



Pushing Infrastructures
assessment
with maintenance to the next level
with **digital twins**



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Civil engineer and developer



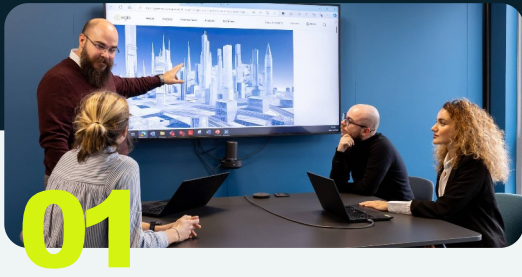
- French
- 9 years of experience in road infrastructures projects
- 3 years of experience in development

- Joined Egis Group in 2013
- Worked in major infrastructures projects in France
- Creation and maintenance of in-house software and plugins



IMAGINE
CREATE
ACHIEVE
a sustainable future

Agenda



01

About Egis



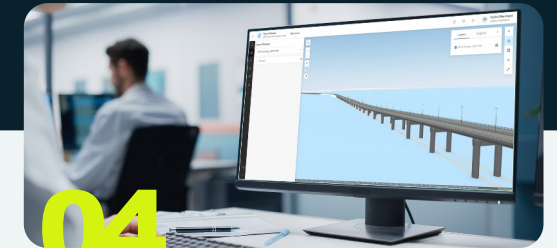
02

The project



03

Create the 3D Model



04

Import into ArcGIS



05

Structure the data



06

Share the digital twin on a web platform



07

Our feedback on the process



About
Egis
s

01



€2.2 bn

Revenue 2024

22,000

employees worldwide

+100 countries represented

Shared capital

40%

Tikehau Capital

34%

Caisse des Dépôts

26%

Partners, Executives, and employees

A global offer



Architecture



Consulting



Programme & project management



Engineering



Operations & mobility services

An international leader



16th

engineering company



1st

French engineering company



7th

in the transportation sector



8th

in the building sector

ENR world ranking



The
**proje
ct**

02

The Project

King Fahd Causeway Assessment

5 main bridges, 3 Flyovers and 7 Artificial embankment, 4 lanes

This 26km crossing is the only land link between the Kingdom of Bahrain and Kingdom of Saudi

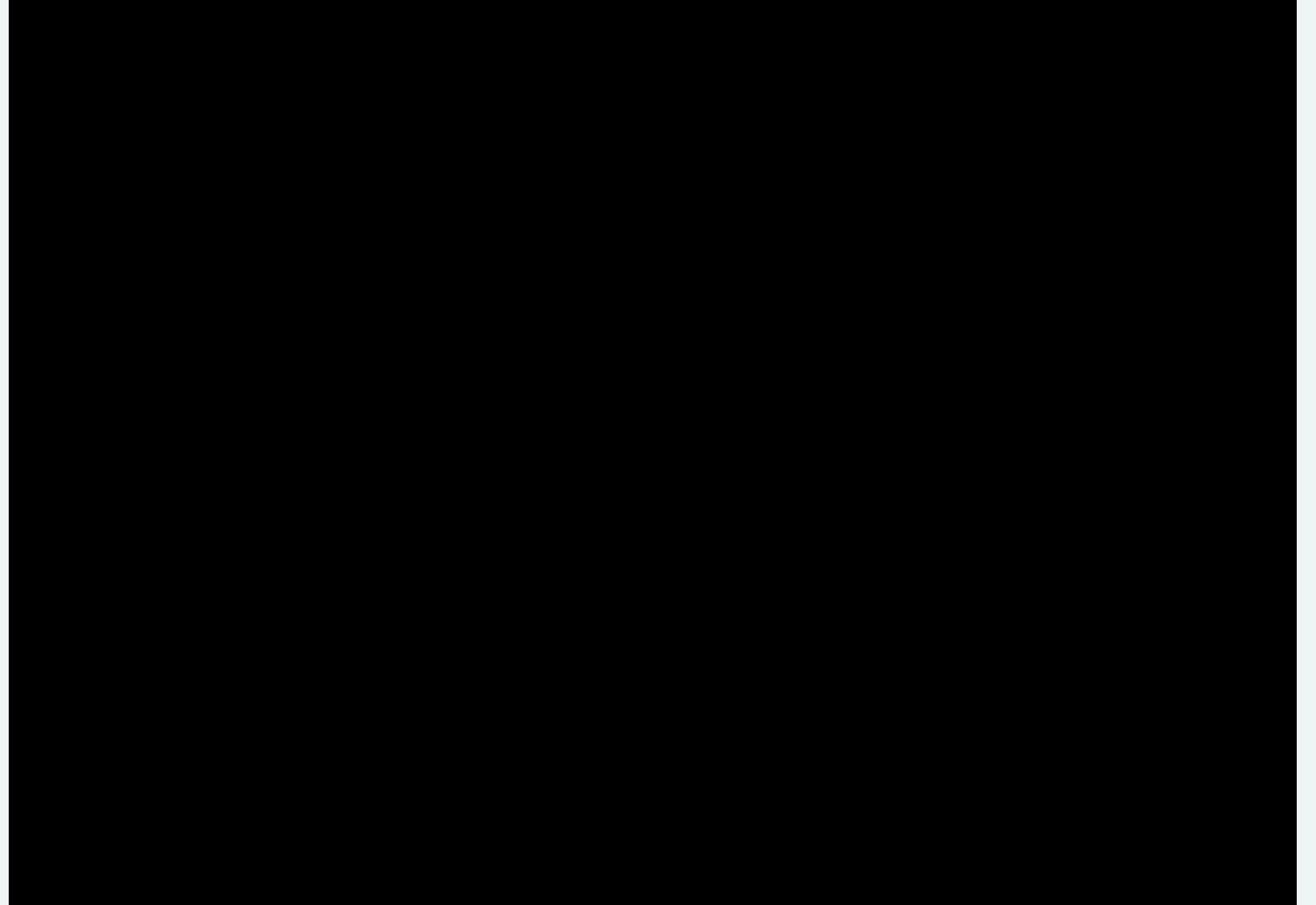
Complete assessment of the bridge, including inspections and maintenance program

