ECSMGE 2019
Reykjavik

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GEOTECHNICAL ENGINEERING,

FOUNDATION OF THE FUTURE

REYKJAVIK, ICELAND
1 - 6 SEPTEMBER 2019

XVII EUROPEAN CONFERENCE ON SOIL MECHANICS AND GEOTECHNICAL ENGINEERING

2 SEPTEMBER – KEYNOTE SESSION 2 – PLENARY PAPERS

THE USE OF BIM TECHNOLOGY IN GEOTECHNICAL ENGINEERING

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- **INTRODUCTION**
- STUDY CASE
- 3/D BIM MODELING
- 4/D BIM MODELING
- 5/D BIM MODELING
- FINAL REMARKS

INTRODUCTION

*Difficulty **implementing** planning **(4D)** and budgeting **(5D)** tools.*

McGraw Hill Construction (2012)

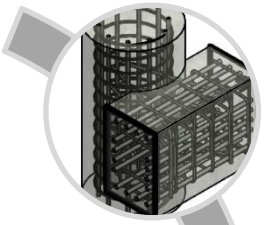
Productivity and construction digitalization

Low national Implementation of BIM

4D+5D capabilities to be seized

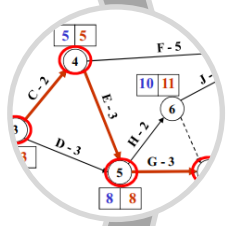
Advantages + Low implementation in Geotechnical Engineering

5D/BIM + Geotechnical Engineering



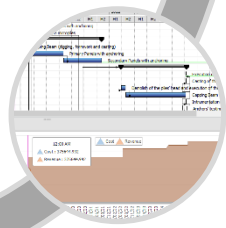
Structure (3D)

- 3D parametric modeling
- Geological and geotechnical layers



Planning (4D)

- Construction Simulation
- Clash detection
- Resource allocation



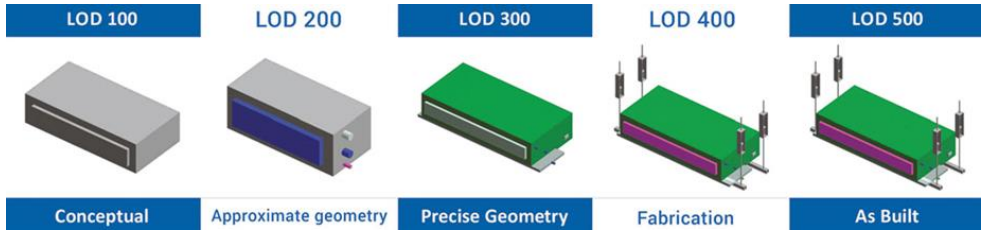
Budgeting (5D)

- Automatized QTO
- Procurement
- Multi-scenario analysis

*"Geotechnical engineering includes not only **financial risks** but also for structural and physical integrity"*

Sterling (2017)

