INTEGRAL BRIDGE USING CUSTOMIZED UHPC GIRDER SECTION

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MIDAS CIVIL NX

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Agenda

01 A Brief Introduction to Dura Technology S/B

Introduction to Dura Technology S/B
Application of UHPC in Bridges
Advantages of UHPC

02 Modelling Sequence in Midas

Define UHPC Material Properties
Create Customized Section in Midas
Construction Stage

03 Construction Stage

Construction Load Sequence
Boundary Condition
Load Combination
Interpretation of Results

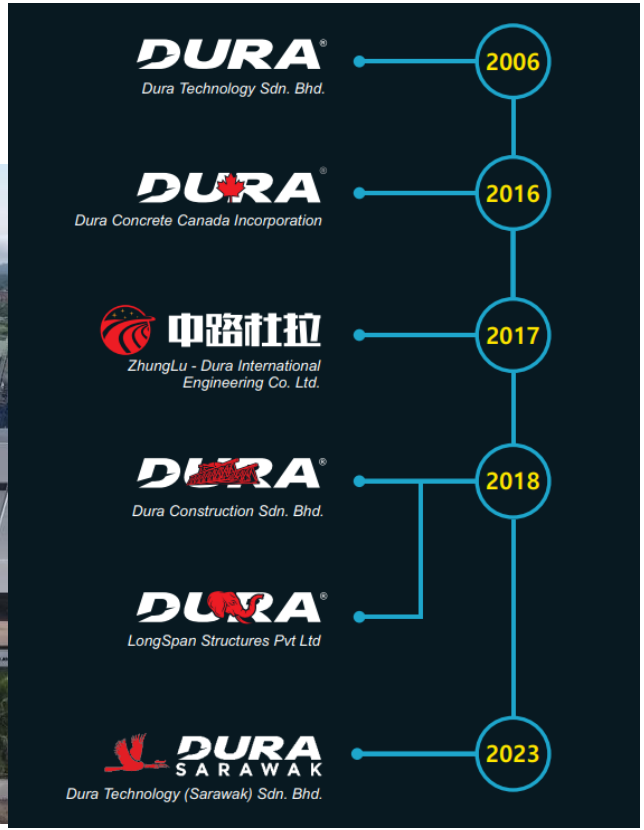
04 Key Takeaway

01

A Brief Introduction to Dura Technology S/B

- Introduction to Dura Technology S/B
- Application of UHPC in Bridges
- Advantages of UHPC

Malaysia l Canada l China l India l Singapore l Australia l Sarawak



Applications of UHPC Technology

Bridges

- All Sorts Of Bridge Structures, Viaduct, Flyover
- Bridge Girder, Precast Deck, & Parapet & Permanent Formworks
- Footbridges

Flooring, Pavement & Road

- UHPC Overlay
- UHPC Road, Strong Floor

Building Construction

- IBS Building
- Warehouse / factory
- Resident Housing/Building
- Airport Runway

Power Plant

- Deflection Tunnel
- Slope Protection
- Stilling Basins, Corewalls
- Spillways

Earthquake

- Before Earthquake (Additional Safety In New Concrete Structure)
- After Earthquake (Preparing, Retrofitting, Strengthening, Rehabilitation, Restoration & Remolding.

Regenerative Energy Production

- Dam (Dam Surface)
- Tidal & Biogas Power Plant

Harbour

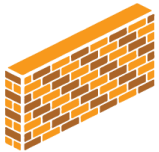
- Jetty Construction/
- Maintenance

Offshore

- Subsea Pipe Protection

Onshore

- Onshore Windmills
- Concrete Tower / Hybrid Tower



Retaining Wall Structure

- Cantilever Retaining Wall
- RE Wall
- Sheet Pile

Disposal

- Radioactive Waste Container
- Radioactive Storage Room

Wear Protection

- Waster Incineration
- Cement Industry
- Iron & Steel Industry
- Mining
- Wpe Dk Wear Protection Of Pipe

Machine Beds

- Foundation beds of highly dynamic machine tools
- Foundation of highly loaded machines
- Paper, wood, printing & textile industries

Architecture

- Decorative UHPC concrete
- Facade & Balcony
- Vertical Garden - Facade
- UHPC nature stone replication for face and flooring

Military

- Military bunker, shelter system
- Firearm Protection
- Splitter proof wall
- Paving

Vaults, ATMs & Terror

- Panic room, terror protection

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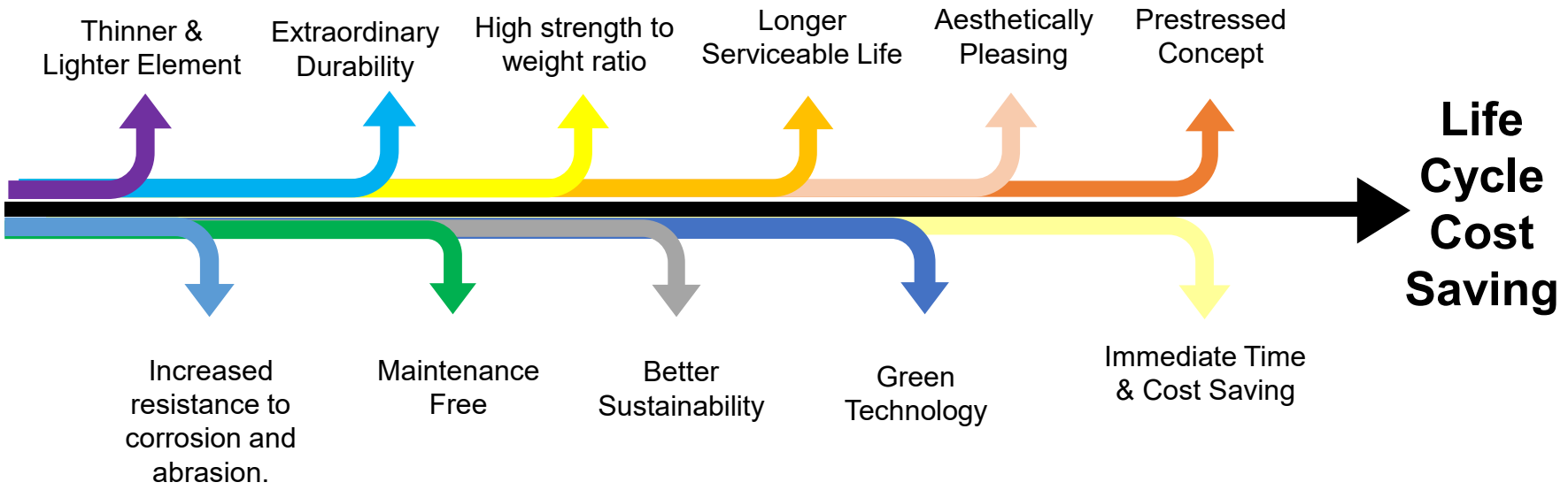
ADVANTAGES OF UHPC BRIDGE SYSTEM



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ACHIEVEMENTS – 105m LANGAT RIVER BRIDGE

aci Excellence in Concrete Construction Awards

2024 PCI DESIGN AWARDS

PCI Precast/Prestressed Concrete Institute

PCI-Certified Precast Concrete Producer and Precast Concrete Specialty Engineer
Dura Technology Sdn Bhd
Perak, Malaysia

Best International Transportation Structure
Langat River Bridge
Banting, Selangor, Malaysia

ACHIEVEMENTS – 105m LANGAT RIVER BRIDGE

ACHIEVEMENTS – 102.6m NIRA CANAL BRIDGE

International Transportation Structure
102.6 M Long-Span UHPFRC Bridge
Over Nira Canal, Pune
Phaltan, India

