AUTODESK UNIVERSITY

Designing Low impact Infrastructures - Carbon footprint & Safety Uses Cases

Lucas GIBAUD
BIM digital Solution Dev.

Eric Pruvost
Head of BIM Transformation Program

Who are we ?

LUCAS GIBAUD

BIM solution developper

lgibaud@systra.com

ERIC PRUVOST

Head of BIM Transformation Program

epruvost@systra.com

Introduction

Why this presentation ?

Our mission is to provide communities with safe and sustainable transportation solutions

Our ambition is to be the signature team for transportation solutions. It means being there where it matters, on the complex projects with the greatest impact, on the solutions that will shape the future of mobility. It's ensuring that people think of SYSTRA because of its unique way of initiating mobility projects, its ability to seek out the best experts and to mobilise them to push ever further.

Pierre Verzat
Chief Executive Officer

SYSTRA BIM R&D Program

Our 6 key challenges to support our business Strategy

INCREASE
project performance through better productivity and design quality whilst controlling costs

IMPROVE
collaboration, communication and decision-making with all players

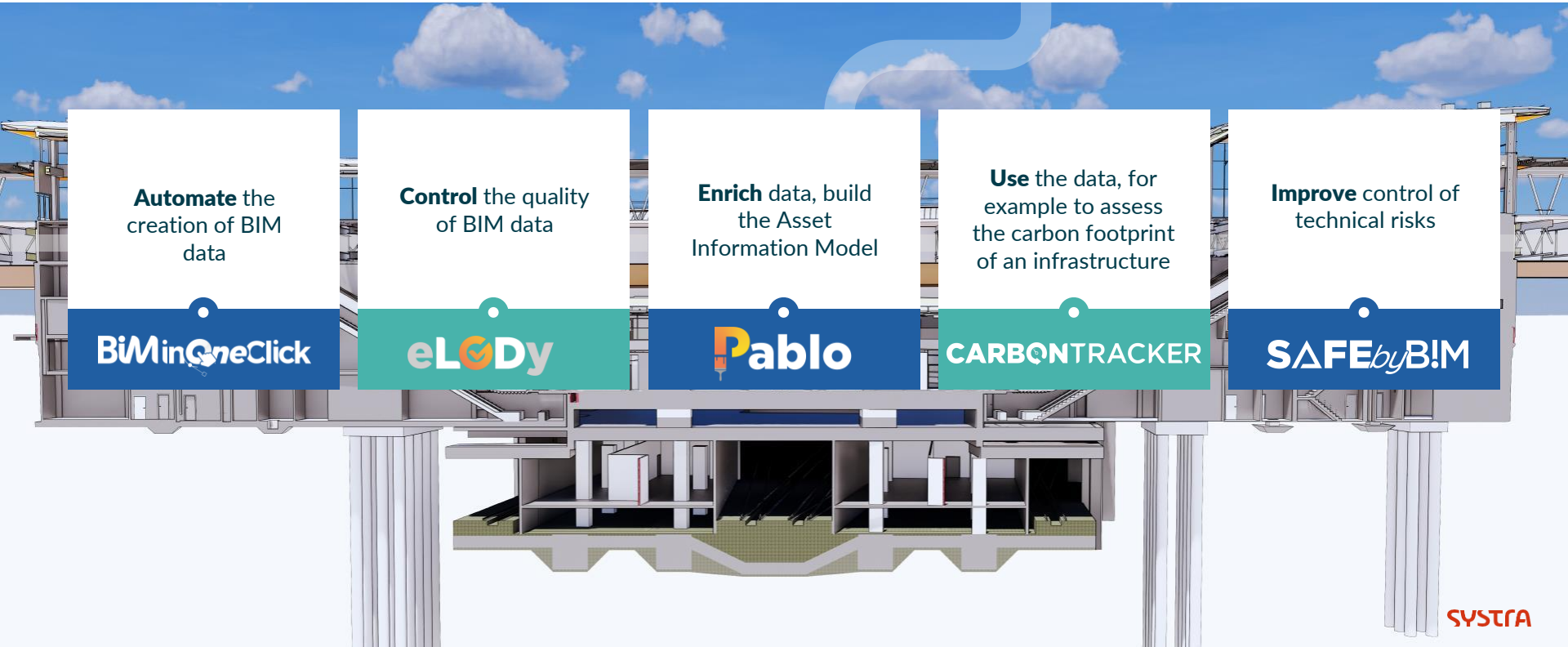
REDUCE
Greenhouse gas emissions

COMPLY
with the budget and project completion timescales

REDUCE
safety-related risks

Having a reliable and sustainable database to **FACILITATE** and **OPTIMISE** operation and maintenance

A range of digital solutions to create, manage and use BIM data throughout the life cycle



Automate the creation of BIM data

BIMinOneClick

Control the quality of BIM data

eLODy

Enrich data, build the Asset Information Model

Pablo

Use the data, for example to assess the carbon footprint of an infrastructure

CARBONTRACKER

Improve control of technical risks

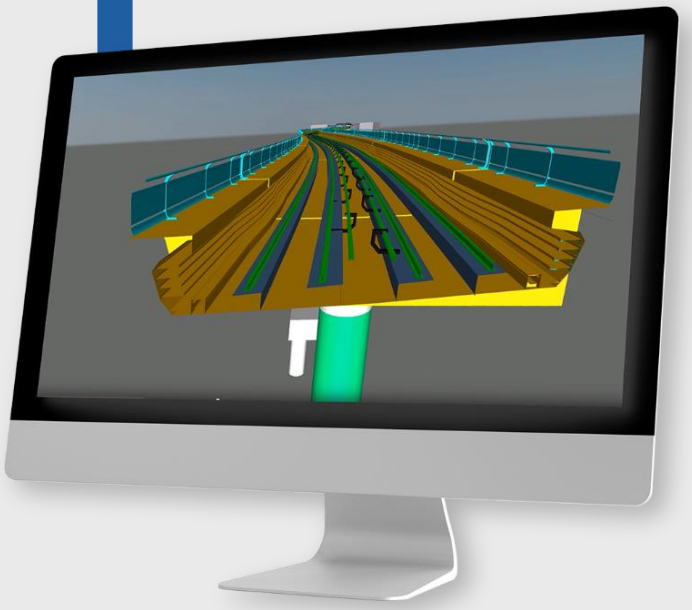
SAFEbyBIM

SYSTRA

SYSTRA'S OFFER

BIM in One Click

FACILITATES AND ACCELERATES **3D MODELLING OF LINEAR INFRASTRUCTURES**



- Automatic modelling of modules
- Quickness of modelling civil engineering infrastructures along a route
- Visualisation of systems interacting with the infrastructure: catenaries, tracks, rail gauges, tunnels, etc.
- Simple and effective data management
- Centralising information
- Reliability of studies and data (4D, 5D)
- Interdisciplinary collaboration
- Productivity gains