INTRODUCTION



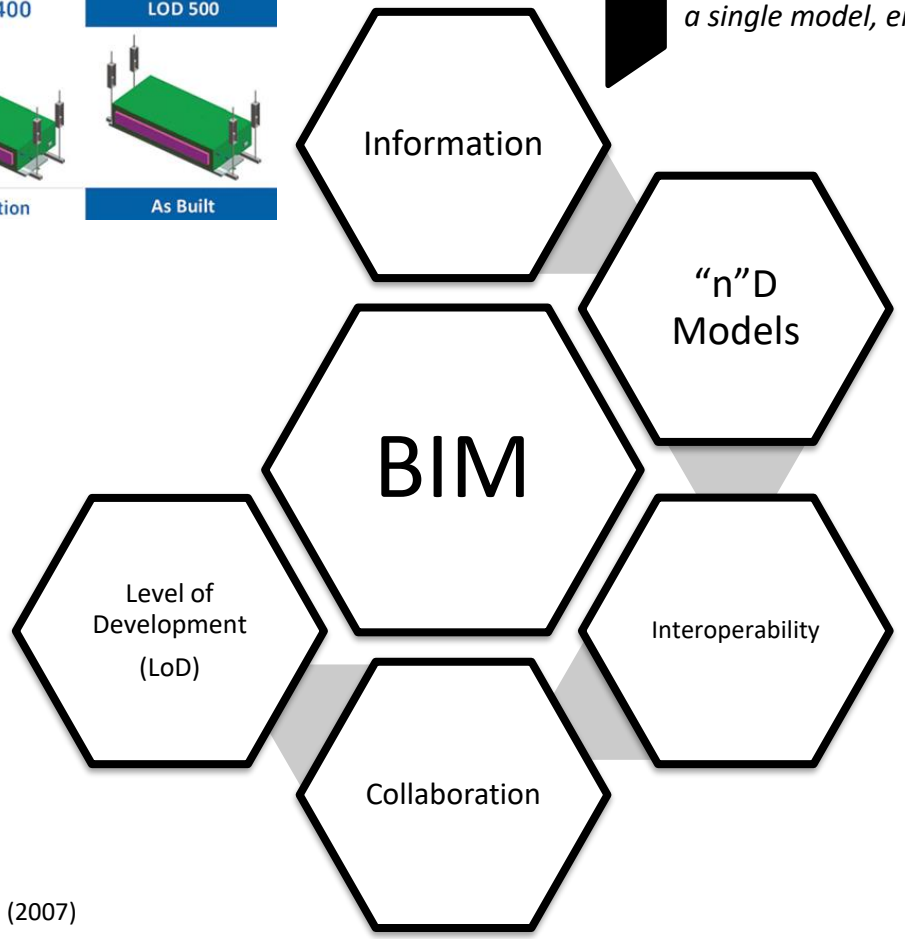
B uilding

I nformation

M odeling

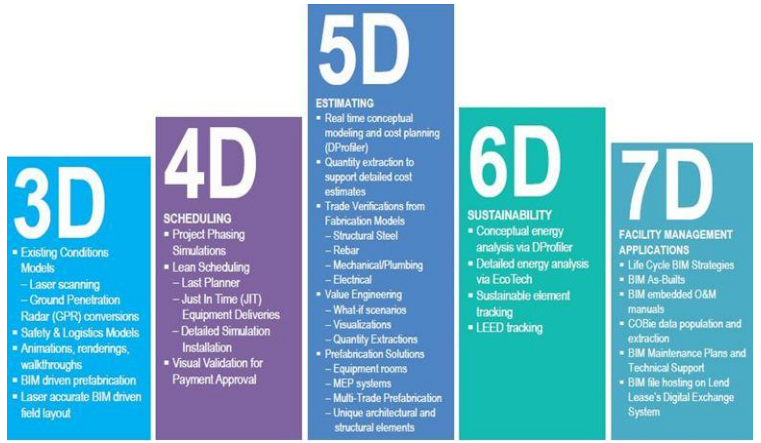
*"The methodology won´t be **linear** but **colaborative**"*

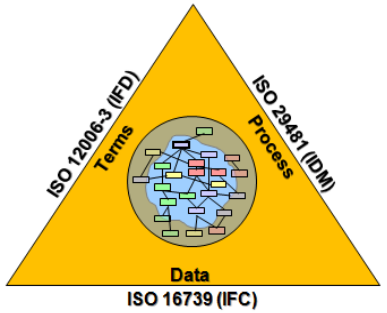
Carmona & Irwin (2007)



*"**Information** coming from different sources is **centralized** in a single model, ensuring its constant share and update"*

Carmona & Irwin (2007)





- INTRODUCTION
- **STUDY CASE**
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- 4/D BIM MODELING
- 5/D BIM MODELING
- FINAL REMARKS

STUDY CASE:
LISBON'S PUBLIC PARKING LOT "ARCO DO CEGO"

Restrains:

- Geological and geotechnical
- Adjacent infrastructures
- Execution deadlines

Constructive Solutions:

- Bored Pile Wall - 600mm //1,2m
- Temporary grout anchors - 2 levels
- King Post Walls - Ramp

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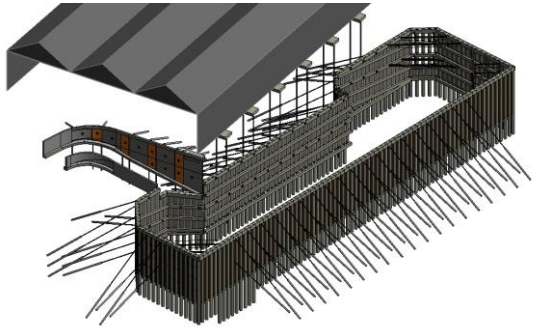
3D/BIM MODELING

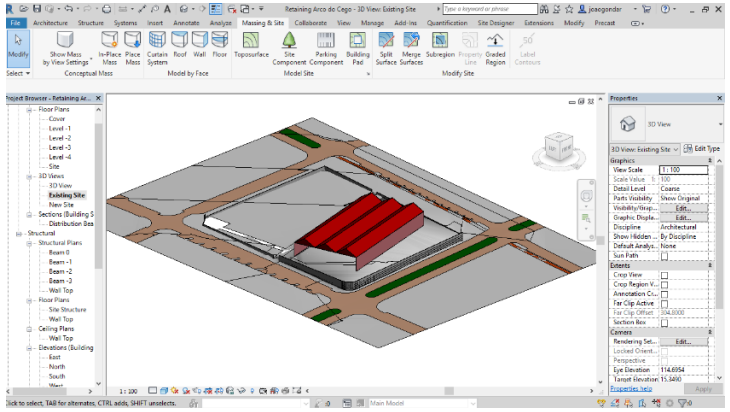


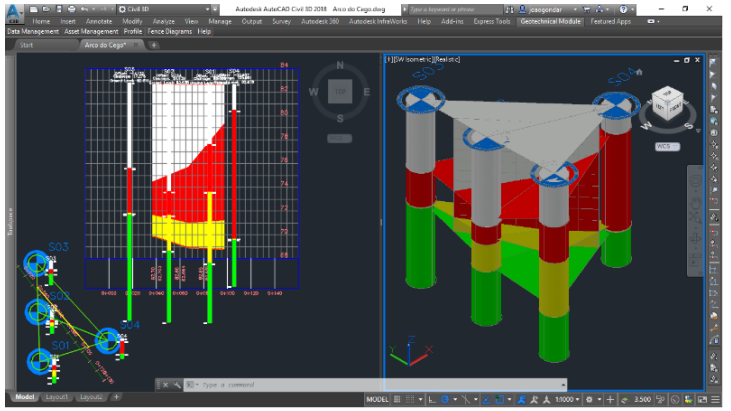
Preparation
- Georeferencing
- Units
- Phasing
- Levels