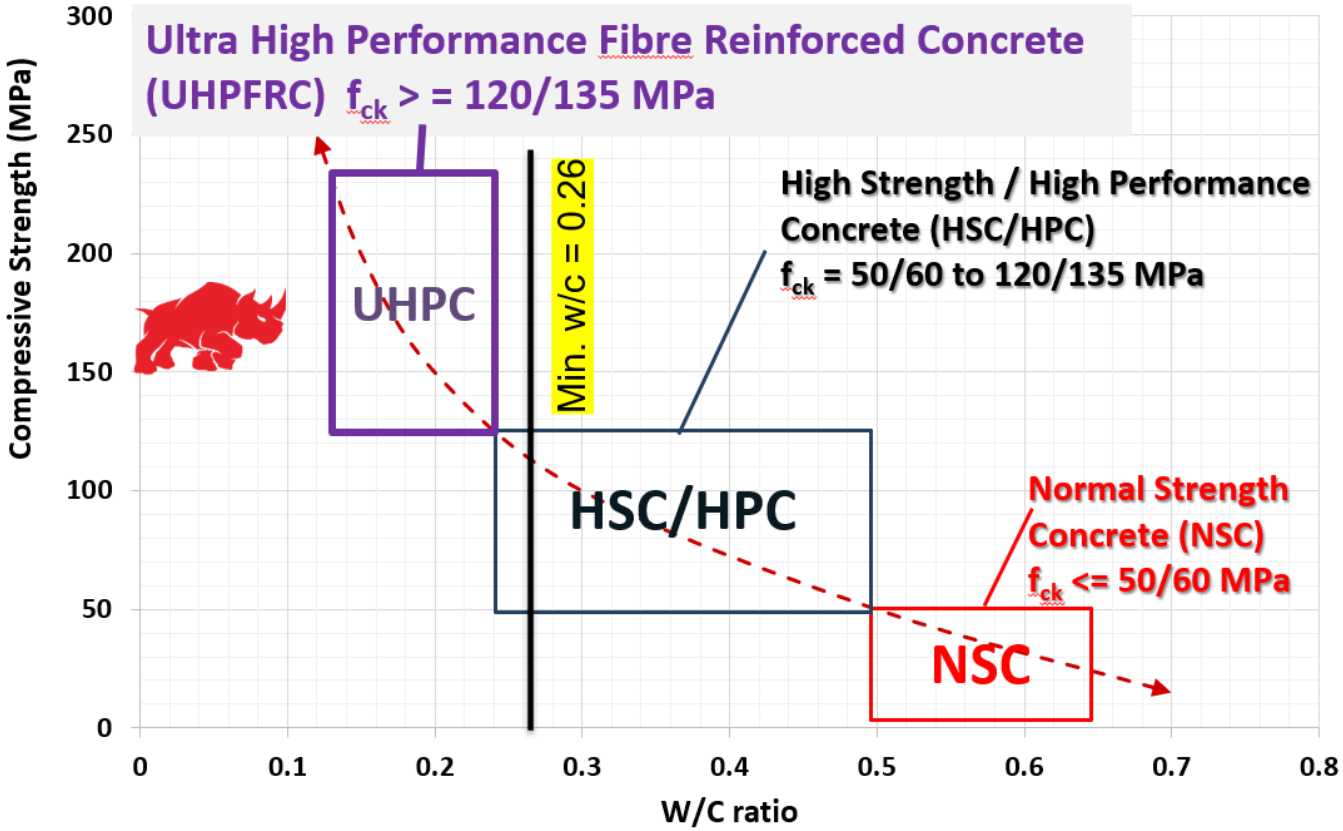
2026 PCI DESIGN AWARDS

PCI Precast/Prestressed Concrete Institute

Precast Concrete Producer
and Engineer of Record
Longspan Structures Pty Ltd
Pune, Maharashtra, India

Structure Owner
National Highway Authority of India
Maharashtra, India

CONCRETE CLASSIFICATION

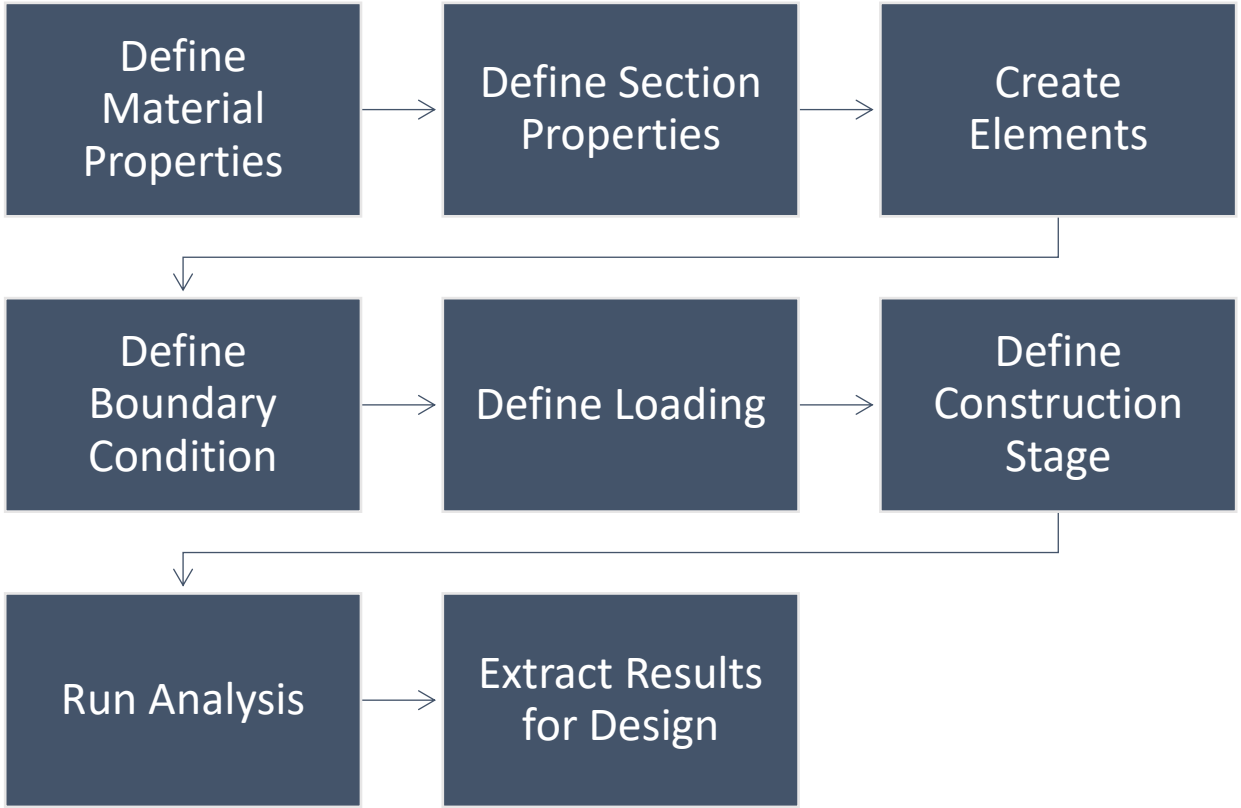


02

MODELLING SEQUENCE IN MIDAS

- Define UHPC Material Properties
- Create Customized Section in Midas
- Construction Stage

MODELLING SEQUENCE IN MIDAS

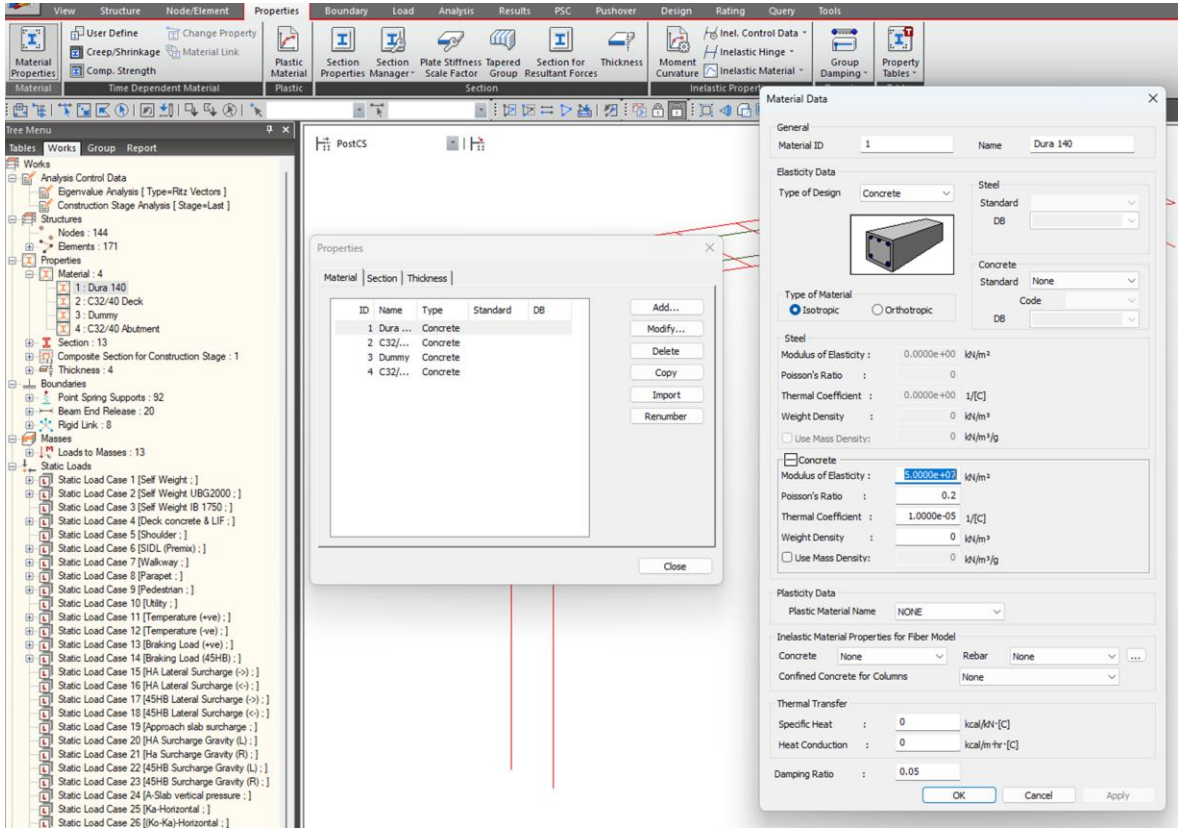


MATERIAL PROPERTIES FOR UHPFRC

Type of Material = Concrete
Concrete Grade, fck = 140 MPa
Standard = None
Mod. Of Elasticity = 5.0000e+07 KN/m2
Poissons Ratio = 0.2
Thermal Coefficient = 1.0000e-05
Weight Density = 25 KN/m3