The project

Our delivery_

A complete web platform

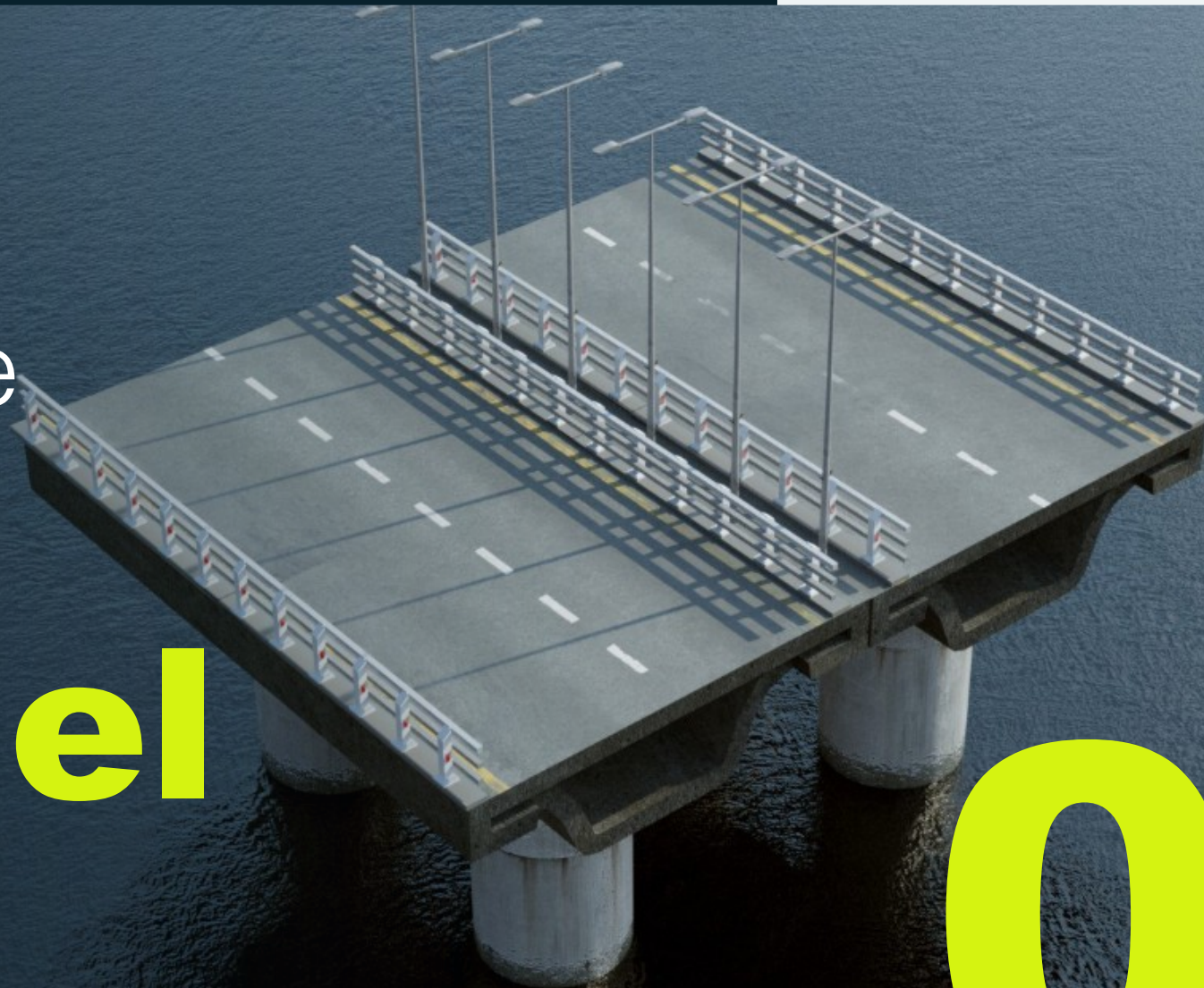
- Interact with the digital twin
- Usable even for non-expert
- User friendly website
- Live data, live dashboards