Topography
- Quantities
- Restrains

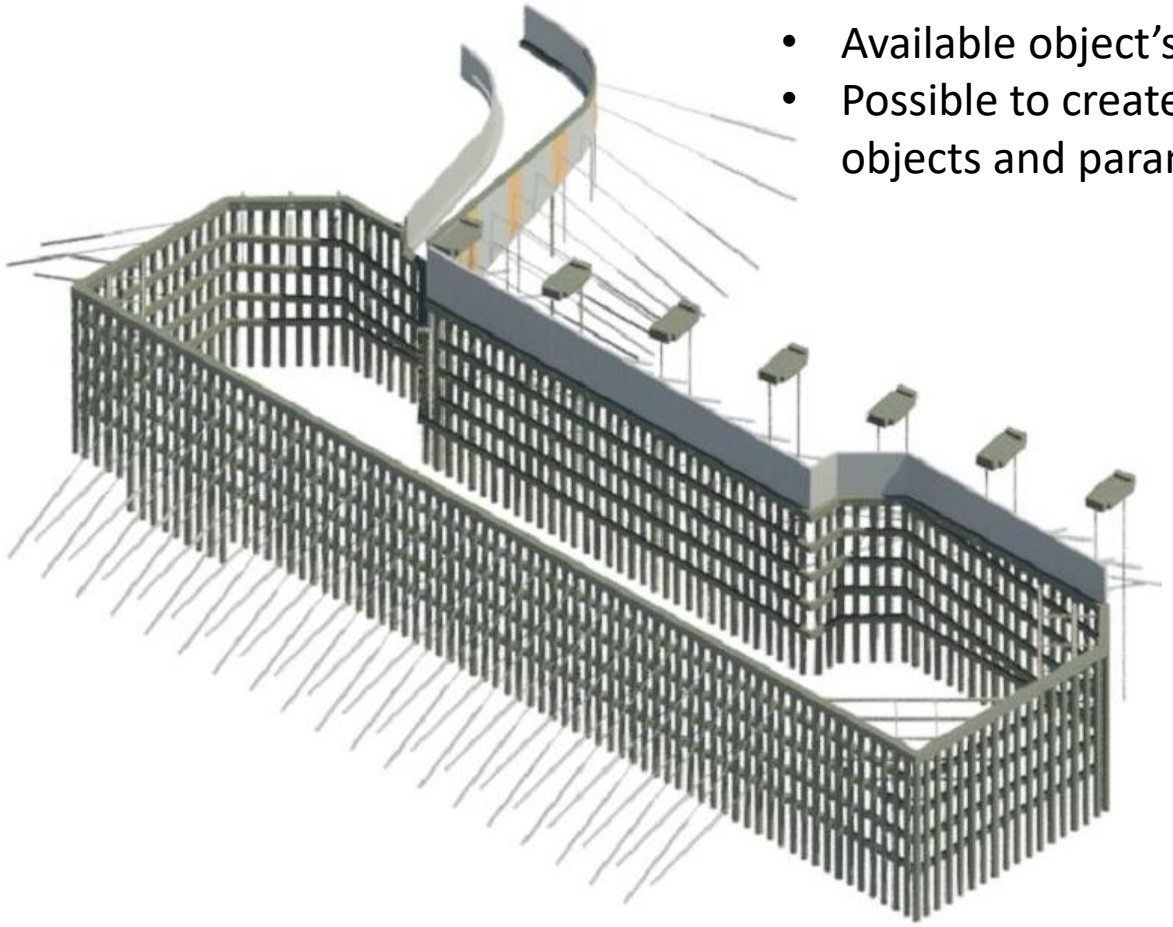
Structure
- Bored Piles
- King Post Walls
- Concrete Beams
- Steel Profiles
- Grout anchors