SYSTRA'S OFFER

eLODy

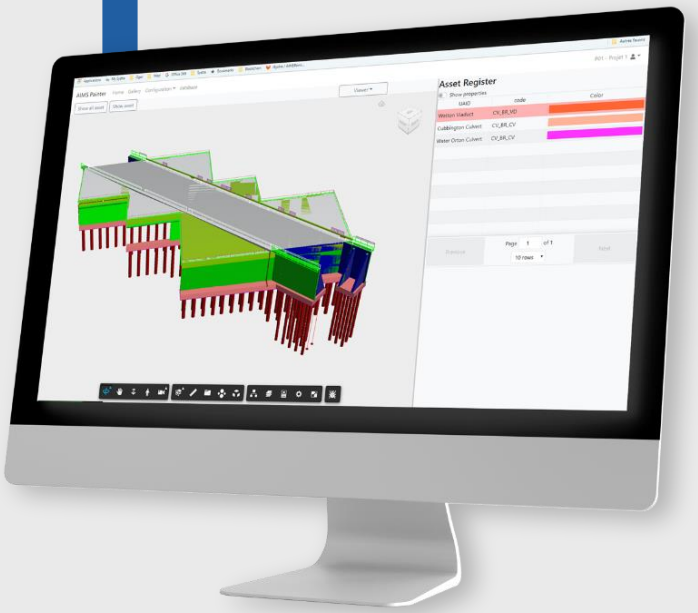
ANALYSES AND MONITORS THE QUALITY OF BIM DELIVERABLES

- Easy to use interface which can be personalised to suit requirements
- Time required to check the BIM model reduced from hours to minutes
- Optimisation of the OpenBIM process with the IFC (ISO 16739) and BCF format
- Exhaustive checks
- Industrialisation of the monitoring process for projects which have a large quantity of BIM output
- Standardisation of the monitoring report

SYSTRA'S OFFER

Pablo

IMPROVES DATA ORGANISATION TO FACILITATE OPERATION AND MAINTENANCE
ON THE BASIS OF BIM DESIGN MODELS



- Structuring project asset data
- Linking design and asset data
- Producing an asset information model

Register of client assets

Defines the structure of the assets and their properties

Lists the assets to return from all those involved in the JV

Design models

Almost any BIM and CAD software can be used with the Autodesk Forge platform

Asset Information Manager (AIM)

Tags objects and links them to an asset in a web browser

SYSTRA'S OFFER

CARBONTRACKER

QUANTIFIES, SIMULATES AND CONTROLS CARBON EMISSIONS FOR A PROSPECTIVE PUBLIC AND RAIL-BASED TRANSPORT INFRASTRUCTURE

- Evaluation of the simplified carbon footprint
- Implementation of a real eco-design approach which incorporates the carbon footprint as a design criteria in the same way as quantities, timescales, methods, etc.
- Analysis tools for eco-designers to optimise and facilitate decision-making

SYSTRA'S OFFER

SAFEbyBIM

EFFECTIVELY MANAGES SAFETY RISKS AT EVERY STAGE OF THE PROJECT LIFE CYCLE

- Visualisation of risks in their environment using the BIM model
- Project teams assured of delivering safe projects and demonstrating robust risk management
- Fast identification, mitigation, transfer and update of technical design risks
- Provides reliable and visual information to all stakeholders

SYSTRA

Designing Low Carbon Infrastructure

Everyone is facing carbon reduction commitments within the context of the climate emergency