Create the

3D

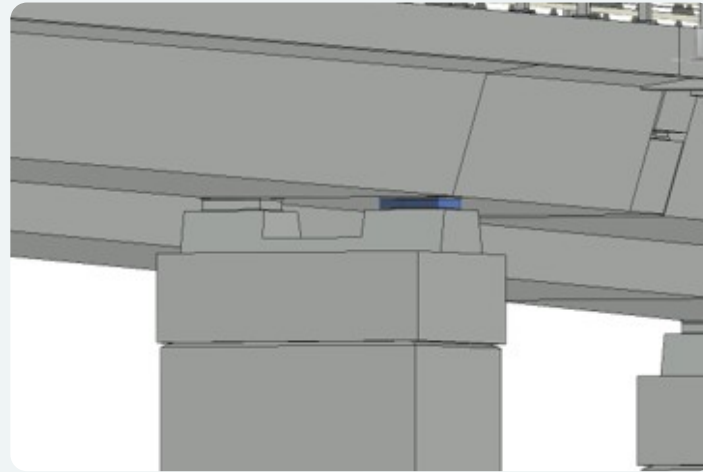
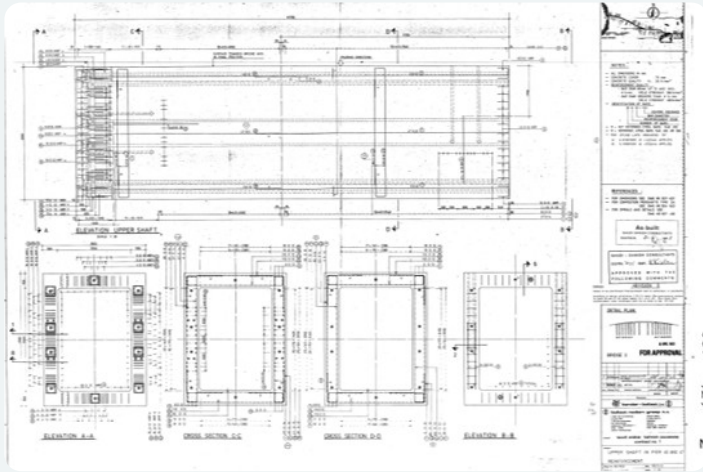
Model



03

Created the 3D Model

Build the 3D Model



From the as-built drawings

- Compile data
- Check history, updates

Define the level of details

- Must be relevant for the context (client, sensors)
- Find a good balance between the level of detail and the time required

Geolocalize your project

The tools we used

- Autodesk Cloud Construction for collaborative work
- Autodesk Revit

Prepare the model to become a digital twin

Define naming rules

- Each object must have a unique name
- Each name must be clear and precise

Naming
You will find here all the naming used in this project.

Full Name	Short Name
Bridge 1	B01
Bridge 5	B05
Embank. 1	E01
Embank. 7	E07
Fly-Over 6	R6
Fly-Over 9	R9
Seabed B01	SB01
Seabed B05	SB05

Full Name	Short Name
North	NO
South	SO
Both	BO

Full Name	Short Name
Equipment	EQ
Deck	DE
Support	SU
Not defined	ND

Not defined : used in last resort for elements that are not on the bridges.

Full Name	Short Name
Pier 1	P1
Pier 102	P102
Span 1	001
Span 102	102
Not defined	ND

Not defined : used in last resort for elements that are not on the bridges.