Geotechnical Layers
- Compatibilization
- Optimization

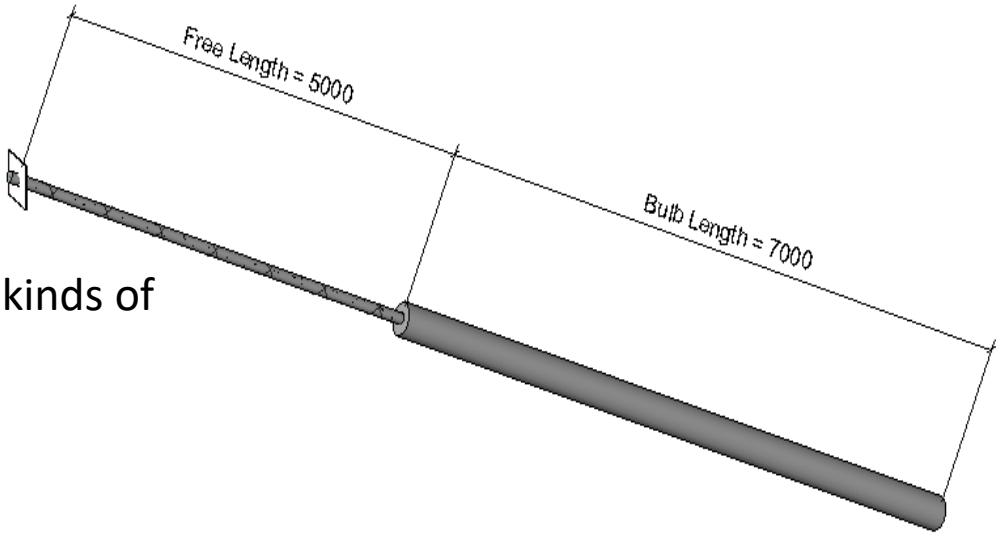


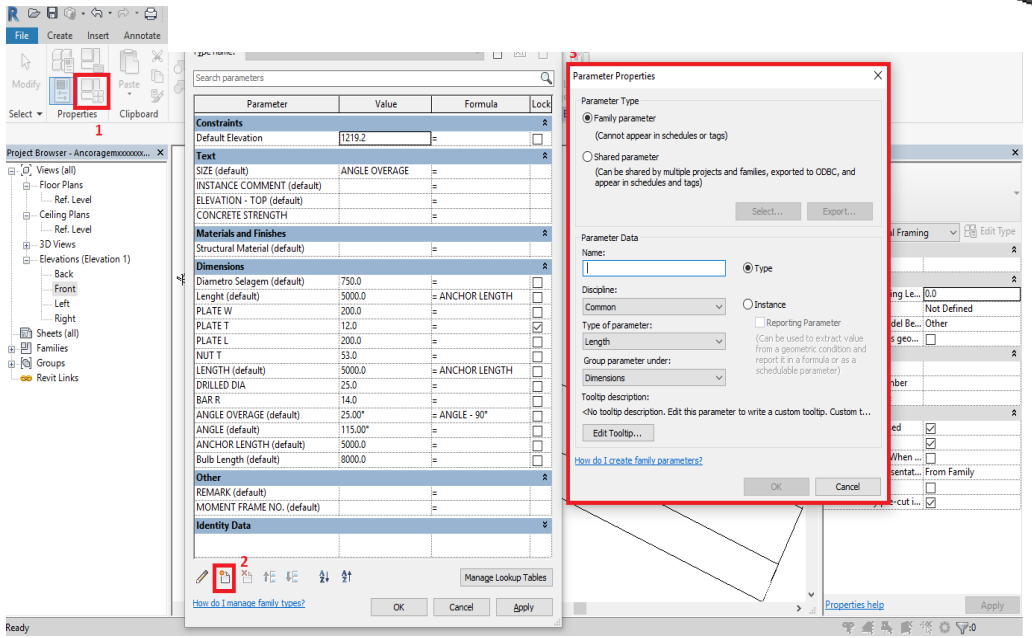


3D/BIM MODELING
PARAMETRIC ELEMENTS



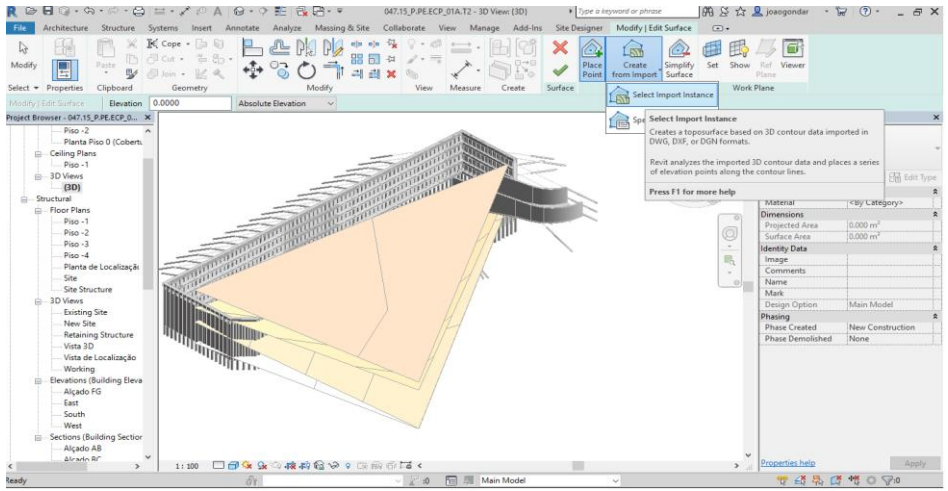
- Available object's library
- Possible to create different kinds of objects and parameters





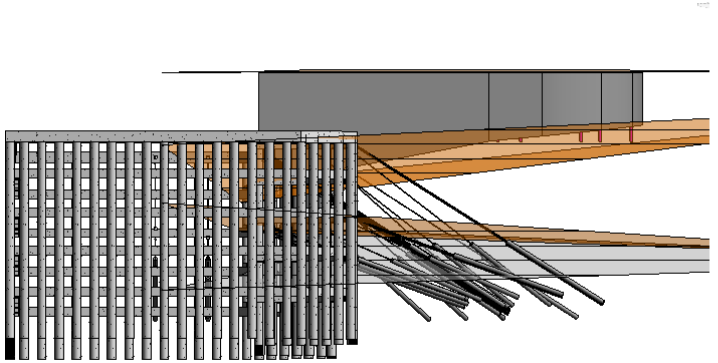
3D/BIM MODELING

GEOTECHNICAL LAYERS



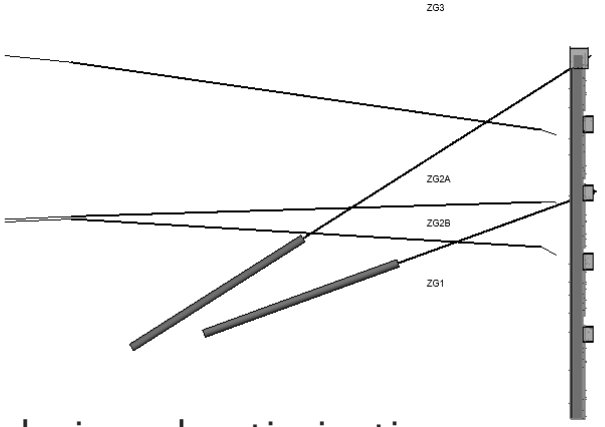
1 – Geological and Geotechnical Study

Layer	Geotechnical Zone	N_{spt}	Weight (kN/m³)	Angle of Friction (°)	Cohesion (kPa)	Young Modulus (MPa)
Landfill	ZG3	0 – 7	18	24	-	3
Miocenic	ZG2A	6 – 26	19	32	5	10
	ZG2B	30 - 45	20	34	10	20
	ZG1	60	20	36	20	50