DEFINE SECTION PROPERTIES FOR UHPFRC

- Properties
- Material Properties
- Add New Material
- Input material data
- OK



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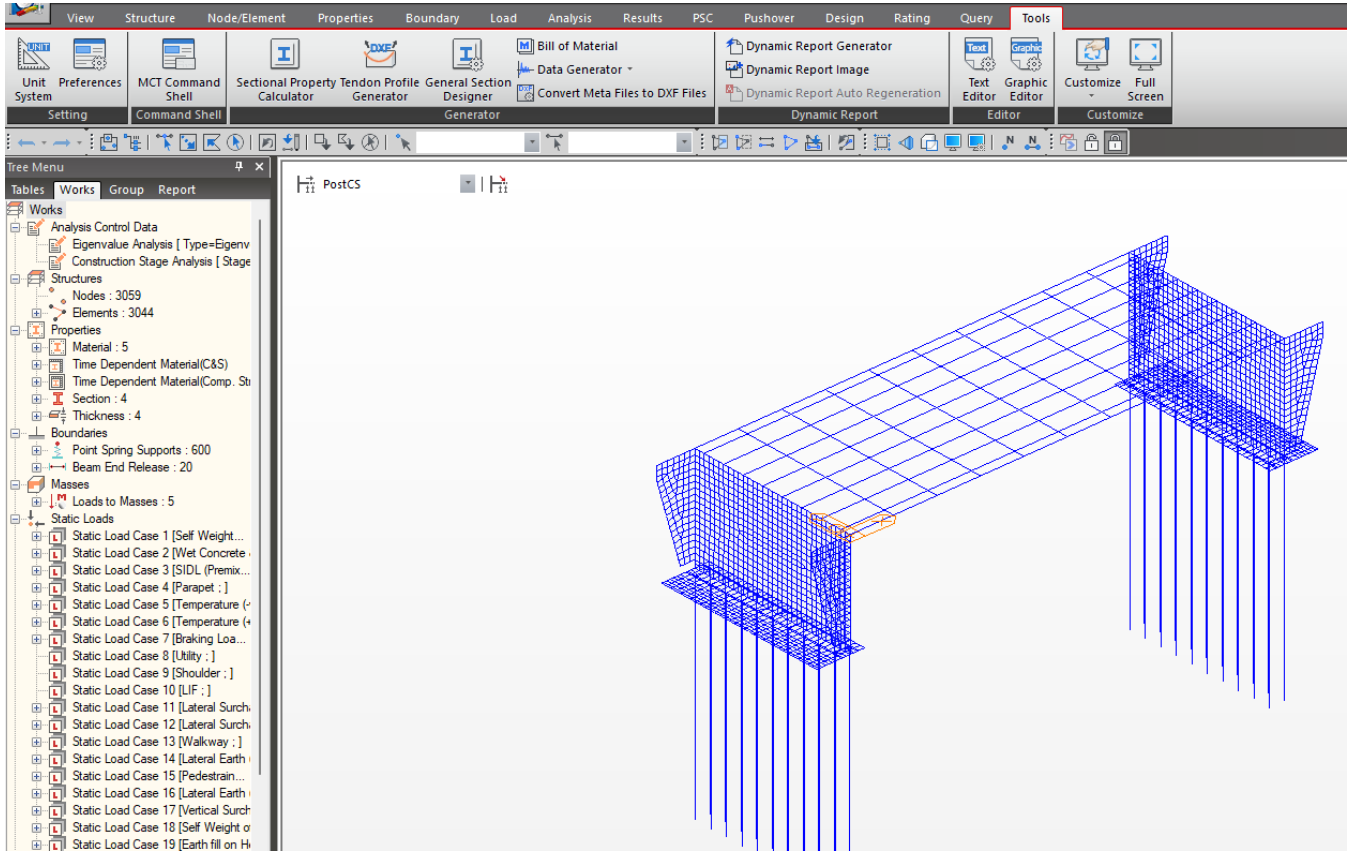
CREATING CUSTOMIZED SECTION IN MIDAS

Draw the section in CAD software

In Midas, under tab “Tools”, click “Section Property Calcular”

Import the file as DXF

CREATING CUSTOMIZED SECTION IN MIDAS



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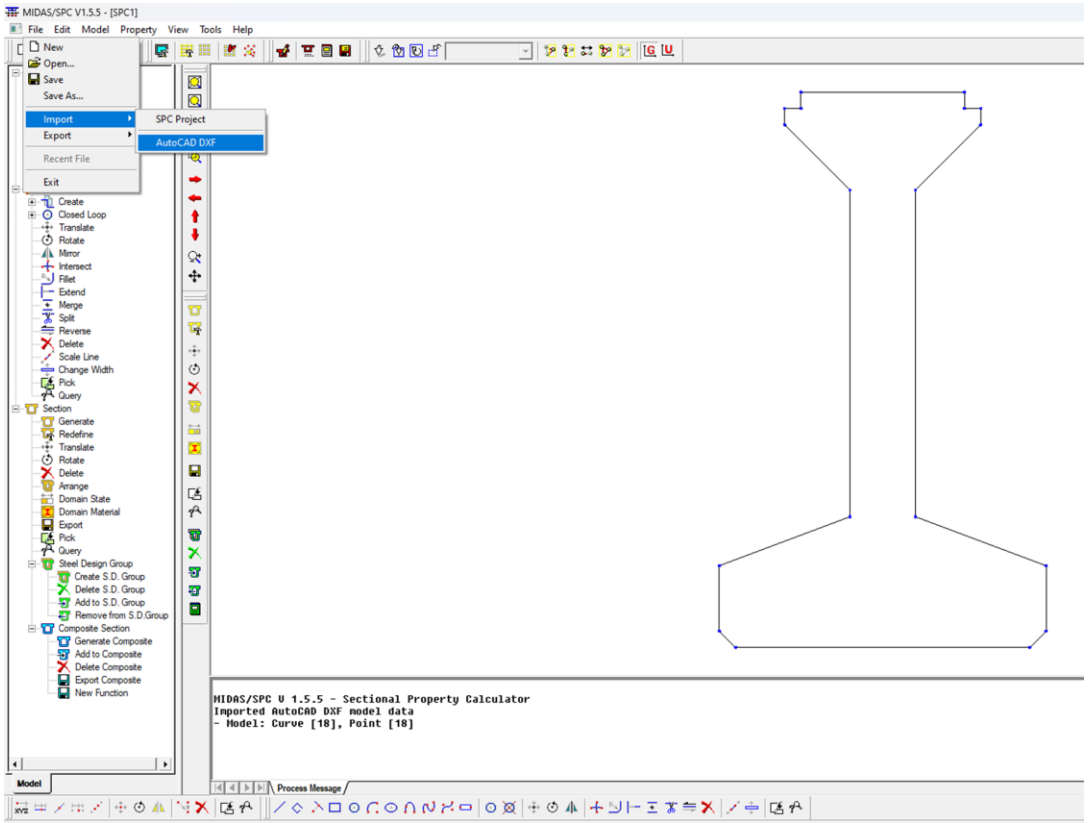
CREATING CUSTOMIZED SECTION IN MIDAS