Exemple : One object on Bridge 3

- Properties of the object

Division Geometry	
Section	B03
Orientation	NO
Part	DE
Location	096
Object	CAN
Number	1.000000
Identification	B03-NO-DE-096-CAN-1

Identity Data	
Mark_Asset_Name	3N-96C-NE
Comments	Cantilever girder

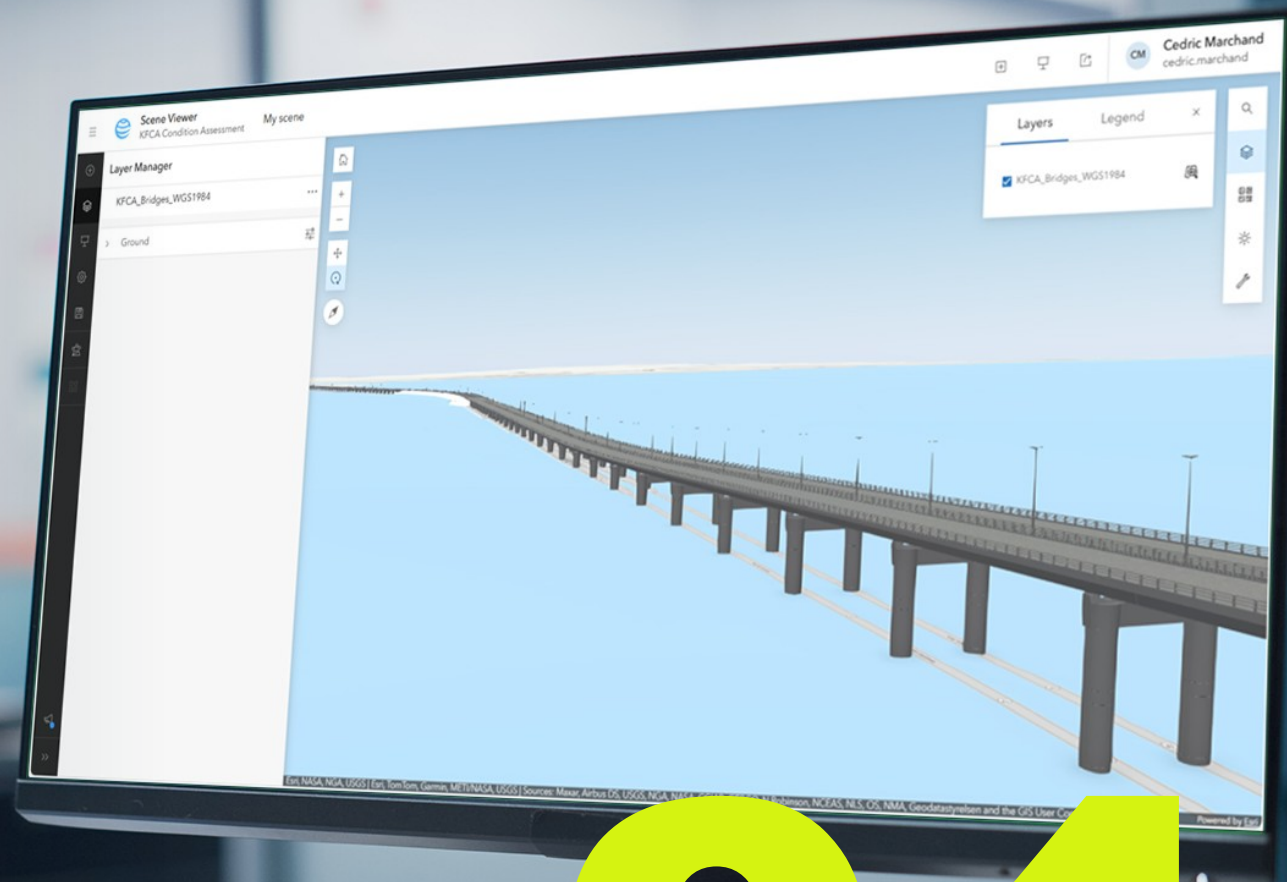
HELPFUL TIPS

Later, to be imported into ArcGis, attributes must be under Identity Data

- Use of schedules in Revit to fill in rapidly the attributes

D	E	F	G	H	I	J
Section	Orientation	Part	Location	Object	Number	Identification
B03	NO	DE	096	CAN	1	B03-NO-DE-096-CAN-1
B03	NO	DE	096	CANTS2	1	B03-NO-DE-096-CANTS2-1
B03	NO	DE	096	CANTS3	1	B03-NO-DE-096-CANTS3-1
B03	NO	DE	096	CANEBJ	1	B03-NO-DE-096-CANEBJ-1