3 – Import to 3D model

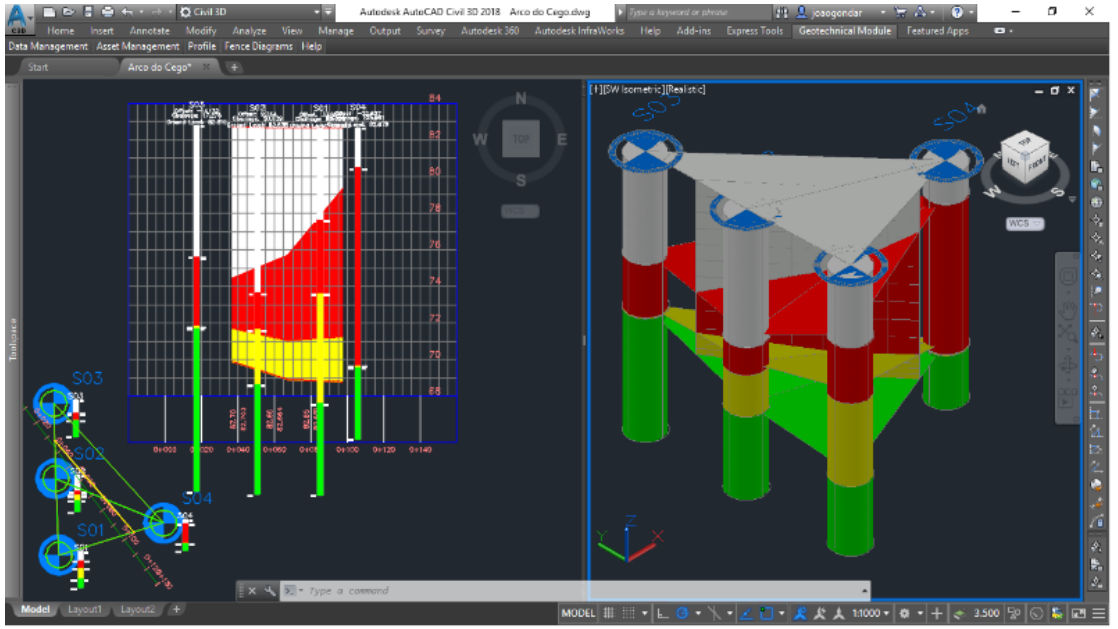
- Revit

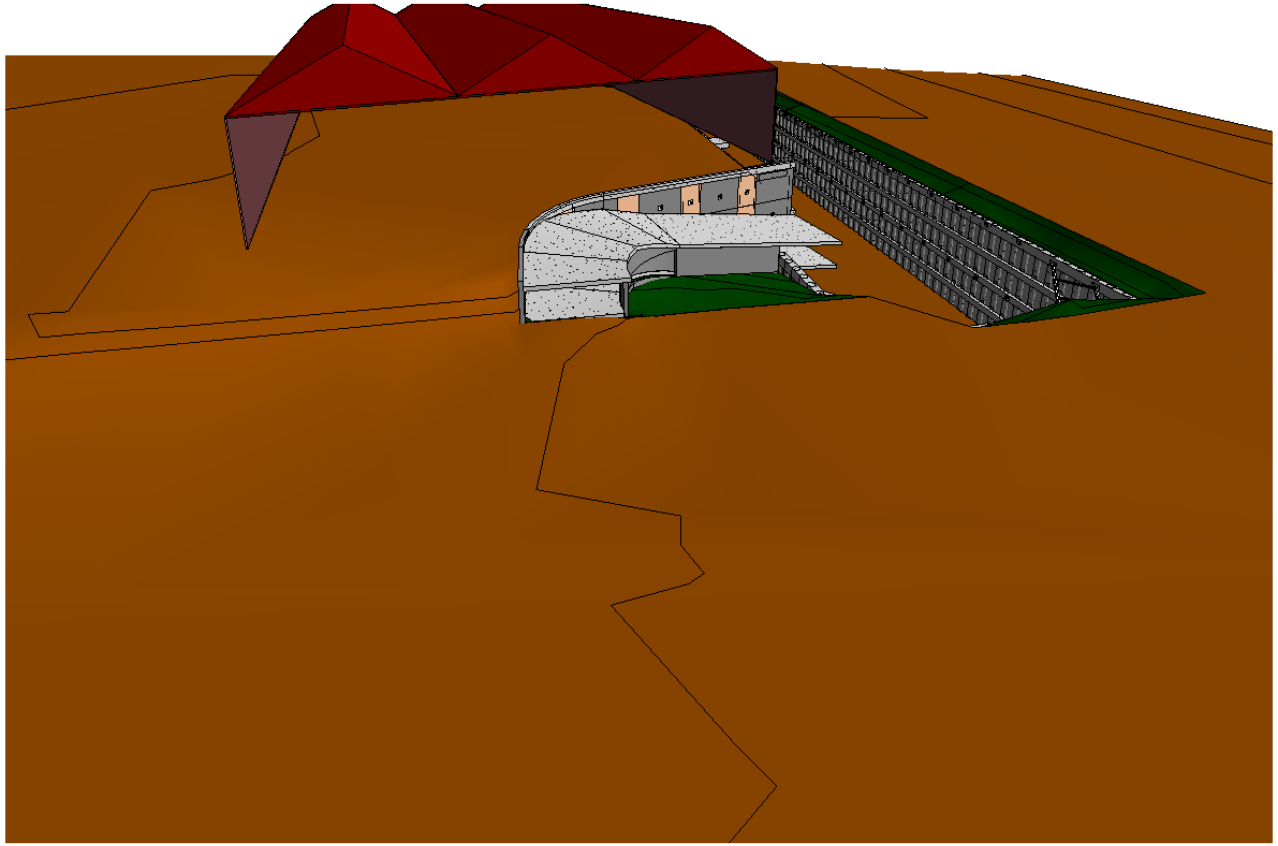


4 – Analysis and optimization

2 - Surfaces

- AutoCAD Civil 3D





+	-
Facilitated design changes	
Immediate quantity take off	
Compatibility and 3D clash check	Topography Modeling