Import CAD file as DXF



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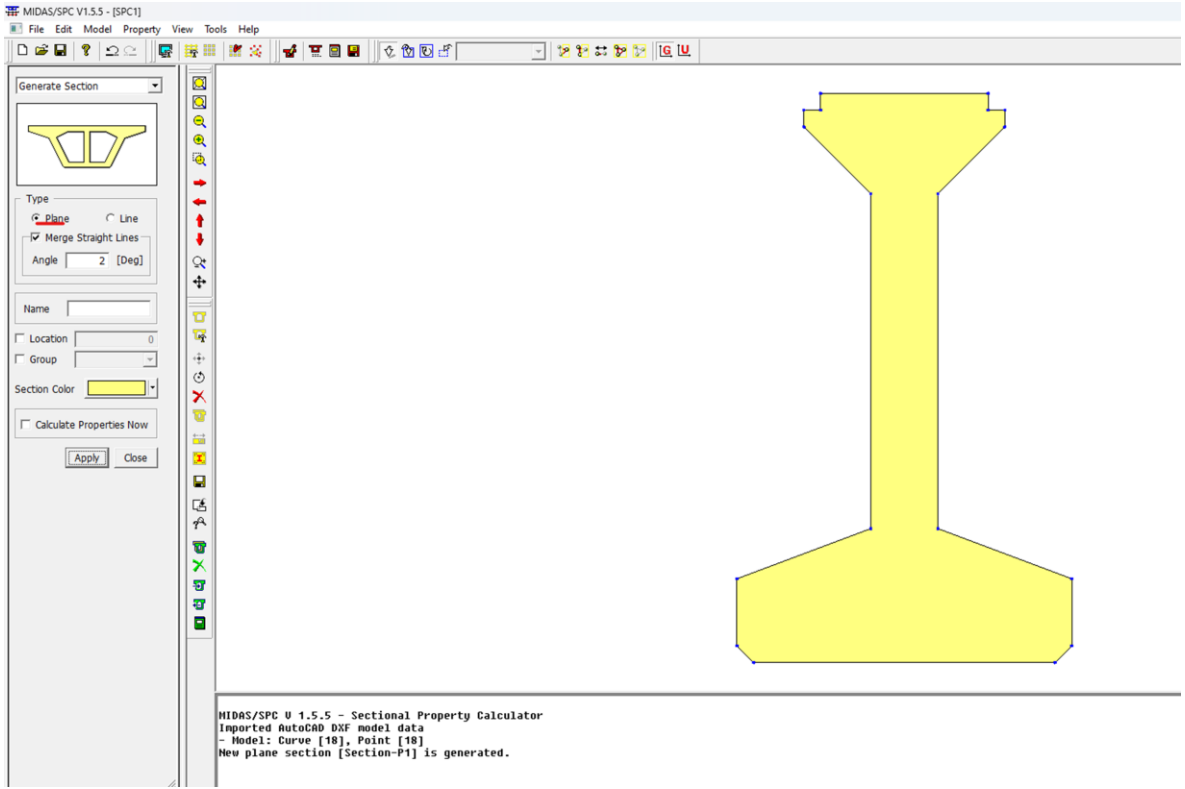
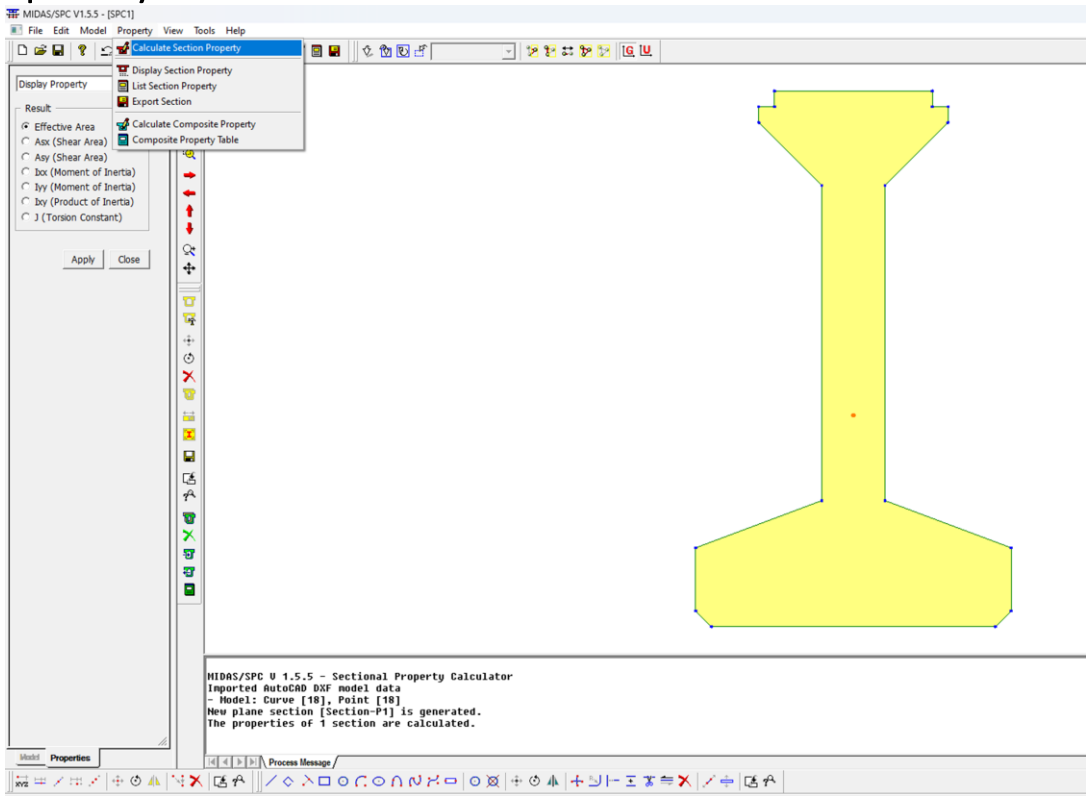
CREATING CUSTOMIZED SECTION IN MIDAS

