0.6 | 0.6         | 0.6 | 0.6        | 0.6 | C6_tem  |         |         |   |   |   |   |  |
| 7   | C7_Tem  | Characteristic | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 0.75  | 0.75   | 0.4   | 0.4     | 0.6  | 1.5     | 0.6  | 0.6                       | 0.6 | 0.6         | 0.6 | 0.6        | 0.6 | C7_Tem  |         |         |   |   |   |   |  |
| 8   | C8_t=0  | Frequent       | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 0.75  | 0.75   | 0.4   | 0.4     |      |         |      |                           |     |             |     |            |     |         | C8_t=0  |         | ✓ |   |   |   |  |
| 9   | C9_t=0  | Frequent       | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          | 0.75  | 0.75   | 0.4   | 0.4     |      |         |      |                           |     |             |     |            |     |         | C9_t=0  |         | ✓ |   |   |   |  |
| 10  | C10_Wi  | Frequent       | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         | 0.2  | 0.5                       |     |             |     |            |     | C10_Wi  |         | ✓       |   |   |   |   |  |
| 11  | C11_Wi  | Frequent       | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         | 0.2  | 0.5                       |     |             |     |            |     | C11_Wi  |         | ✓       |   |   |   |   |  |
| 12  | C12_Ter | Frequent       | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         |      |                           |     |             |     |            |     | C12_Ter |         | ✓       |   |   |   |   |  |
| 13  | C13_Ter | Frequent       | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         |      |                           |     |             |     |            |     | C13_Ter |         | ✓       |   |   |   |   |  |
| 14  | C14_tx  | Quasi-perman   | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         |      |                           |     |             |     |            |     |         | C14_tx  |         |   | ✓ |   |   |  |
| 15  | C15_tx  | Quasi-perman   | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         |      |                           |     |             |     |            |     |         | C15_tx  |         |   | ✓ |   |   |  |
| 16  | C16_tx  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 1.35  | 1.35   | 1.35  | 1.35    |      |         |      |                           | 0.9 | 0.9         |     |            |     |         | C16_tx  |         |   |   | ✓ |   |  |
| 17  | C17_tx  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 1.013 | 1.013  | 0.54  | 0.54    | 1.35 | 1.35    | 1.35 | 1.35                      | 0.9 | 0.9         |     |            |     |         | C17_tx  |         |   |   |   | ✓ |  |
| 18  | C18_tx  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 1.35  | 1.35   | 1.35  | 1.35    |      |         |      |                           | 0.9 | 0.9         |     |            |     |         | C18_tx  |         |   |   |   |   |  |
| 19  | C19_tx  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 1.013 | 1.013  | 0.54  | 0.54    | 1.35 | 1.35    | 1.35 | 1.35                      | 0.9 | 0.9         |     |            |     |         | C19_tx  |         |   |   |   |   |  |
| 20  | C20_Wi  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 0     | 1.013  | 1.013 | 0.54    | 0.54 | 0       | 0    | 0                         | 0   | 1.5         | 0   | 0.9        | 0   | 0       | 0       | C20_Wi  |   |   |   |   |  |
| 21  | C21_Wi  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 0     | 1.013  | 1.013 | 0.54    | 0.54 | 0       | 0    | 0                         | 0   | 1.5         | 0   | 0.9        | 0   | 0       | 0       | C21_Wi  |   |   |   |   |  |
| 22  | C22_Ter | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 0     | 1.013  | 1.013 | 0.54    | 0.54 | 0       | 0    | 0                         | 0   | 1.5         | 0   | 0.9        | 0   | 0       | 0       | C22_Ter |   |   |   |   |  |
| 23  | C23_Ter | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1.2        | 0     | 1.013  | 1.013 | 0.54    | 0.54 | 0       | 0    | 0                         | 0   | 1.5         | 0   | 0.9        | 0   | 0       | 0       | C23_Ter |   |   |   |   |  |
| 24  | C24_0<  | ULS            | 1.35   | 1   | 1.35    | 1   | 1      | 1   | 1      | 1.35 | 1     | 1   | 1      | 1   | 1.2        |       |        |       |         |      |         |      |                           |     |             |     |            |     |         | C24_0<  |         |   |   |   |   |  |
| 25  | C25_LM  | Fatigue        | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   |            | 0.7   | 0.3    |       |         |      |         |      |                           |     |             |     |            |     |         | C25_LM  |         |   |   |   |   |  |
| 26  | C26_Ea  | Accidental     | 1      | 1   | 1       | 1   | 1      | 1   | 1      | 1    | 1     | 1   | 1      | 1   | 1          |       |        |       |         |      |         |      |                           |     |             | 0.5 | 1          | 1   | 1       | C26_Ea  |         |   |   |   | ✓ |  |





# RESULTADOS



Alplan Bridge 2020@20190930-1237 - D:\Daten\Allplan\2020\_Verification 2020\Pj\Bridge\PreStressed-concrete