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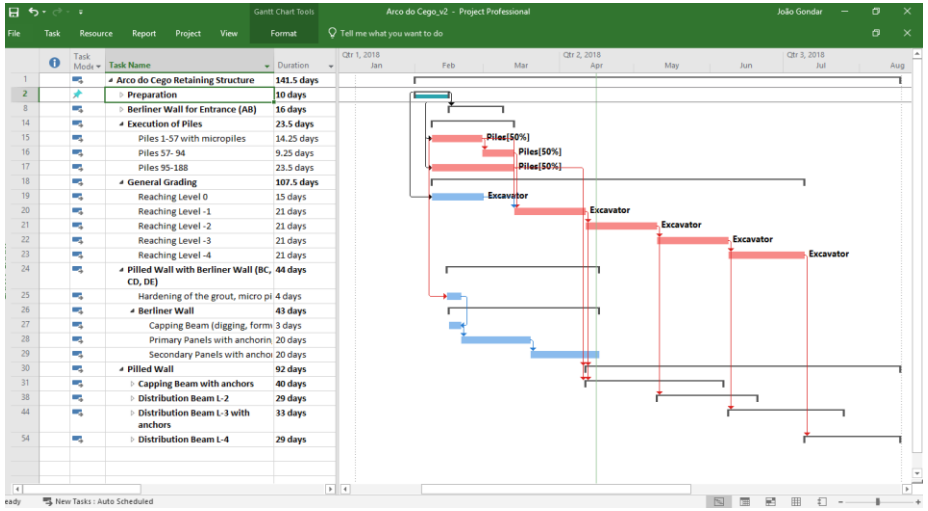
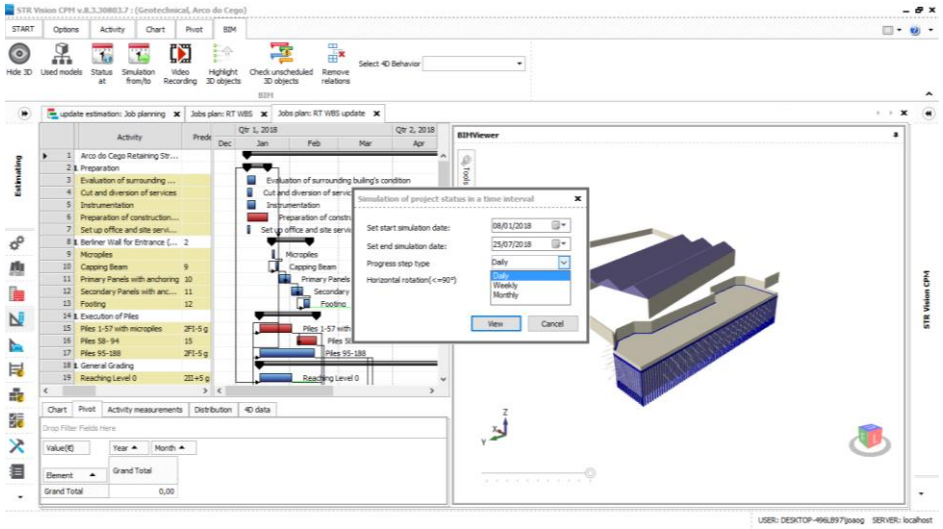
4D/BIM MODEL





Construction Planning

(MS Project)

Import

3D Model (IFC) + Planning (XML);

Link

3D elements with planning

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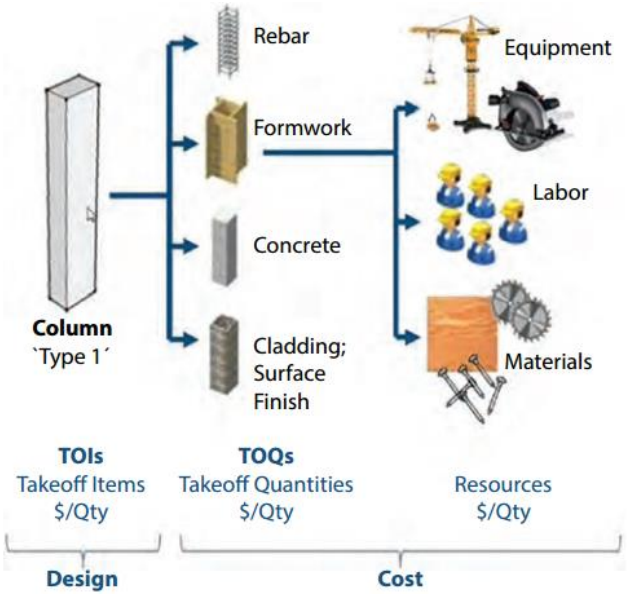
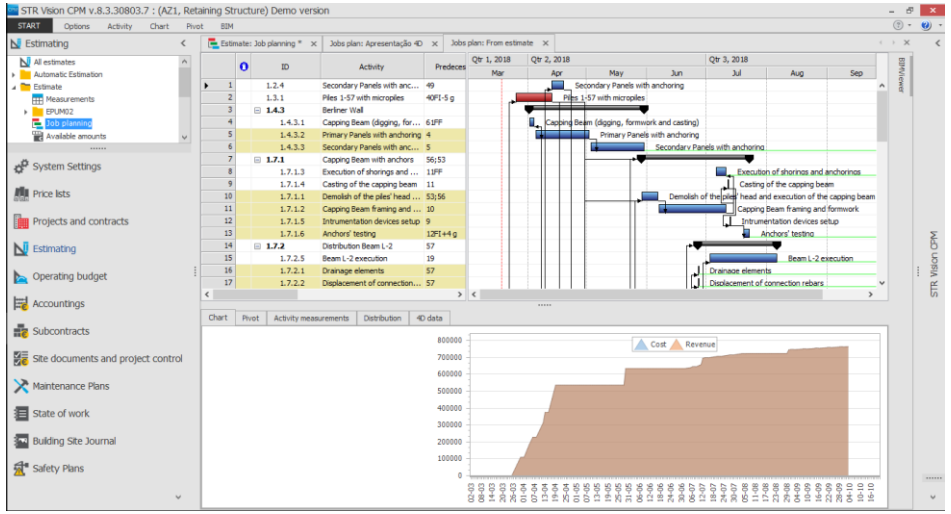
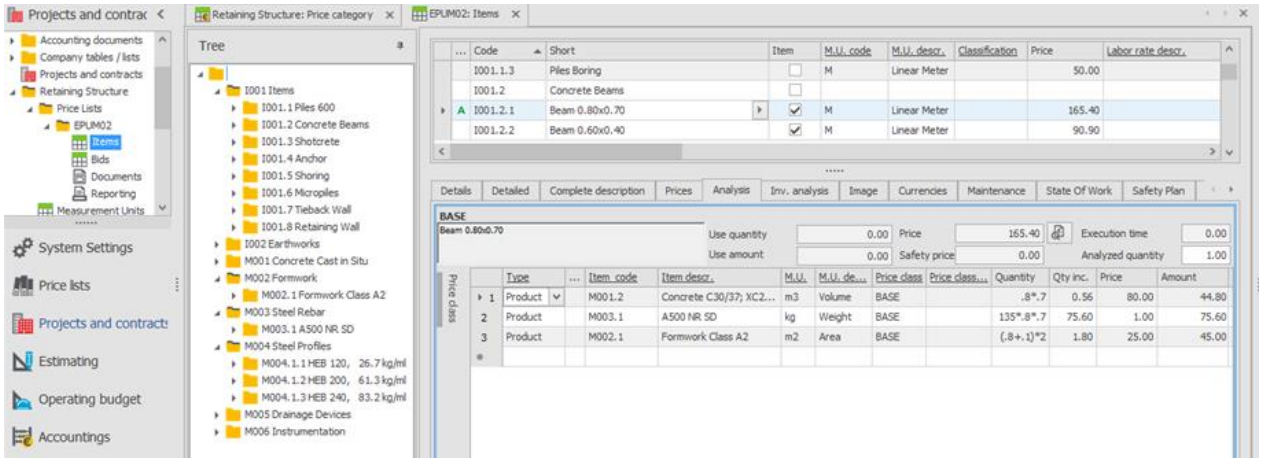
5D/BIM MODEL