Import into **ArcGIS** **S**



04

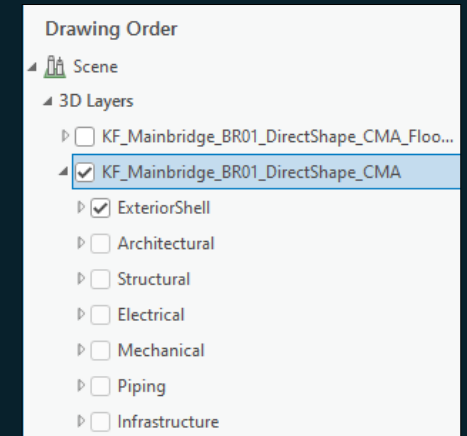
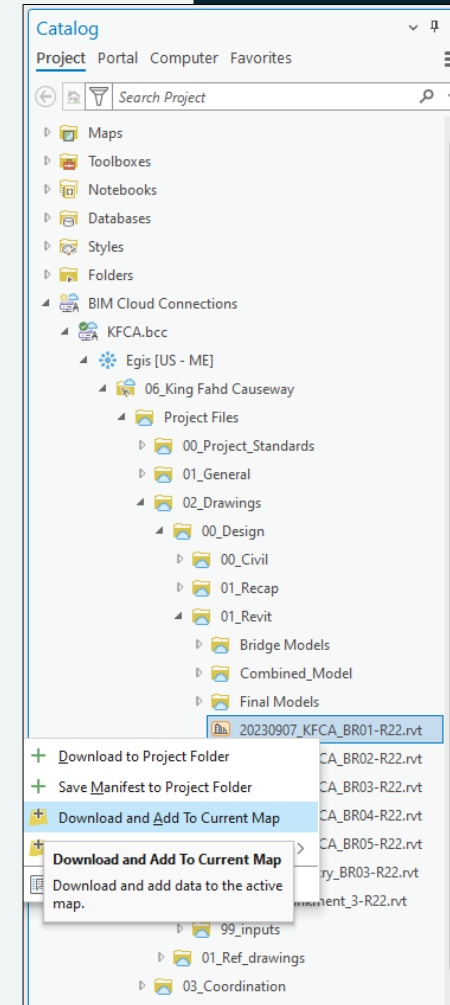
Import into ArcGIS

From ACC to ArcGIS

Seamless integration

- ArcGIS can directly import from ACC
- Support .PRJ files (data positioning), manage the coordinate systems of your model

The model is downloaded locally so the link is static. If your ACC Model is updated, you need to update your layer.



Import into ArcGIS

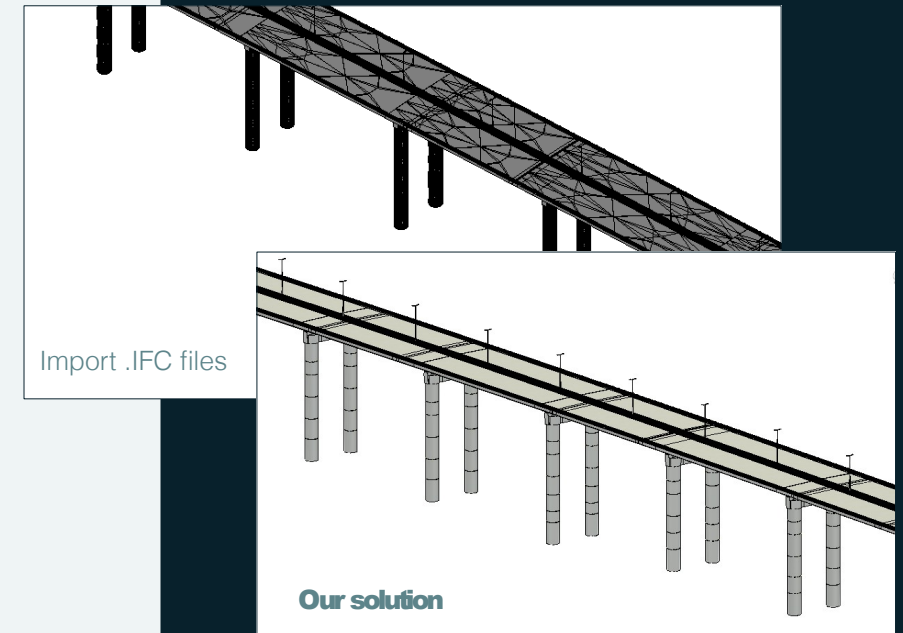
Details that matter

Nested Families

- Import the .RVT will only take the 'main' family -> loss of data
- Import the .IFC will divide objects in visible polygons and with default material -> loss of data