THE PARIS AGREMEENT

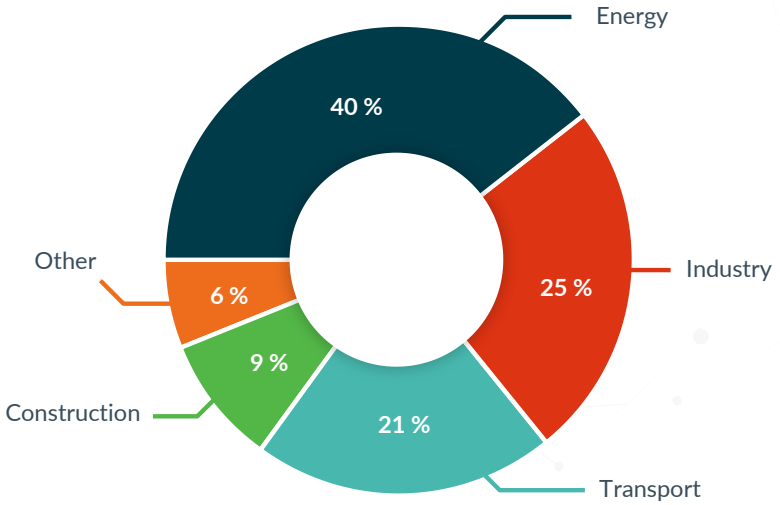
2050: Carbon neutrality

WITHIN THE EU

2030: 50% reduction in carbon emissions

SUSTAINABLE DEVELOPMENT GOALS

As a mobility and transport expert, SYSTRA has a key role to play



CO2 emissions by sector in 2020

Source: International Energy Agency

With CARBONTRACKER, optimise your carbon footprint

Using our web-based application, which is BIM compatible

MEASURE **MANAGE** **CONTROL**

carbon emissions at **every stage of your project**

Compare carbon emissions for various design scenarios

Analyse to what extent carbon performance objectives have been achieved

Identify carbon emission entries

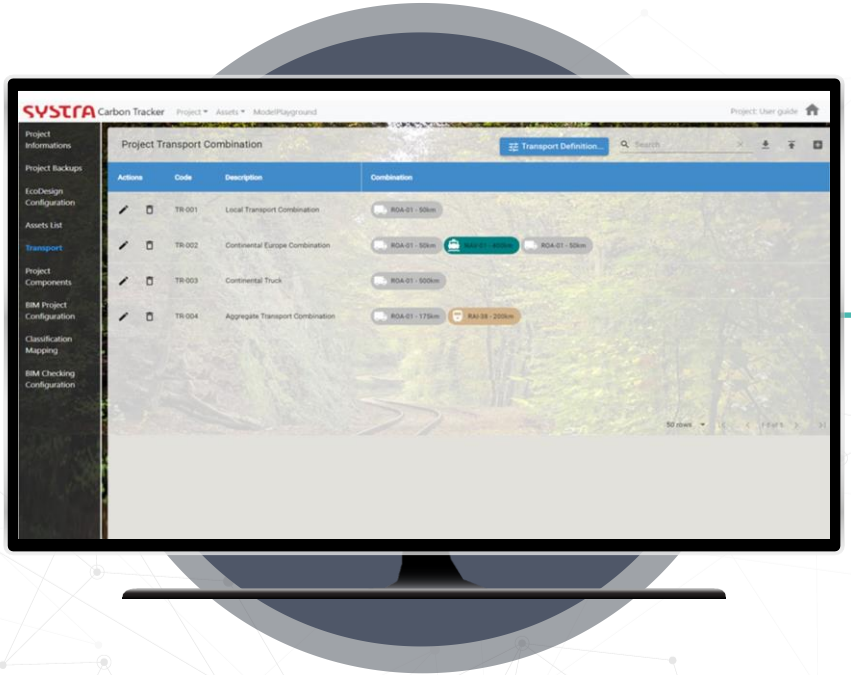
Measure carbon emissions for various assets

Calculate in real time the carbon footprint and emissions avoided

OPTIMISING PROJECT DESIGN

Tracking the carbon footprint in 3 stages

Configuring the tool to suit project characteristics and local conditions



CARBONTRACKER can be configured for any type of project and mode of transport. It takes into account the specific contextual features such as emission ratios in each country depending on local weather conditions.

- Project information
- Back-up management
- Definition of project assets
- Configuration of the carbon calculation
- Configuration of the transportation of project components
- Database of project components and their carbon emissions
- Configuration and checking of BIM data

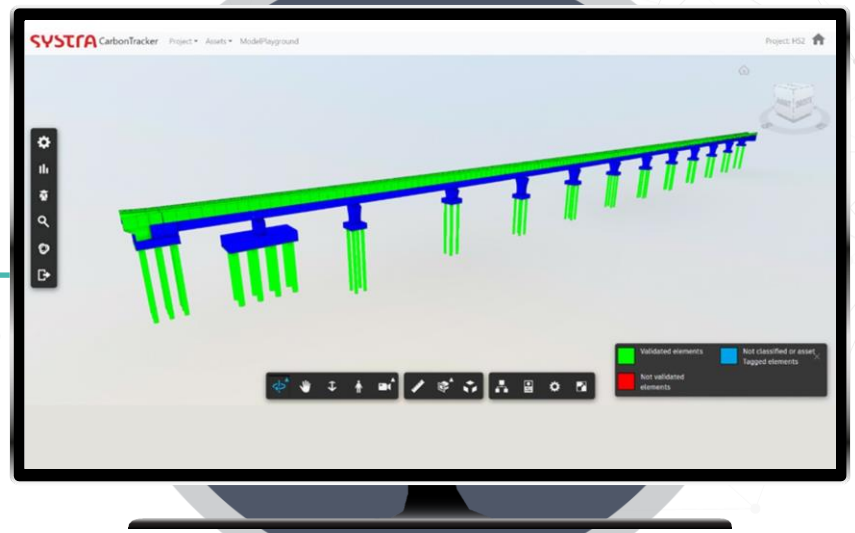
Calculating carbon emissions based on project data

2

CARBONTRACKER incorporates the carbon criterion in all project design assets with the help of BIM technology and adapts to your project's specific features

- **Capture** BIM data based on project models.
- **Check** data based on the established configuration
- **Identify** project components and calculate their carbon emissions

Option to add non-BIM data from multiple sources (Excel, JSON, database)



ASSESS THE CARBON FOOTPRINT FROM THE UPSTREAM PHASES OF THE PROJECT'S REFERENCE SCENARIO IN THE VARIOUS TECHNICAL AND/OR GEOGRAPHICAL ASSETS

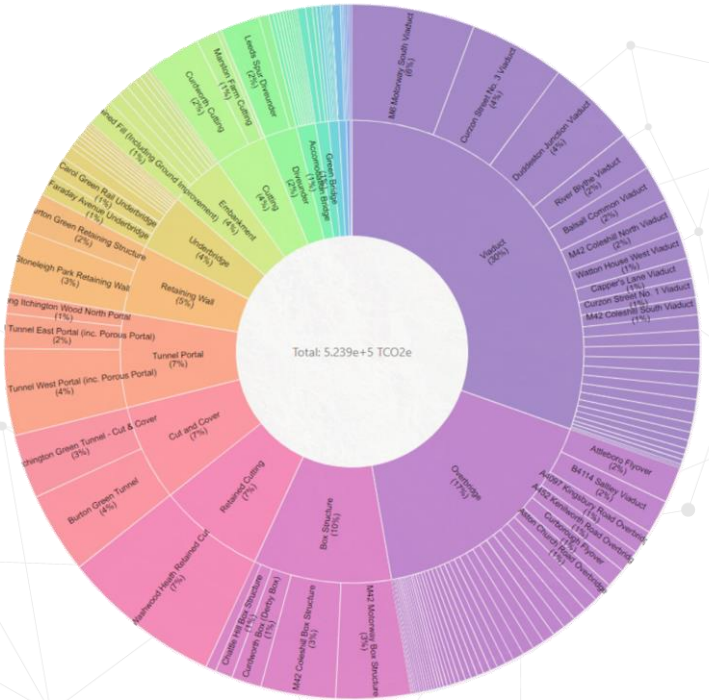
Monitoring and visualising the project's carbon performance

Visualisation of the carbon footprint depending on the project's characteristics

- Analyse to what extent **the carbon performance objective** has been achieved
- Measure the carbon emissions of the various assets **throughout the infrastructure's life cycle**
- Calculate in real time **the carbon footprint and emissions avoided**