- Unit prices;
  Price categories.
- Cost breakdown
- Work Breakdown Structure
- Measurement Rules

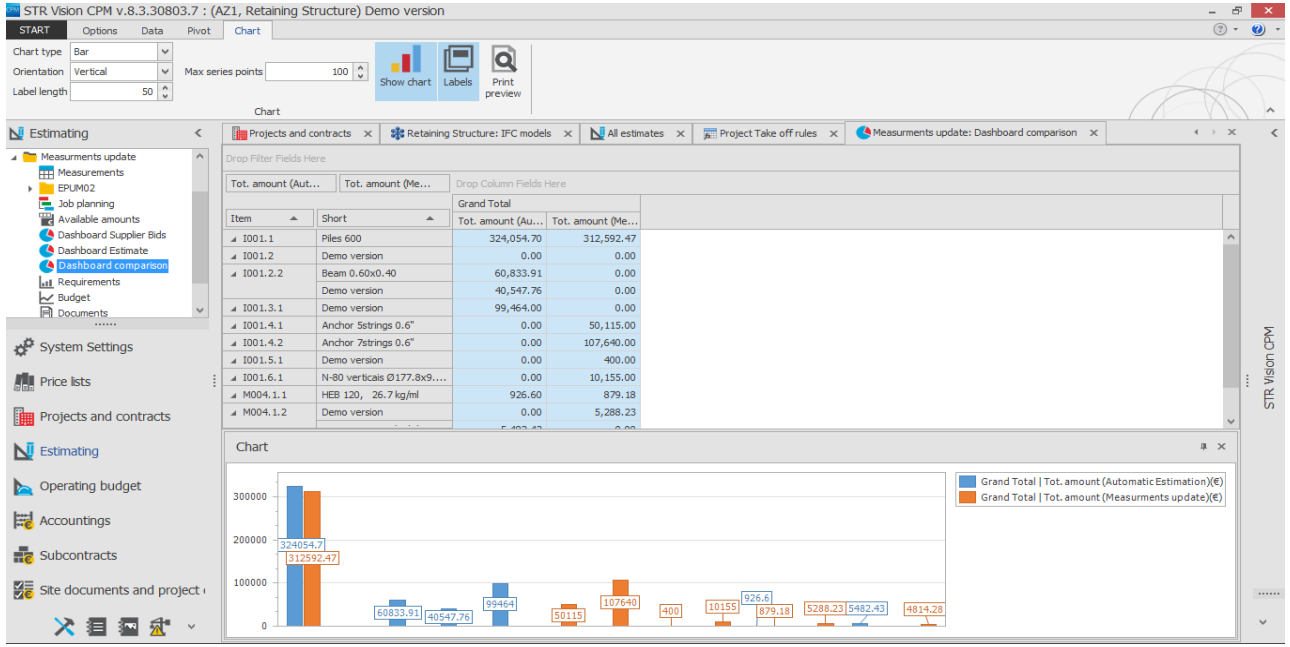


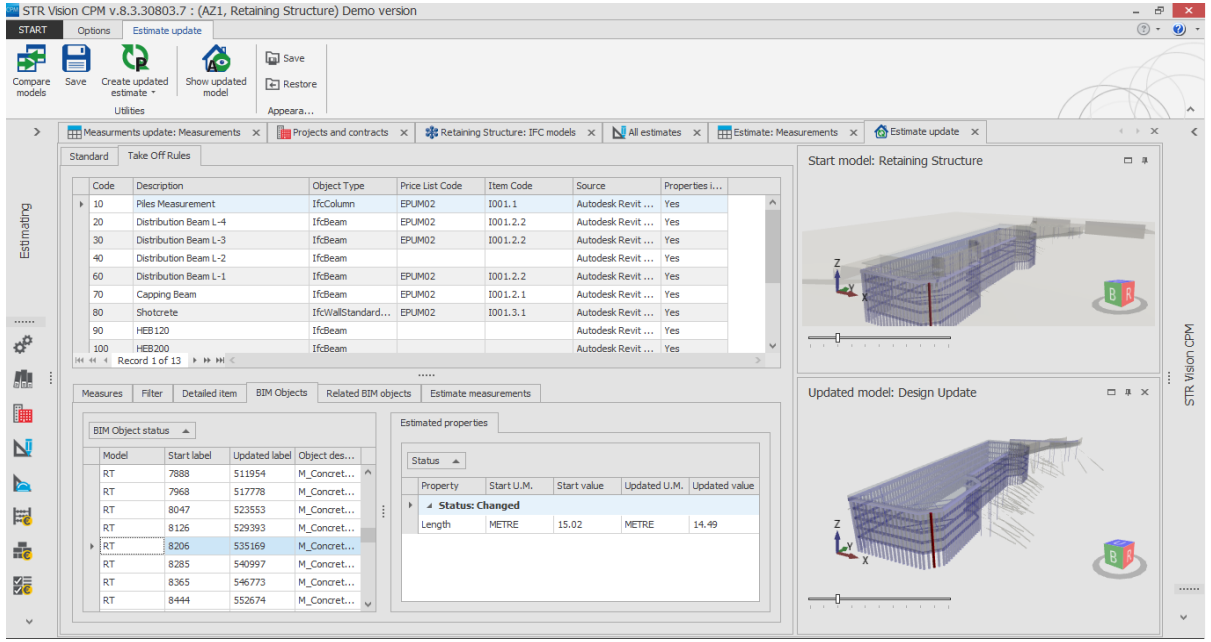
5D/BIM Model

5D/BIM MODEL

Available Tools:

- Price comparison between different design solutions;
- Constructive materials price analysis;
- Analyze different planning options;
- Procurement and bid selection support.



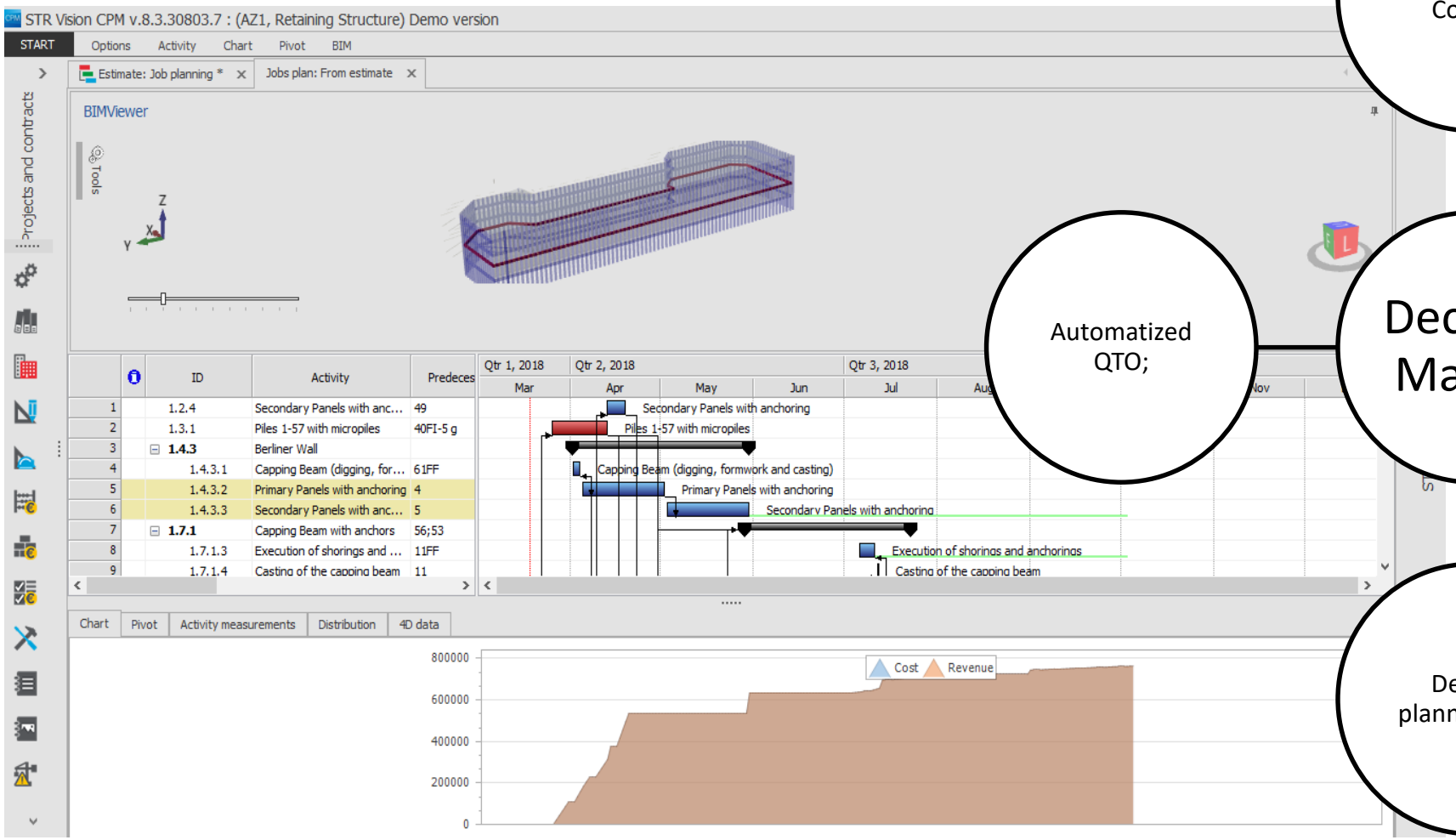


5D/BIM MODEL

Design

Planning

Budget



Operational Control

Automatized QTO;

Decision Making

Design/material price analysis

Design-planning-cost

- INTRODUCTION
- STUDY CASE
- 3/D BIM MODELING
- CONSTRUCTION MANAGEMENT BASED ON BIM
- **FINAL REMARKS**

FINAL REMARKS

Advantages for Geotechnical Engineering:

- 3D analysis;
- Collaboration;
- Optimized solutions;
- Decision-making;
- Reduced risk.

Challenges:

- Improve interoperability;
- Training + experience.

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THANK YOU FOR YOUR KIND ATTENTION

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