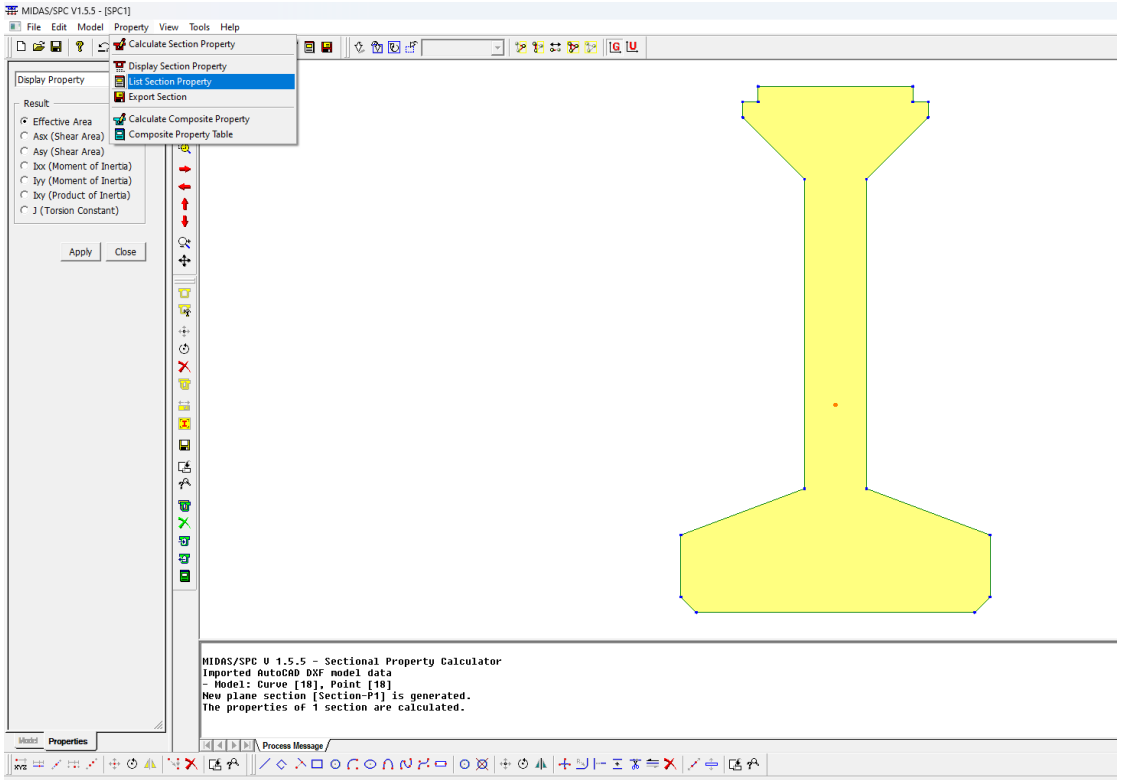
Generate the section as PLANE



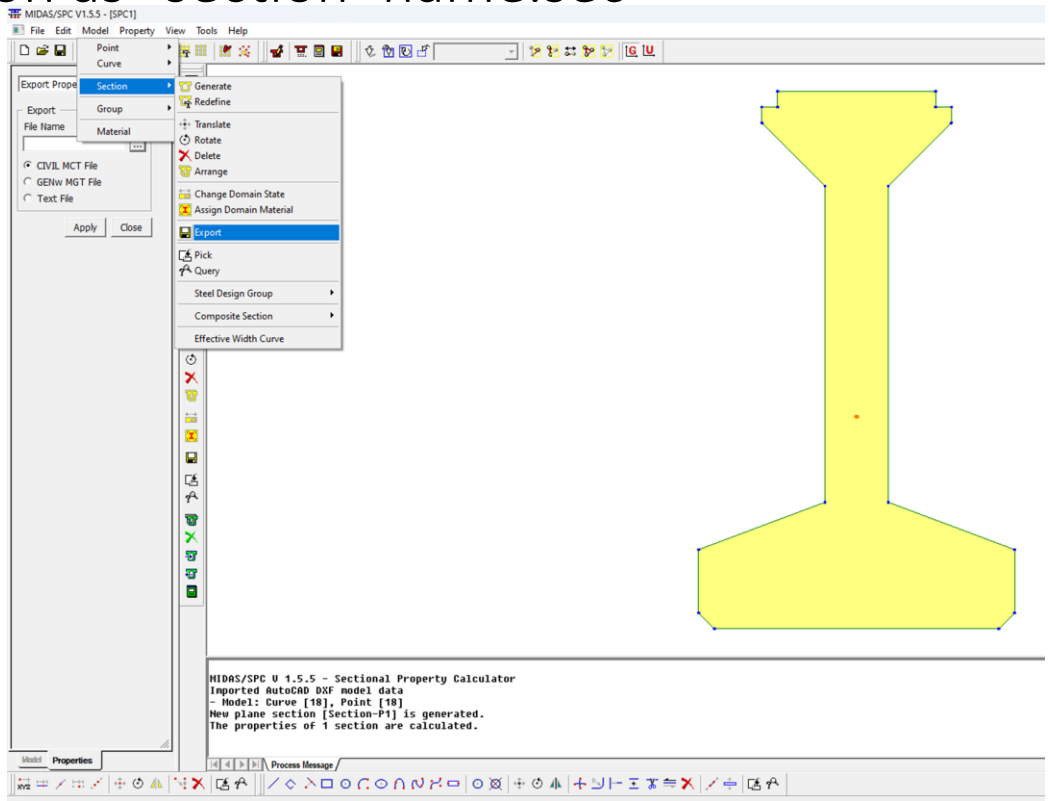
Calculate Section Property



List Section Property

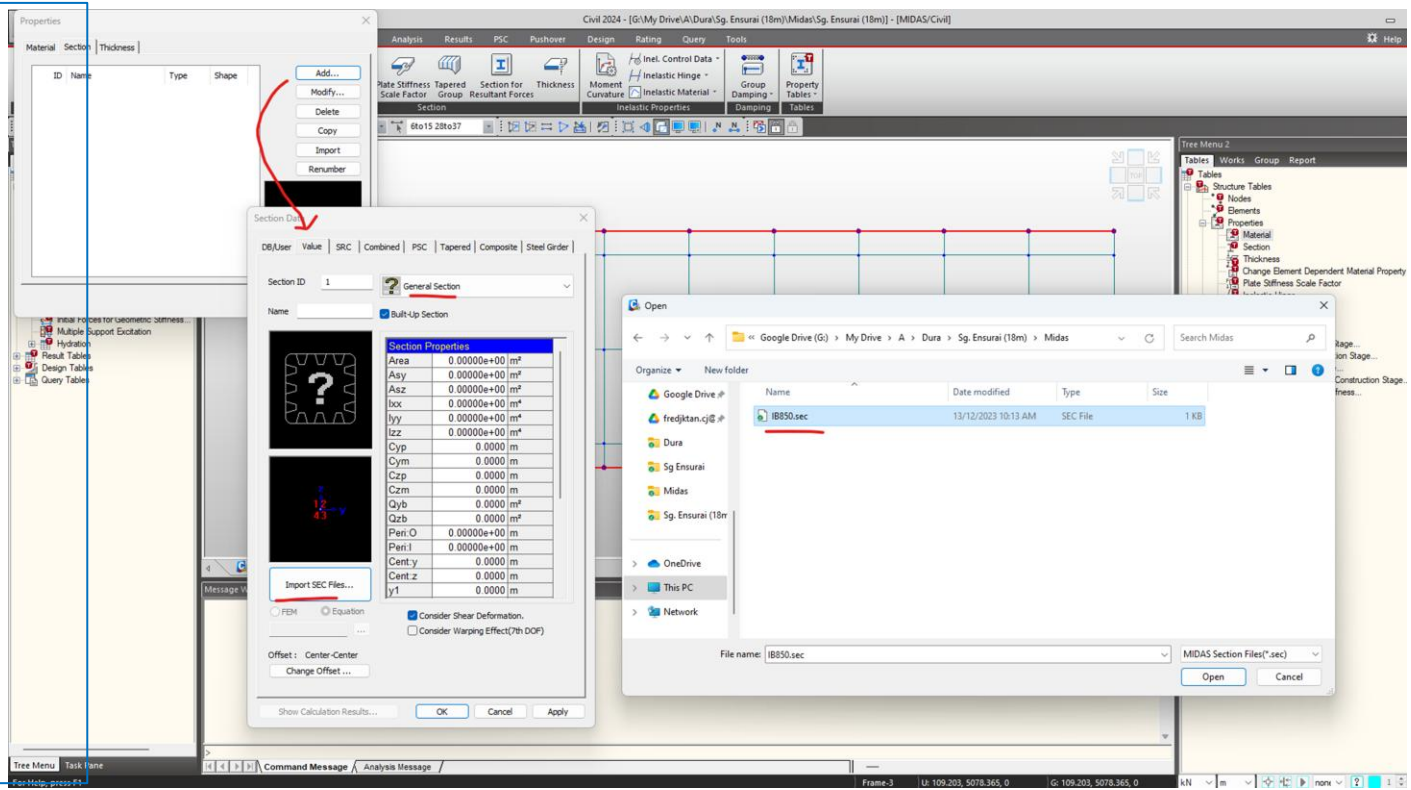


Export the section as “section name.sec”



Importing Customized Section in Midas

- Properties
- Section Properties
- Under “Section”, click “Add”
- Select “Value”
- Select “General Section”
- Import SEC Files
- OK



03

CONSTRUCTION STAGE

- Construction Load Sequence
- Boundary Condition
- Load Combination
- Interpretation of Results

CONSTRUCTION STAGE

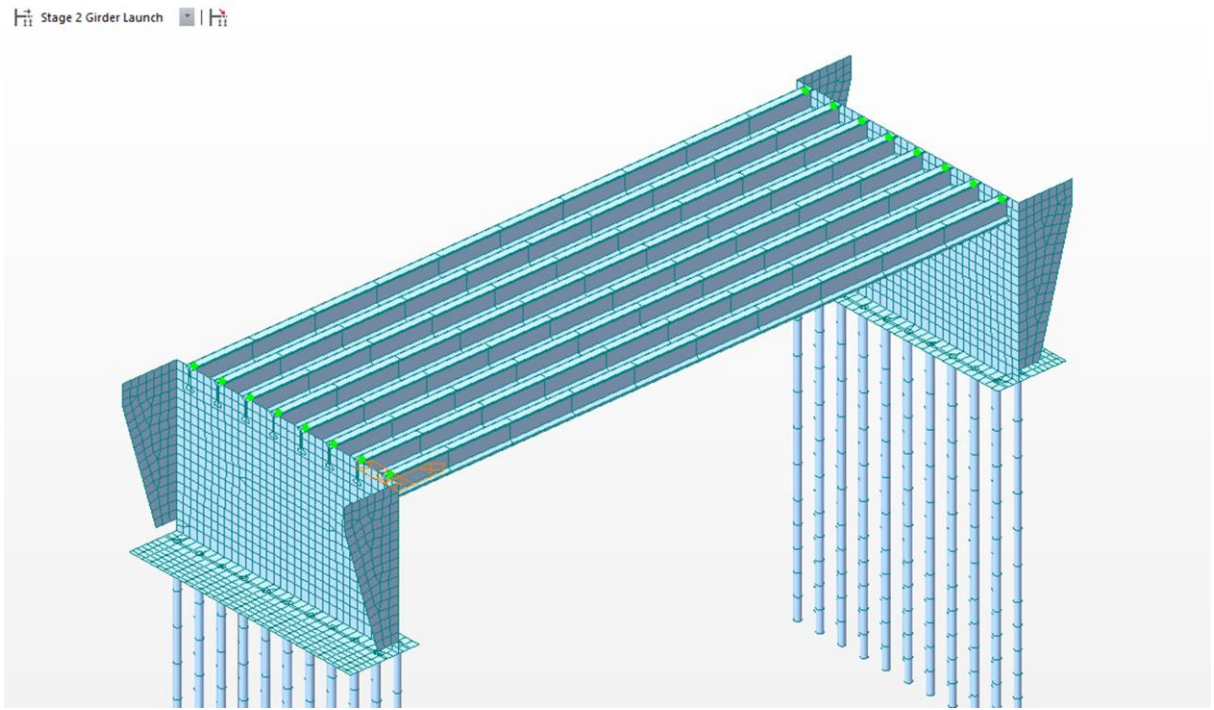
Simply Supported Condition from Stage 2 to Stage 3 (Wet Concrete Deck)