A multi-level analysis of emissions for the comprehensive and systematic reduction in carbon emissions

3




CARBONTRACKER
TIME 4 DEMO

Quick Words before Demo…

Project Asset Breakdown

Our Linear Project

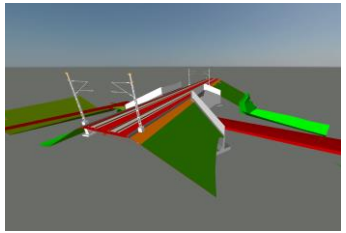
Asset FRP-00001253

Asset FRP-00001255

Asset FRP-00001257

Asset Code: FRP-0000001051
Asset Type: EMB
Name: Mogen Embankment

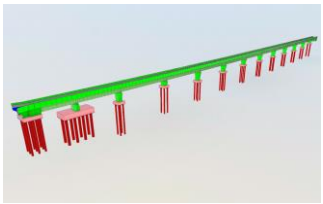
File:
- FRP-BIM-1051-STR.ifc
- FRP-BIM-1051-EMB.ifc
- FRP-BIM-1051-TRK.ifc
- Accomodation.xlsx

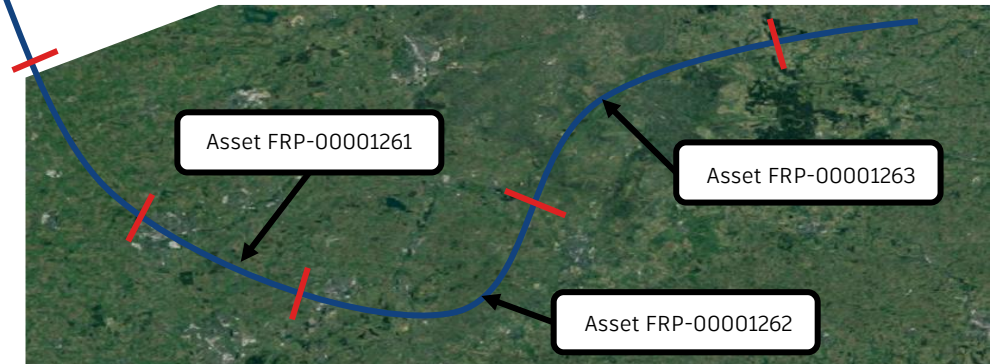


Asset FRP-00001259

Asset Code: FRP-0000001259
Asset Type: VIA
Name: River 1259 Viaduct

File:
- FRP-BIM-1259-STR.ifc
- Accomodation.xlsx





Demo Summary

1) Project Hub & Project Configuration
2) BIM Model Integration
3) Non-BIM Data Integration
4) Project Cockpit
5) Reducing Carbon Emission with Variant Management and Analysis Tools

Carbon Tracker | Project

co2-bim-test.systra.info/views/project

SYSTRA CarbonTracker Project Assets ModelPlayground Project: Railway Demo Project

Available Projects

+ NEW PROJECT

HS2

Contract Name: High Speed 2 - MWCC
Client: HS2
SPOT: FR01T18EXX
Eco Designer: FOTIADOU Sofia
Creation Date: 07/12/2019, 12:39

ACTIVATE MODIFY

OLP3

Contract Name: Ligne à grande vitesse Ostlänken (Suède – section de Nyköping)
Client: Travikverket
SPOT: FR01T17EXX
Eco Designer: ROCHETTE Marie
Creation Date: 16/05/2018, 13:39

ACTIVATE MODIFY

TAE

Contract Name: Etudes Préliminaires Ligne 3 TAE
Client: TISSEO
SPOT: FR01T19EXX
Eco Designer: FOTIADOU Sofia
Creation Date: 07/06/2020, 13:39

ACTIVATE MODIFY

TAE AVP2

Contract Name: Ligne 3 TAE AVP2
Client: TISSEO
SPOT: FR01S20A44.A.001
Eco Designer: Soukaina LACHHAB
Creation Date: 04/11/2020, 11:48

ACTIVATE MODIFY

HS2 N1N2

Contract Name: HS2
Client: HS2
SPOT: SPOT
Eco Designer: Soukaina LACHHAB
Creation Date: 15/04/2021, 11:34

ACTIVATE MODIFY

Test Consolidation

Contract Name: HS2 test
Client: HS2 test
SPOT: HS2 test
Eco Designer: Soukaina
Creation Date: 16/04/2021, 14:50

ACTIVATE MODIFY

Cable Car Manila

Contract Name: Cable Car Manila
Client: AFD
SPOT: .
Eco Designer: Soukaina Lachhab
Creation Date: 06/05/2021, 17:29

ACTIVATE MODIFY

User guide

Contract Name: Contract Name
Client: Client Name
SPOT: SPOT
Eco Designer: Eco Designer
Creation Date: 04/06/2021, 11:14

ACTIVATE MODIFY

Alvesta Triangelspår

Contract Name: SE01T21A20 Alvesta triangelspår
Client: Trafikverket
SPOT: SE01T21A20
Eco Designer: Maria Andersson, Anna Hulterström

ACTIVATE MODIFY

Test Toulouse

Contract Name: Toulouse
Client: Toulouse
SPOT: FRXXXXXXXXX
Eco Designer: Nisrine AHAGAN
Creation Date: 13/07/2021, 14:53

ACTIVATE MODIFY

Carbon Tracker | Modify Project

co2-bim-test.systra.info/views/project/6123368ef5fe25af9a721157

SYSTRA CarbonTracker Project Assets ModelPlayground Project: Railway Demo Project