Solution

- Custom function to transform all elements in Direct Shape : all data is preserved and imported



Import into ArcGIS


Export to ArcGis Online

Publish your layer (web scene)

- The model is now a complete layer
- Create your relationship with other layers using the naming convention of your objects

The screenshot displays the ArcGIS Scene Viewer interface. On the left, the 'Layer Manager' shows a layer named 'KFCAs_Bridges_WGS1984'. The main view shows a 3D perspective of a long bridge structure over water. On the right, a 'Layers' panel is visible. Below the scene viewer, a data table is shown for the layer 'KFCAs_Bridges_WGS1984'. The table has columns for 'Exid', 'Identification', 'Location', 'Number', 'Object', 'Orientation', 'Part', and 'Section'. The table contains 15 rows of data representing different bridge components.

Exid	Identification	Location	Number	Object	Orientation	Part	Section
69b511c5-614-4111-9ae9...	B05-SO-SU-P1-AWW-1	P1	1.000000	AWW	SO	SU	B05
69b511c5-614-4111-9ae9...	B05-SO-SU-P1-AMW-1	P1	1.000000	AMW	SO	SU	B05
69b511c5-614-4111-9ae9...	B05-BO-SU-P1-ABW-1	P1	1.000000	ABW	BO	SU	B05
69b511c5-614-4111-9ae9...	B05-BO-SU-P1-ABE-1	P1	1.000000	ABE	BO	SU	B05
69b511c5-614-4111-9ae9...	B05-SO-SU-P1-BB-101	P1	101.000000	BB	SO	SU	B05
69b511c5-614-4111-9ae9...	B05-BO-SU-P1-ABS-1	P1	1.000000	ABS	BO	SU	B05
69b511c5-614-4111-9ae9...	B05-NO-SU-P1-AMW-1	P1	1.000000	AMW	NO	SU	B05
69b511c5-614-4111-9ae9...	B05-NO-SU-P1-AWW-1	P1	1.000000	AWW	NO	SU	B05
69b511c5-614-4111-9ae9...	B05-SO-SU-P1-BB-102	P1	102.000000	BB	SO	SU	B05
69b511c5-614-4111-9ae9...	B05-NO-SU-P1-BB-102	P1	102.000000	BB	NO	SU	B05
69b511c5-614-4111-9ae9...	B05-NO-SU-P1-BB-101	P1	101.000000	BB	NO	SU	B05
69b511c5-614-4111-9ae9...	B05-NO-SU-P1-CPIL-1	P1	1.000000	CPIL	NO	SU	B05

A digital tunnel of data with glowing blue lines and floating data blocks.

Structure the
data
a

05

Structure your data

Our aim_

Our digital twin have to be a representation of the state of the bridge

- We have the 3D Model
- We need to add all the defects of the bridges
- We need to be able to update the state of those defects

Complement

- They will be campaigns to fix specific types of defect
- It will be part of a maintenance program
- We need to be able to plan and follow the progress of the campaigns