Stage 1 – Substructure & Soil Spring

Stage 2 – Girder Launched

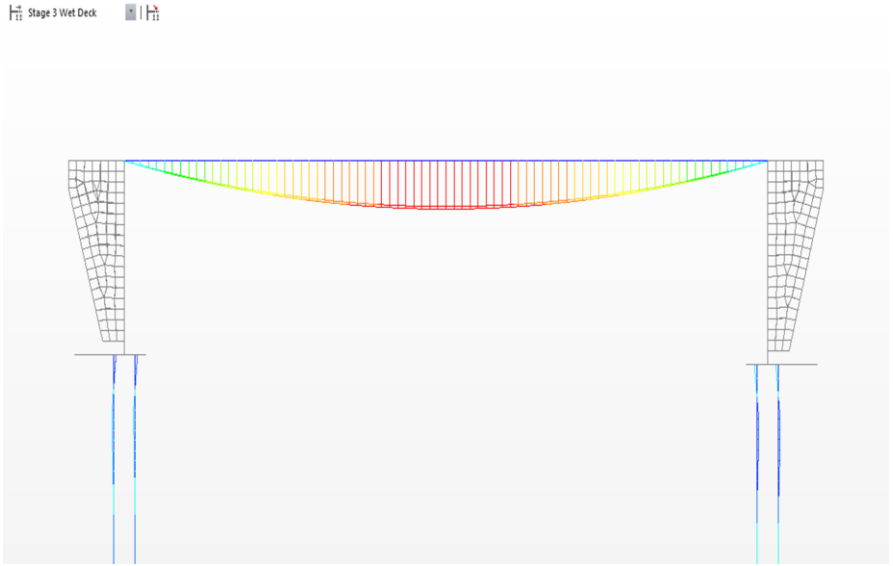
Stage 3 – Casting of Concrete Deck

Stage 4 – Completion / Last Stage

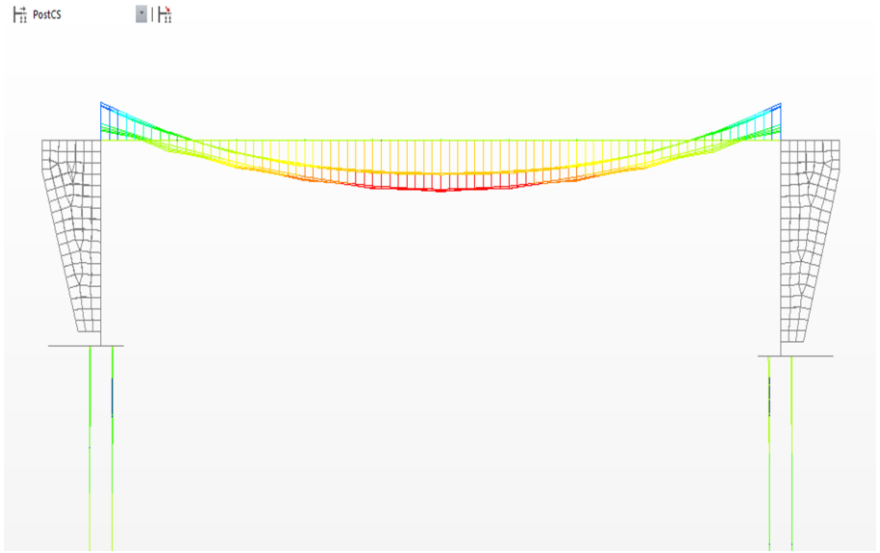


CONSTRUCTION STAGE

Simply Supported Condition from Stage 1 to Stage 3 (Wet Concrete Deck)