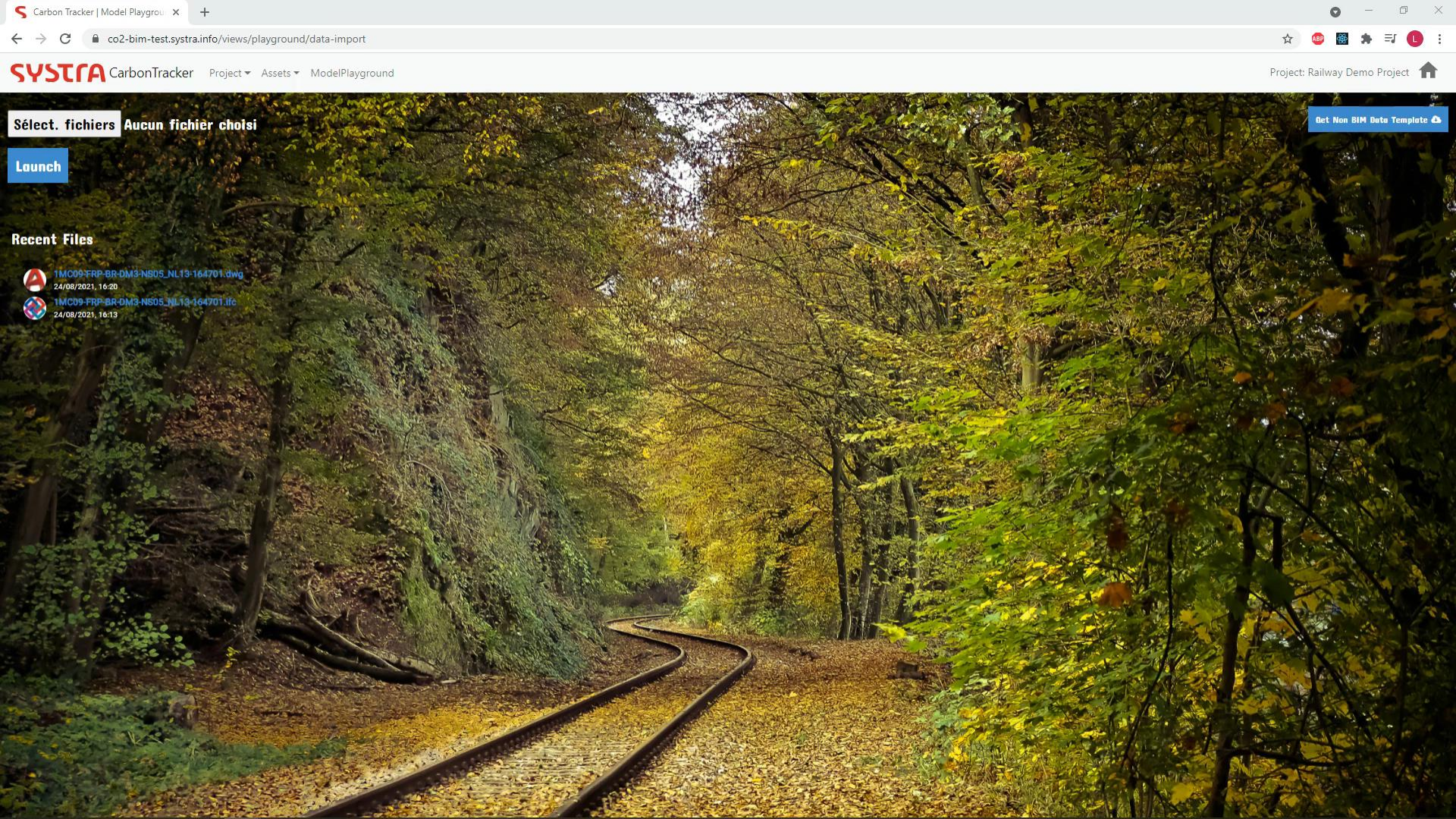
- Project Informations
- Project Backups
- EcoDesign Configuration
- Assets List
- Transport
- Project Components
- BIM Project Configuration
- Classification Mapping
- **BIM Checking Configuration**