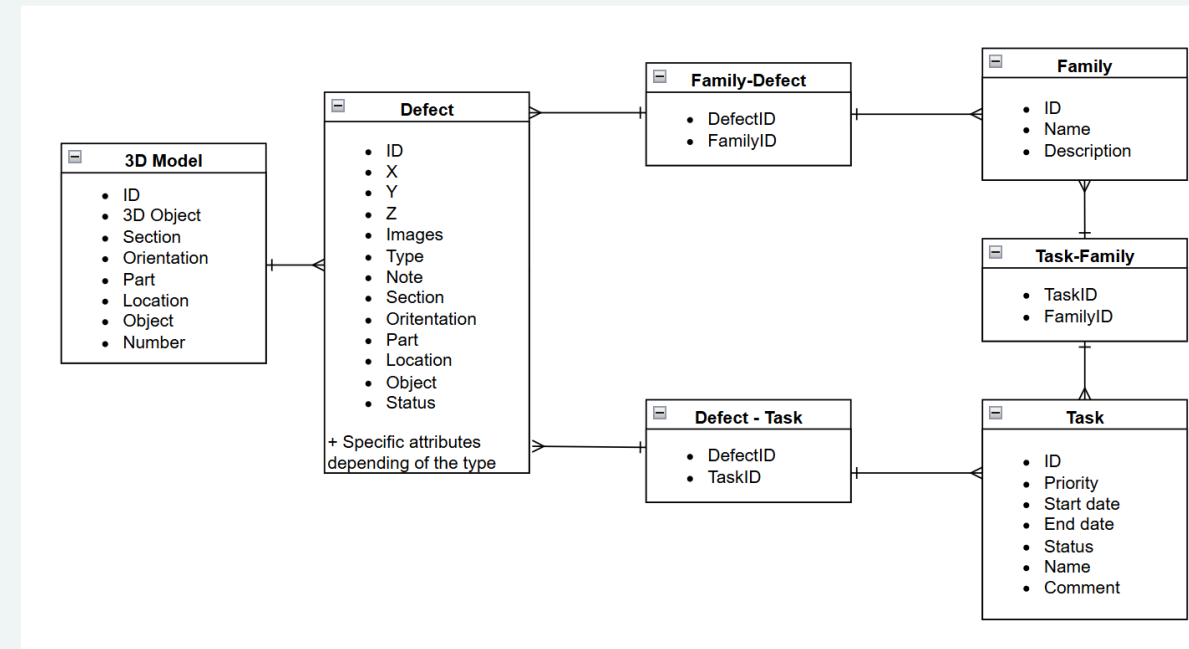
Structure your data

The structure

Links defects to the 3D Model to create a Digital twin

- One to many relationship, using the naming rule
- Defects can have any numbers of attributes
- Defects are geolocalized

Final structure of our database





Share the
digital
on a web platform
twin

06

Digital twin on the web

ArcGIS Online ecosystem



ArcGis Hub

- Web platform
- Can integrate all the other tools



Experience builder

- Display and interact with data
- Launch python scripts



Dashboard

- Display data



Survey 123

- Modify data with forms
- Available on site (tablet, android)



ArcPy

- ArcGis scripting module based on Python

Digital twin on the web

The result

Explore all the defects into the platform

Defects

You can find here all the defects detected on the King Fahd Causeway.

Defects are detected on all parts of the Causeway : Pavement, Expansion Joint, Concrete elements, Bearings, Barriers, Lamppost, Drainage, and Embankment.

In the first part of this page, you will find a summary of the defects, in the second part you will be able to filter and see defects in the 3D Model.

Total : 8,367

By ratings :

Rating	Count
4	7,430
5	4,38
6	3,765
7	6,314

By parts :

Part	Count
DE	8,972
EQ	1,697
ND	8
SU	1,715

By section :

Section	Count
B01	443
B03	5,327
B05	3,481
E02	1,515
E04	638
E06	13
R1	34
R9	80
	499
	278
	117
	288
	7
	28
	9

By Orientation :

Orientation	Count
BO	56
NO	4,192
SO	4,119

Explore defect by types

Filter the Model

Object is an... 0 Selected

Filter defects by attributes

- Section is an... 0 Selected
- Orientation... 0 Selected
- Part is any of 0 Selected
- Location is a... 0 Selected
- Object is an... 0 Selected
- Defects is a... 0 Selected
- PriorityWork... 0 Selected
- OverallDegr... 1 Selected
- CorrosionIn... 0 Selected
- ProfileCorro... 0 Selected
- DefectsDet... 0 Selected

CON-014

ObjectID	105
UUID	9c5492b-cc6a-41ba-bc5d-1775d6d8be22
Name	CON-014
AnnotationType	POINT
Description	
Creator	Ruben Perez
DateCreated	

Name : CON-014 **Description :**

Creator : Ruben Perez **Date Created :** 6/20/24, 2:00

Defect : efflorescence **Priority of work :** no work

Surface dist : **Perimeter :**

Point to point dist : **Area :**

Resistance rating : 7 **Road safety rating :** 7

Durability rating : 7 **Overall rating :** 7

Corrosion index : **Corrosion Profile corrosion :**

Cracks

Element : **Pattern :**

Location : **Add. pathology :**

Orientation : **Signs of movement :**

Width :

Bearings

Direction of displ. : **Value of displ. :**

Corrosion location :

Expansion Joints

Element : **Excessive displac. :**

Misalignment Orien. :

Selected features: 1

View image in fullscreen

Share this card

Digital twin on the web

The result

Manage your maintenance plan

KFCA Condition Assessment

You can select and see the defect by clicking on a task, and then "Selected features". All statuses are automatically updated.