Axis Cross Section Tendon Construction Calculation Results Options

Displacements Forces Stresses Leading component Scaling Export

Geometry Analysis Results

3D-Model Internal Forces Results

Properties

View

| Name           | DEFAULT                             |
|----------------|-------------------------------------|
| Beams          | <input checked="" type="checkbox"/> |
| Names          | <input checked="" type="checkbox"/> |
| Directions     | <input checked="" type="checkbox"/> |
| Direction      | <input checked="" type="checkbox"/> |
| Eccentricity   | <input checked="" type="checkbox"/> |
| Nodes          | <input checked="" type="checkbox"/> |
| Names          | <input checked="" type="checkbox"/> |
| Points         | <input checked="" type="checkbox"/> |
| Cross Sections | <input checked="" type="checkbox"/> |
| Mesh           | <input checked="" type="checkbox"/> |
| Areas          | <input checked="" type="checkbox"/> |
| Structural Mem | <input checked="" type="checkbox"/> |
| Paths          | <input checked="" type="checkbox"/> |
| Areas          | <input checked="" type="checkbox"/> |
| Tendons        | <input type="checkbox"/>            |
| Geometry       | <input type="checkbox"/>            |
| Tendon points  | <input type="checkbox"/>            |
| Supports       | <input checked="" type="checkbox"/> |
| Names          | <input checked="" type="checkbox"/> |
| DOF            | <input checked="" type="checkbox"/> |
| Symbol         | <input checked="" type="checkbox"/> |
| Eccentricity   | <input checked="" type="checkbox"/> |

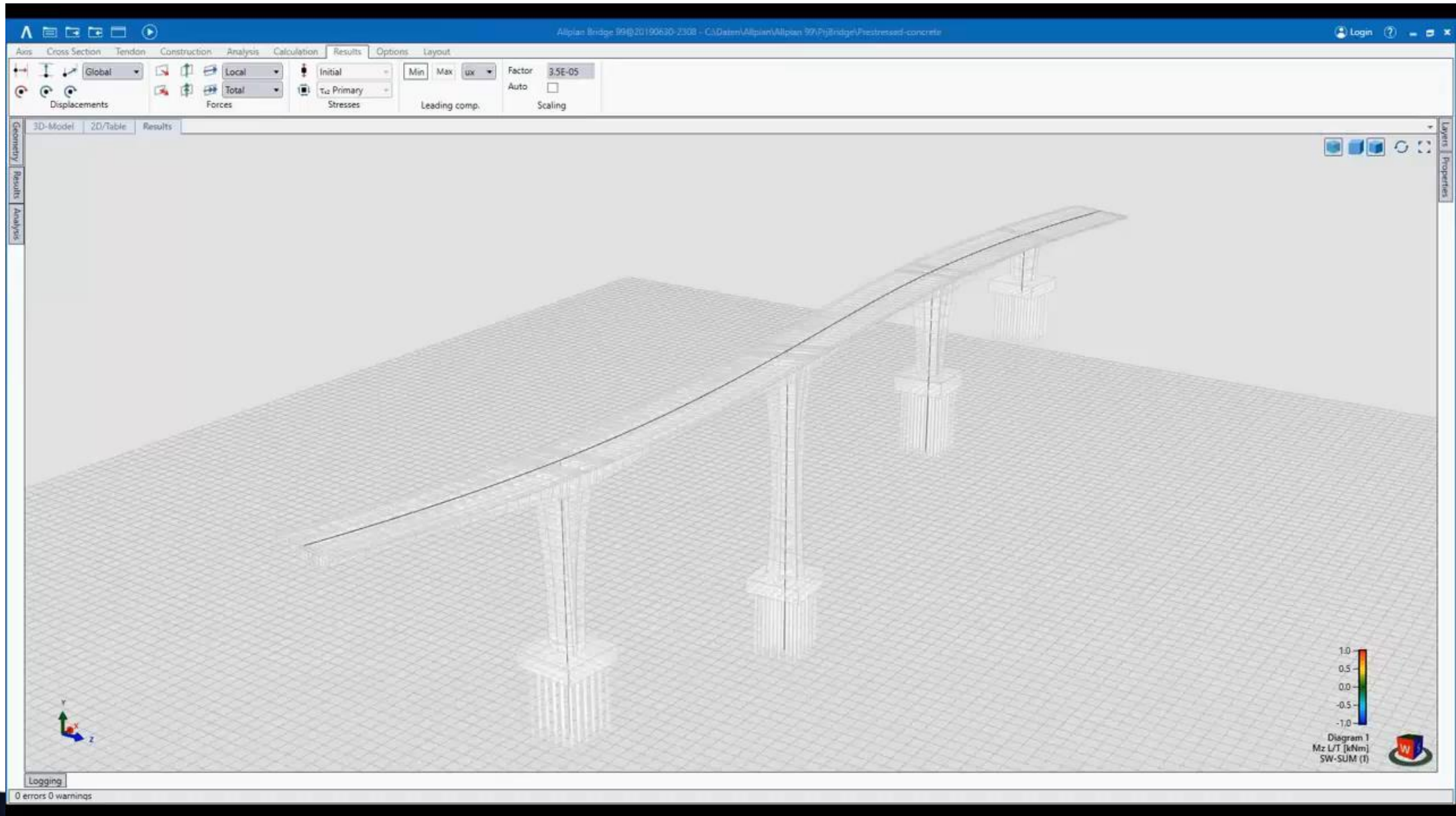
Layers

| Name               | Status                              |
|--------------------|-------------------------------------|
| DEFAULT            | <input checked="" type="checkbox"/> |
| Equipment          | <input type="checkbox"/>            |
| Outer Boundary     | <input type="checkbox"/>            |
| Inner Boundary     | <input type="checkbox"/>            |
| Reference Sets     | <input type="checkbox"/>            |
| Loads-RefPoint     | <input type="checkbox"/>            |
| Reinforcement Sets | <input type="checkbox"/>            |
| GradCool-Lin-Temp  | <input type="checkbox"/>            |
| GradHeat-Lin-Temp  | <input type="checkbox"/>            |
| Stress Points      | <input type="checkbox"/>            |
| Grids              | <input type="checkbox"/>            |

Logging

0 errors 0 warnings

# \ MODELO ANALÍTICO



$$2x + 2y = 20$$

$$2''$$

**ALLPLAN SYSTEMS ESPAÑA S.A.**

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