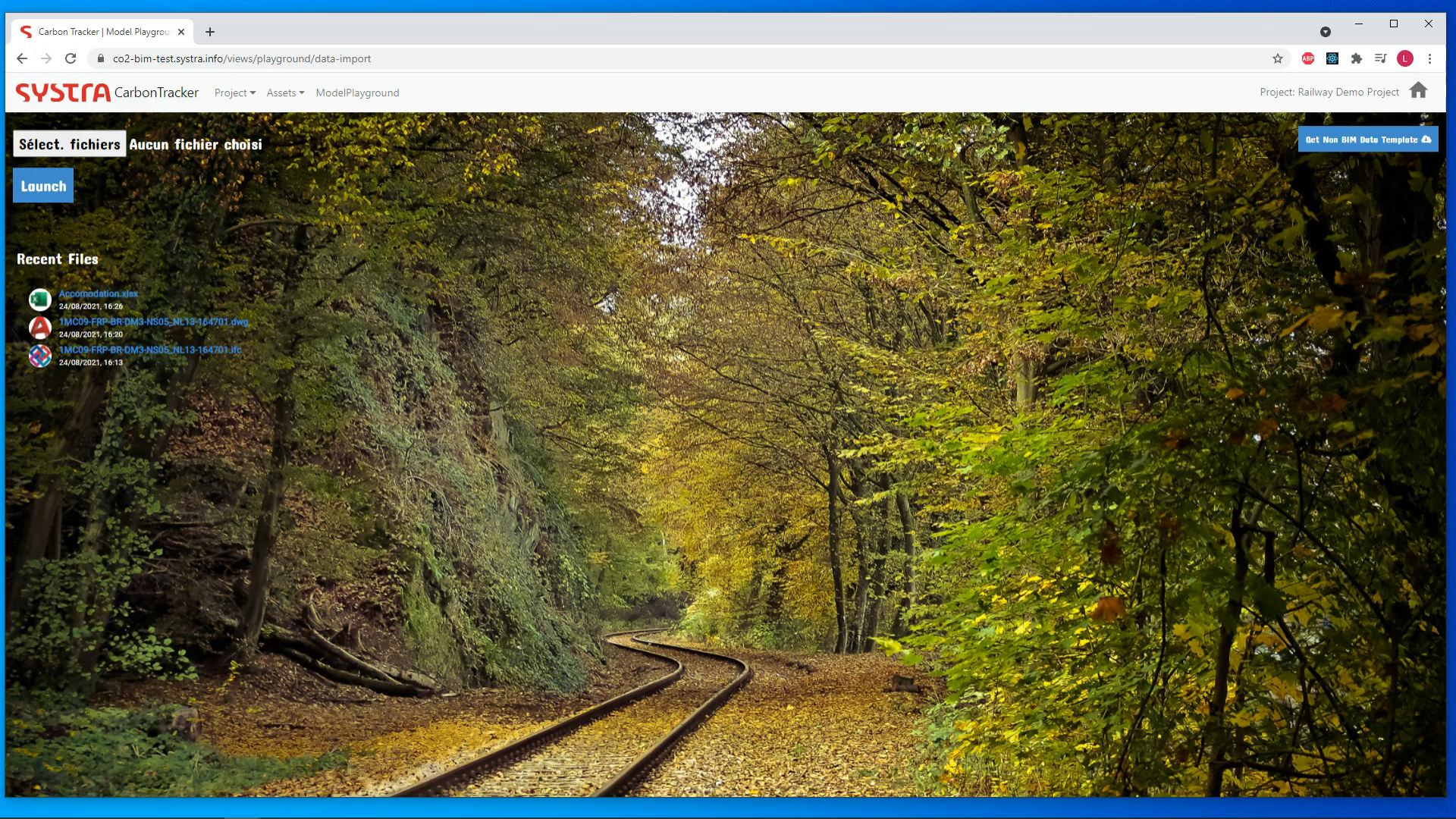
BIM Checking Configuration

Category Selection: Concrete

Search

Actions	Parameter	Name	Required	Rule 1	Rule 2	Rule 3
✎	Volume	Volume	✓	/^([0-9]*[.])?[0-9]+/g	<1000000	
✎	Reinforcement Ratio	Ratio_Armature	—			
✎	Prestressing Ratio	Ratio_Precontrainte	—			
✎	Concrete Mix	Type_Beton	—			
✎	Concrete Class	Classe_Beton	—			


Carbon Tracker | Model Playgrou
co2-bim-test.systra.info/views/playground/data-import
SYSTRA CarbonTracker
Project
Assets
ModelPlayground
Project: Railway Demo Project
Sélect. fichiers
Aucun fichier choisi
Launch
Get Non BIM Data Template
Recent Files
1MC09-FRP-BR-DM3-NS05_NL13-164701.dwg
24/08/2021, 16:20
1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc
24/08/2021, 16:13


Carbon Tracker | Model Playgrou
co2-bim-test.systra.info/views/playground/data-import
SYSTRA CarbonTracker
Project
Assets
ModelPlayground
Project: Railway Demo Project
Sélect. fichiers
Aucun fichier choisi
Launch
Get Non BIM Data Template
Recent Files
Accomodation.xlsx
24/08/2021, 16:26
1MC09-FRP-BR-DM3-NS05_NL13-164701.dwg
24/08/2021, 16:20
1MC09-FRP-BR-DM3-NS05_NL13-164701.ifc
24/08/2021, 16:13

Carbon Tracker | Project

co2-bim-test.systra.info/views/project/cockpit

SYSTRA CarbonTracker | Project | Assets | ModelPlayground | Project: Railway Demo Project

Project Name: Railway Demo Project

Contract Name: Contract Name
Client: Client
SPOT: XYZXYZXYZ
Eco Designer: Mr Dupond
Creation Date: 23/08/2021, 07:47
Last Update: 24/08/2021, 18:39

233
Assets
Number of assets

159
Files
Number of files (BIM Models or Non BIM Data files) attached to assets

Emissions Reduction
Estimated Emissions Reduction from Baseline
40.82%
1.76e+6 TCO2e saved from Baseline

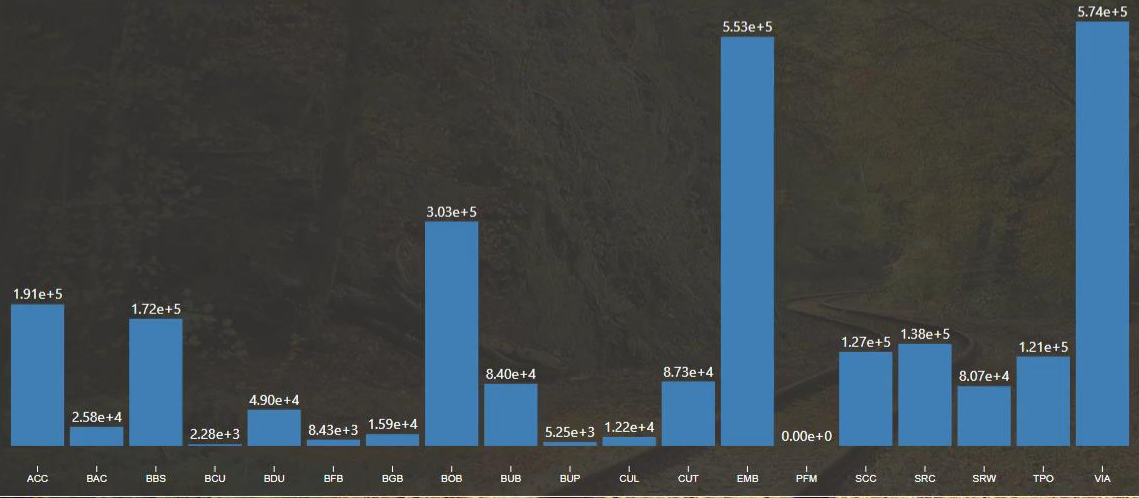
Calculation Target Year Slider
120
CAPEX/OPEX | 0Y — OPEX | +120Y

68%
Extraction Progress
Percentage of assets with at least one extraction

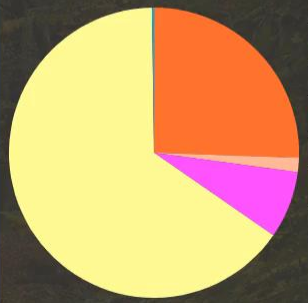
75781
Constituent Parts
Number of constituent part in the project

111
Object Types
Number of different object types in the project

Project Life Cycle Result (TCO2e)



Project Assets Analytics



A1A3-Construction	6.520e+5	25.6%
A4-Transport	4.032e+4	1.6%
A5-SiteActivities	1.915e+5	7.5%
B2-Maintenance	1.662e+6	65.1%
B4-Remplacement	5.385e+3	0.2%
B6-Operation	0.000e+0	0.0%
C1-Demolition	0.000e+0	0.0%

Designing infrastructure SAFE by Design

Why Safety Risk Management is Key ?

Construction is a high risk industry

Over 4500 RIDDOR Reported accidents and 40 fatal injuries sustained in 2019 / 2020 in the UK alone.

SAFETY RISK Management is crucial to protect :

EVERYONE
who could be affected by our works

ALL USERS
of the infrastructures we deliver

Our first responsibility as a professional design organisation is to identify, manage and control these risks

But not implemented on many projects ?