Number of tasks registered : 8

Tasks by starting date :

Tasks by status :

List of tasks :

Task Name	Start Date	End Date	Status	Comments
Cracks	4/1/24, 1:00	5/1/24, 1:00	Late	comments
Faets	7/1/24, 1:00	6/1/25, 1:00	Done	comments
Lights	6/1/24, 1:00	7/1/25, 1:00	Late	comments
Fix 805	9/1/24, 1:00	9/15/24, 1:00	Late	All pavements on
Repair all cracks of 801	9/20/24, 1:00	9/28/24, 1:00	Done	*
Expansion joint maintenance	11/17/24, 12:00	12/8/24, 12:00	Late	All expansion joint
Fixing all the bearing 801	1/2/25, 12:00	1/16/25, 12:00	Late	*
GW2026	5/6/26, 1:00	10/6/26, 1:00	Planned	To Delete

Number of defects of selected task : (please select a task)

KFCA Condition Assessment

Manage tasks

Please find here all the tools necessary to manage the tasks : create, edit, delete, associate or dissociate from a family or defects.

- use unselect any task in the main page before going to any other command.
- may need to refresh the entire page after associating a family to a task to see the modifications.

Task Name	Start Date	End Date	Status	Comments
Cracks	4/1/24, 1:00	5/1/24, 1:00	Late	comments
Faets	7/1/24, 1:00	6/1/25, 1:00	Done	comments
Lights	6/1/24, 1:00	7/1/25, 1:00	Late	comments
Fix 805	9/1/24, 1:00	9/15/24, 1:00	Late	All pavements on
Repair all cracks of 801	9/20/24, 1:00	9/28/24, 1:00	Done	*
Expansion joint maintenance	11/17/24, 12:00	12/8/24, 12:00	Late	All expansion joint
Fixing all the bearing 801	1/2/25, 12:00	1/16/25, 12:00	Late	*
GW2026	5/6/26, 1:00	10/6/26, 1:00	Planned	To Delete

Total: 8 | Selection: 1

Tools

CreateTask

Name *

TaskForTest

Commentary *

Status *

Planned

Priority *

1

Starting date *

1/6/2026 11:00 PM

Ending date *

5/6/2026 11:00 PM

Run

Pushing Infrastructures assessment and maintenance to the next level with digital twins

Digital twin on the web

The result

And more (dashboard, automatic calculation, gallery, photogrammetry...)

Inspection progress

To be able to assess the King Fahd Causeway, many different inspection have to be performed. We can define three mains types of inspection :

- Manual inspection
- Drone inspection
- Underwater inspection

Another important part of the surveys is the Post-Tension investigations. A specific graph has been made at the bottom of the page to display the progress of those investigations.

All of the data is updated monthly and displayed below.

Last update : 03/10/2024

Inspections Progress

Element inspected	Drone (%)	Manual (%)	Underwater (%)
B01	100	100	100
B02	100	100	100
B03	50	100	100
B04	100	100	100
B05	100	100	100
E01	100	100	100
E02	100	100	100
E03	100	100	100
E04	100	100	100
E05	100	100	100
E06	100	100	100
E07	100	100	100
FLY1	100	100	100
FLY2	100	100	100
FLY3	100	100	100

Manual inspections

Manual inspection are directly done on site while the circulation is closed. It allows the inspector to check precisely the defects on all parts of the bridge and embankments. They can make precise measurements such as concrete cracks width.

During those inspections, the inside parts of the bridge and the critical areas are also inspected.

Explore defects with photogrammetry

Defects OneDrive

Overall DegreeScore is any of
Selected

Section is any of
0 Selected

Orientation is any of
0 Selected

Part is any of
0 Selected

Location is any of
0 Selected

Object is any of
0 Selected

Selected features: 0

© 2024 KFCA Condition Assessment - Cédric Marchand

A close-up photograph of two business professionals in a meeting. They are looking at a document on a table that features several bar charts and data tables. One person is holding a white pen, and the other is holding a silver and gold pen. The background is softly blurred, showing an office environment.

Our
feedback
on the
process

07

Our feedback on the process

Conclusion

From static inspections to digital twin

- Live status of all the defects in the 3D model
- Each object can be modified using surveys on the field
- You can keep track of changes

Improve the performance of your analysis and maintenance plan

- All in one platform to analyze the defects :
20% time gained by structural engineers
- Preview in your bridge the different maintenance task :
30% time gained on clash analysis
- Focus your next inspections on sensible points :
25% less on the cost of future inspection



Contact



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