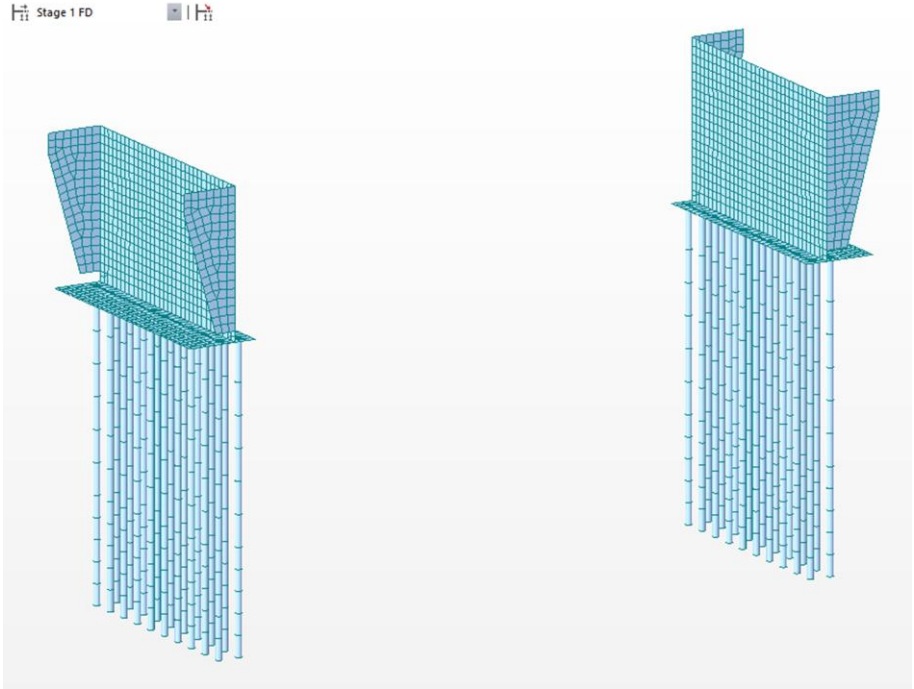


Fully Integral Condition – Post Construction



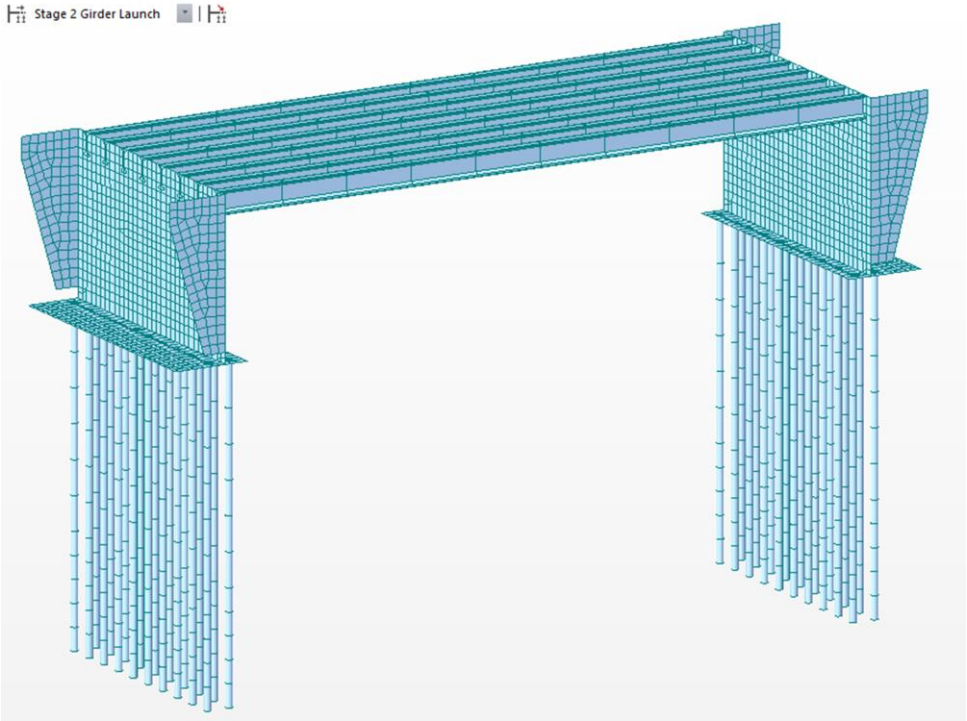
CONSTRUCTION STAGE

Stage 1 – Substructure & Soil Boundary Condition



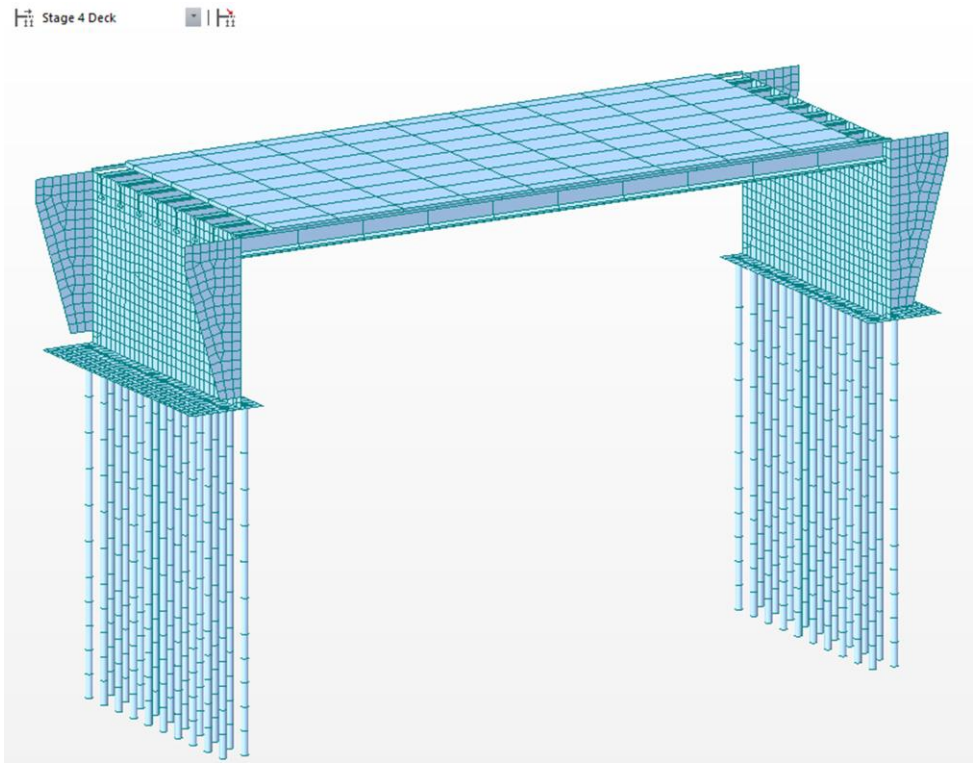
CONSTRUCTION STAGE

Stage 2 – Launching of Girder



CONSTRUCTION STAGE

Stage 3 – Casting of Deck Slab & Stage 4 – Completion of Bridge



LOAD COMBINATION

We can use partial load factors with construction stage loads, but if any construction stage load is deactivated during CSA, then it will have no effects in Post CS.
Therefore, due care must be taken in defining your construction load case carefully.

Load Cases and Factors

	LoadCase	Factor
▶	Dead Load(CS)	1.0000
	SIDL (CS)(CS)	1.2000
	Deck & LIF(CS)	1.0000
	Parapet(CS)	1.0000
	Temperature (+ve)(ST)	1.0000
	Earth pressure at rest(CS)	1.0000
	Walkway(CS)	1.0000
	Pedestrain(ST)	1.0000
	SW IB1000(CS)	1.0000
	MLC 1(MV)	1.1000
	Earth Fill on heel(CS)	1.0000
	Earth fill on Toe(CS)	1.0000
	Backfill(CS)	1.0000
*		

Load Cases and Factors

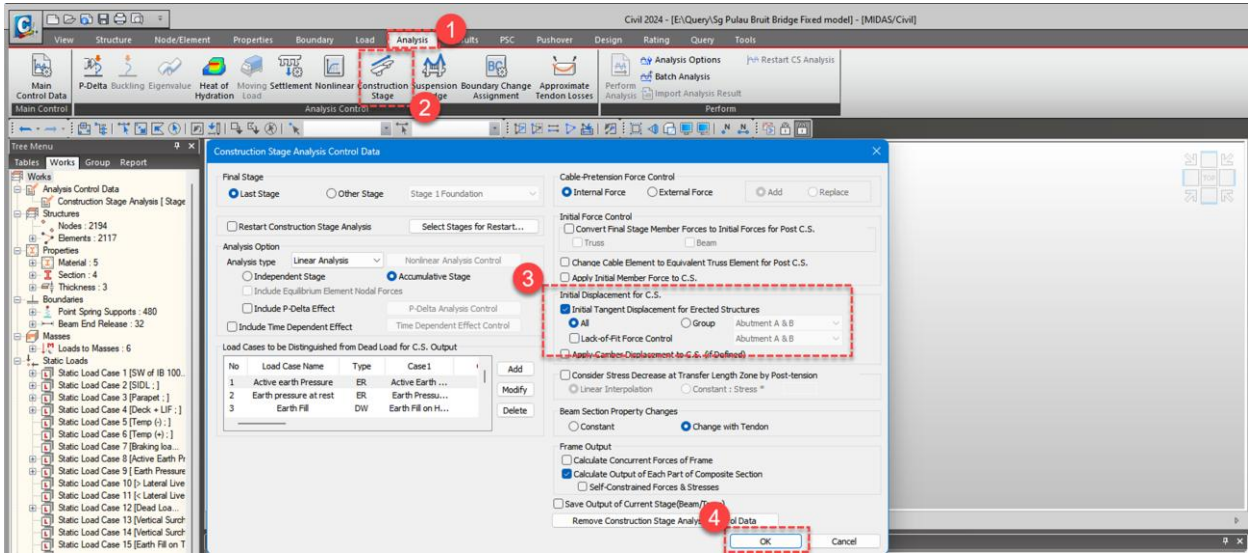
	LoadCase	Factor
▶	Dead Load(CS)	1.2650
	SIDL (CS)(CS)	1.9250
	Deck & LIF(CS)	1.2650
	Parapet(CS)	1.2650
	Earth pressure at rest(CS)	1.6500
	Walkway(CS)	1.2650
	Pedestrain(ST)	1.6500
	SW IB1000(CS)	1.2650
	Earth Fill on heel(CS)	1.2000
	Earth fill on Toe(CS)	1.2000
	Passive Earth Presssure(CS)	1.6500
	MLC 2(MV)	1.4300
*		

CONSTRUCTION STAGE SETTING

While performing construction stage analysis it is recommended to turn on “Initial Displacement for C.S.” to check “stage/step real displacement”.

Follow the below steps to check the stage/step real displacement.

Analysis > Construction stage > Turn on Initial displacement for C.S. > OK



✓ **Initial Tangent Displacement for Erected Structures**

This function calculates real displacements of the elements, which will be created in the next stage, considering the rotational angles of nodes resulting from each current construction stage. This functionality is used for fabrication cambers for structural steel and precast concrete members.

CONSTRUCTION STAGE SETTING

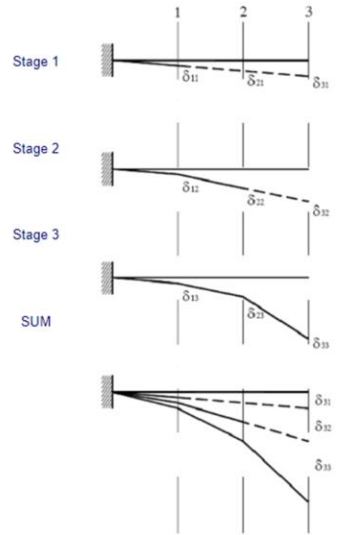
And the real displacement of the structure for each construction can be checked by checking on the "Stage/step Real Displacement" as shown in the below image.

Stage/Step Real Disp.

Display the Real Displacements for each construction stage when the construction stage analysis is performed.

Note

Real displacement is relevant only for construction stage analysis. To illustrate real displacement, a cantilever is constructed in 3 stages as shown below. Node 3 is activated at the stage 3, and the deflection δ33 occurs due to the self weight of the segment 3. But when constructing steel girders or PC girders, the virtual displacements δ31 and δ32 occur at the stage 1 and stage 2 respectively. Real displacement is the summation of virtual displacements, which occur before the corresponding node is even activated and net displacement, which occurs after the node is activated. Real displacement corresponds to the fabrication camber.