LACK OF MATURITY

LACK OF EFFICIENT TOOLS & PROCESSES

SAFEbyBIM IS A SOLUTION THAT...

- ✓ ALLOW DATA CENTRIC SAFETY RISK MANAGEMENT
- ✓ FOSTER INTEGRATED SAFETY RISK MANAGEMENT
- ✓ ENABLE SAFETY RISK MODELLING
- ✓ ENHANCE COLLABORATIVE SAFETY RISK MANAGEMENT

FOR A ROBUST SAFETY RISK MANAGEMENT PROCESS

...TO DELIVER AN INFRASTRUCTURE


SAFE by BIM
TIME 4 DEMO

Quick Words before Demo…

Demo Summary

1) Project Hub
2) Hazard Database
3) Hazard Importation Process
4) BIM Model Hazard Integration
5) Dashboard

Definitions

CSM Hazard: Common Safety Method, used to assess the safety of the operational railway project.

CDM Hazard: Construction Design and Management, used to assess the health & safety in construction

Hazard Management Process

Projects - SAFEbyBIM

safebybim-demo.systra.digital/project

SYSTRA SAFEbyBIM - Projects Dashboard Hazards Models GIBAUD Lucas

Available Projects

NEW

HS2

Contract Name: High Speed 2 - MWCC
Client: HS2
SPOT: FR01XXXXXX
Creation Date: 05/05/2021, 23:20

ACTIVATE CONFIGURATION

TAE (public)

Contract Name: Etudes Préliminaires Ligne 3 TAE
Client: TISSEO
SPOT: FR01T19EXX
Creation Date: 05/05/2021, 23:20

ACTIVATE CONFIGURATION

Railway Demo Project

Contract Name: Railway Project
Client: Client
SPOT: XYZXYZXYZ
Creation Date: 05/05/2021, 23:20

CURRENT CONFIGURATION

OLP3

Contract Name: Ligne à grande vitesse Ostlänken (Suède – section de Nyköping)
Client: Travikverket
SPOT: FR01T17EXX
Creation Date: 05/05/2021, 23:20

ACTIVATE CONFIGURATION

Euan Test Project

Contract Name: Project Contract Name
Client: Hillerby
SPOT: ABC
Creation Date: 07/06/2021, 14:41

ACTIVATE CONFIGURATION

Test Project Glen

Contract Name: Contract
Client: Client
SPOT: SPOT
Creation Date: 20/08/2021, 15:55

ACTIVATE CONFIGURATION

Projects - SAFEbyBIM

safebybim-demo.systra.digital/project

SYSTRA SAFEbyBIM - Projects

Dashboard Hazards Models

GIBAUD Lucas

Available Projects

NEW

HS2

Contract Name: High Speed 2 - MWCC
Client: HS2
SPOT: FR01XXXXXX
Creation Date: 05/05/2021, 23:20

ACTIVATE CONFIGURATION

TAE (public)

Contract Name: Etudes Préliminaires Ligne 3 TAE
Client: TISSEO
SPOT: FR01T19EXX
Creation Date: 05/05/2021, 23:20

ACTIVATE CONFIGURATION

Railway Demo Project

Contract Name: Railway Project
Client: Client
SPOT: XYZXYZXYZ
Creation Date: 05/05/2021, 23:20

CURRENT CONFIGURATION

OLP3

Contract Name: Ligne à grande vitesse Ostlänken (Suède – section de Nyköping)
Client: Travikverket
SPOT: FR01T17EXX
Creation Date: 05/05/2021, 23:20

ACTIVATE CONFIGURATION

Euan Test Project

Contract Name: Project Contract Name
Client: Hillerby
SPOT: ABC
Creation Date: 07/06/2021, 14:41

ACTIVATE CONFIGURATION

Test Project Glen

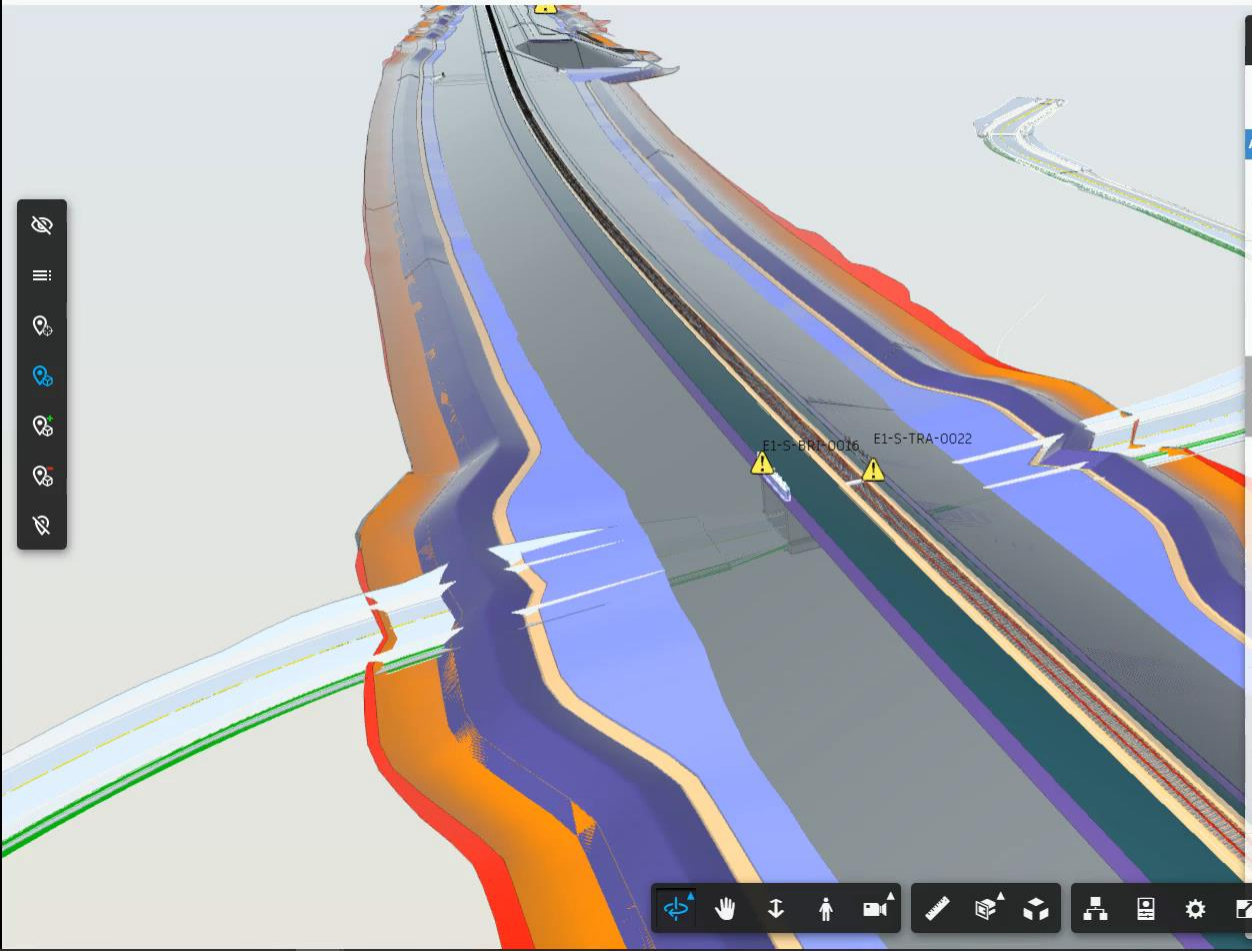
Contract Name: Contract
Client: Client
SPOT: SPOT
Creation Date: 20/08/2021, 15:55

ACTIVATE CONFIGURATION

Hazard Table | Allow Grouping | References | Assessment | Classification | Measures | Transfer | Position | Database | NEW | IMPORT | TRU CDM | Search

Actions	Identifier	Title	Description	Cause of Accident	Consequence	Discipline	Hazard Owner	CDM/CSM
	E1-S-BRI-0014	Potential for Structural failure (CSM)	Culvert collapse caused by collapse of undertrack pipework, leading to loss of train guidance. Due to loss of track formation / alignment	Structural failure	Multiple Fatalities	Bridges	Bridges CRE	CSM
	E1-S-BRI-0015	Potential for Structural failure (CSM)	Attachment of OLE support to deck soffit would increase the load on pre-stressed beams, causing failure in ULS and SLS. Failure of pre-stressed beams in ULS and SLS condition might lead to structural collapse.	Structural failure	Multiple Fatalities	Bridges	Bridges CRE	CSM
	E1-S-BRI-0016	Person struck/ impact with object hazards (CSM)	Individuals unaware of height restriction	Individual could strike their head with the top of the subway, especially at the upside end, at the joint between span 6 and 7 (lowest point of the subway).	Single Major Injury	Bridges	Bridges CRE	CSM
	E1-S-BRI-0017	Potential for Structural failure (CSM)	Realignment of the existing culvert would affect the integrity of the side bearing of OLE mast, and potentially lead to the excessive deflection/collapse of the mast.	Collapse of OLE mast	Single Fatality	Bridges	Bridges CRE	CSM
	E1-S-BRI-0018	Failure to protect workforce on track from train movements (CSM)	Increase in line speed requires greater distance for safe separation of operative from moving vehicle. Existing abutments and/or piers restrict the cess/6ft width, providing inadequate space for a position of safety.	Train Strikes Maintainer	Single Fatality	Bridges	Bridges CRE	CSM
	E1-S-BRI-0019	Failure to protect workforce on track from train movements (CSM)	Increase in line speed requires greater distance for safe separation of operative from moving vehicle. Existing parapets restrict the cess width, providing inadequate space for a position of safety. Current arrangement does not provide refuges and structure is greater than 40m in length	Train Strikes Maintainer	Single Fatality	Bridges	Bridges CRE	CSM
	E1-S-BRI-0020	Electrical Hazards (CSM)	Pre IDC design development meeting - The holes for endoscope survey are at the rail side of the parapet. During endoscope inspection of coper on the parapet inspector comes into contact with live OLE.	Electrocution of Maintainer	Single Fatality	Bridges	Bridges CRE	CSM
	E1-S-BRI-0021	Unauthorised access to track (CSM)	The barriers on deck level at approach walls are low and there is possibility for trespassing to the railway, in which case people might be hit by operational trains, leading to	Train strikes public	Single Fatality	Bridges	Bridges CRE	CSM

50 rows | 1-50 of 476



Hazards Table

In Model Only | Ref. | Assess. | Pos. | Search

Actic	Identifier	Title	Description	Discipline
	E1-S-BRI-0014	Potential for Structural failure (CSM)	Culvert collapse caused by collapse of undertrack pipework, leading to loss of train guidance. Due to loss of track formation / alignment	Bridges
	E1-S-BRI-0015	Potential for Structural failure (CSM)	Attachment of OLE support to deck soffit would increase the load on pre-stressed beams, causing failure in ULS and SLS. Failure of pre-stressed beams in ULS and SLS condition might lead to structural collapse.	Bridges
	E1-S-BRI-0016	Person struck/ impact with object hazards (CSM)	Individuals unaware of height restriction	Bridges
	E1-S-BRI-0017	Potential for Structural failure (CSM)	Realignment of the existing culvert would affect the integrity of the side bearing of OLE mast, and potentially lead to the excessive deflection/collapse of the mast.	Bridges
	E1-S-BRI-0018	Failure to protect workforce on track from train movements (CSM)	Increase in line speed requires greater distance for safe separation of operative from moving vehicle. Existing abutments and/or piers restrict the cess/6ft width, providing inadequate space for a position of safety.	Bridges
	E1-S-BRI-0019	Failure to protect workforce on track from train movements (CSM)	Increase in line speed requires greater distance for safe separation of operative from moving vehicle. Existing parapets restrict the cess width, providing inadequate space for a position of safety. Current arrangement does not provide refuges and structure is greater than 40m in length	Bridges
	E1-S-BRI-0020	Electrical Hazards (CSM)	Pre IDC design development meeting - The holes for endoscope survey are at the rail side of the parapet. During endoscope inspection of coper on the parapet inspector comes into contact with live OLE.	Bridges

Thank you !

LUCAS GIBAUD

BIM solution developper

lgibaud@systra.com

ERIC PRUVOST

Head of BIM Transformation Program

epruvost@systra.com

AUTODESK UNIVERSITY