Legend

δ(a),(b): Displacement at the point □(a)□, stage □(b)□

Real disp. at the point 1: δ11+ δ12+ δ13

Real disp. at the point 2: δ21+ δ22+ δ23

Real disp. at the point 3: δ31+ δ32+ δ33

Net disp. at the point 1: δ11+ δ12+ δ13

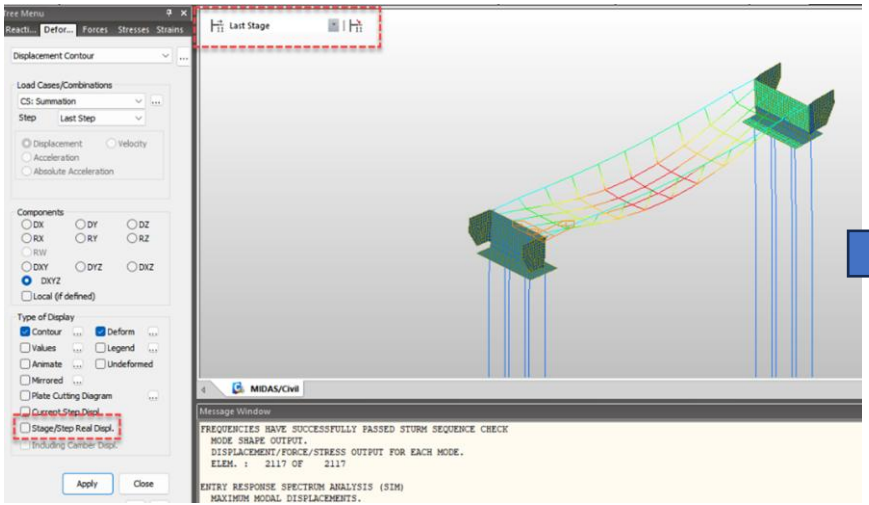
Net disp. at the point 2: δ22+ δ23

Net disp. at the point 3: δ33

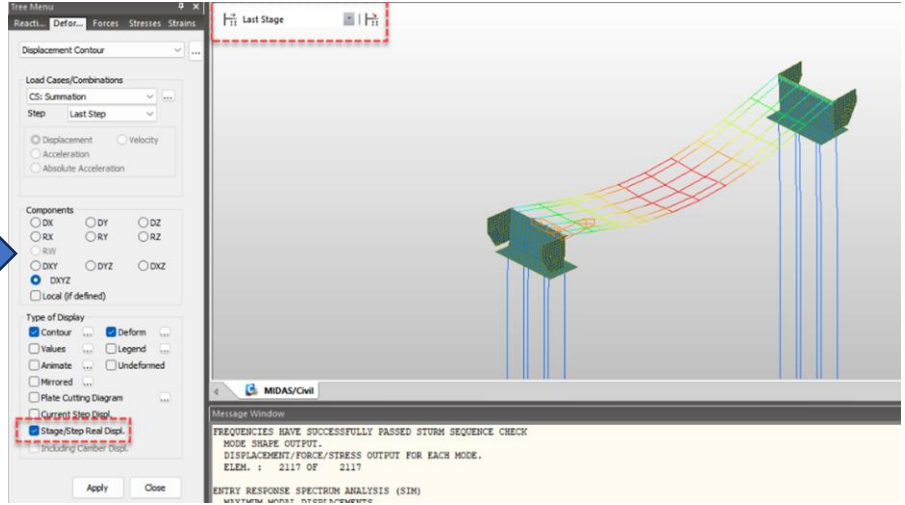
STAGE/STEP REAL DISPLACEMENT

Comparison of the stage/step real displacement for "Last Stage" are as follows:

Before Checking Stage/Step Real Displacement

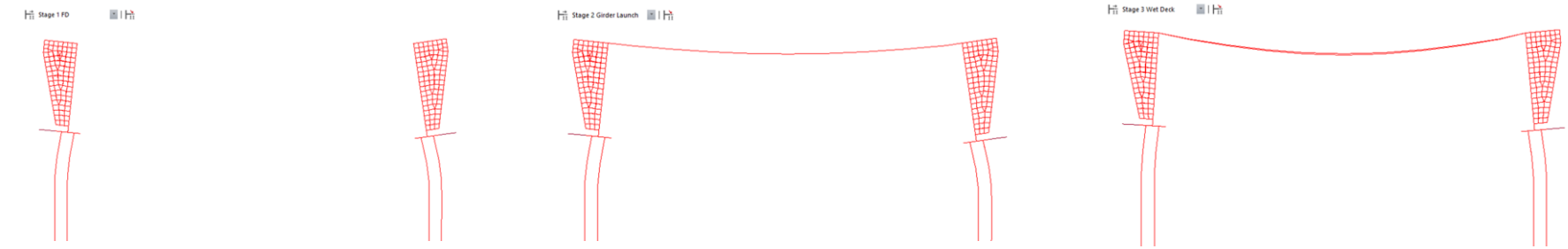


After Checking Stage/Step Real Displacement

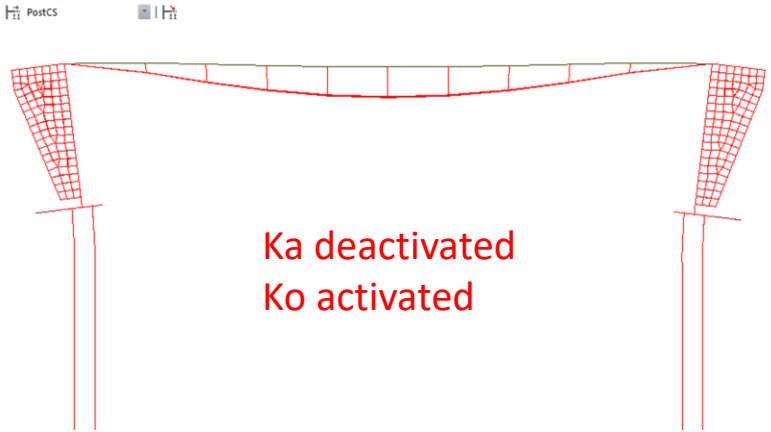


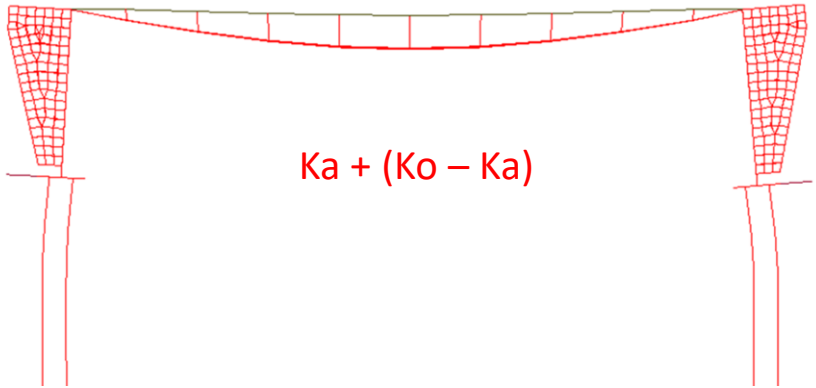
In short, Stage/Step Real Displacement is a function that calculates the real displacement of elements that will be generated in the next step, taking into account the rotation angle of the nodes generated in each construction stage.

EARTH PRESSURE IN CONSTRUCTION STAGE



*Initial Displacement for C.S. must be on to capture construction stage displacement correctly

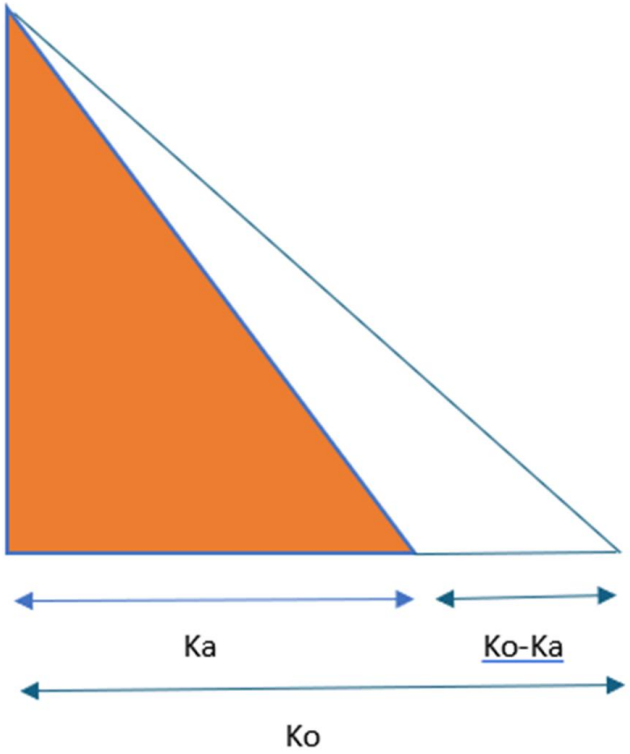




Comparison of earth pressure

Please take note that load deactivated during construction stage will not be carried forward to PostCS.
Therefore, in order to capture the active earth pressure correctly, instead of deactivate Ka, pressure net of Ka, i.e. Ko-Ka to be added after activation of superstructure. Principle of superposition applies.

For construction stage load, suffix (CS) must be used instead of (ST).



04

KEY TAKEAWAY

KEY TAKEAWAY

1. Material properties must be defined properly
2. Customised section units in CAD must tally with the one in Midas.
3. Boundary condition must be carefully taken care of (from simply supported to fully integral).
4. Construction load case must be defined properly so that subsequent displacement and node rotation can be catered for properly.
5. Construction load case must be defined respectively, i.e. deck slab, asphaltic concrete, live load etc so that respective partial factor can be applied in load combination.
6. Deformation setting must be set properly and deformation at each stage must be checked properly to ensure it’s realistic (there won’t be any warning from the software).
7. Nature of earth pressure (active & at-rest) shall be catered for from construction stage onwards, and shall match actual construction sequence.

Thanks for watching :)

INTEGRAL BRIDGE USING CUSTOMIZED UHPC GIRDER SECTION

Ir. Tan Jiunn Ket Frederick

2026.02.28

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