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University of Antwerp  
Faculty of Applied  
Engineering

# Sustainable and Resilient Infrastructure and Buildings

**1 February 2022 – 30 April 2022**

**15 March 2022**

**Lecture 6: BIM - the process of intelligent management of the project information**

# Introduction



Dr Eng. Mariusz Szóstak employed at the Faculty of Civil Engineering, at Wrocław University of Science and Technology (WUST), Poland.

MSc in Civil Engineering from WUST in 2013.  
PhD (Hons) in Civil Engineering in April 2018.

Author of more than 60 scientific papers, including papers on work safety in construction and articles in journals in the Journal Citation Reports database.

I developed several dozens of reviews of articles in journals from the JCR list such as: *Applied Sciences, Buildings, International Journal of Environmental Research and Public Health, Sustainability.*



# Introduction



**Deputy Head of the Department of Building Engineering,  
Faculty of Civil Engineering,  
Wroclaw University of Science and Technology (WUST).**

**Project Manager from the WUST of the project Erasmus+ Strategic Partnerships for vocational educational and training innovation “SafeCRobot Virtual Reality Immersive Safety Training Environment for Robotised and Automated Construction Sites” 2020-1-UK01-KA202-079176, 2020-2022**

**Guest Editor: Applied Sciences, Special Issue: Technology and Management Applied in Construction Engineering Projects**



# Introduction



## Scientific interest:

- **occupational Health and Safety;**
- **modeling of the development of accident situations in construction;**
- **analysis of the causes of occupational accidents at work in construction;**
- **management of construction projects;**
- **BIM technology.**



Wrocław University  
of Science and Technology



# BIM

## and what is this?



# BIM

(acronym)

BUILDING INFORMATION MODEL

BUILDING INFORMATION MODELLING

BUILDING INFORMATION MANAGEMENT



# BIM

(acronym)

## BUILDING INFORMATION MODEL

is the DIGITAL REPRESENTATION of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onwards.



# BIM

(acronym)

## BUILDING INFORMATION MODELLING

is a BUSINESS PROCESS for generating and leveraging building data to design, construct and operate the building during its lifecycle. BIM allows all stakeholders to have access to the same information at the same time through interoperability between technology platforms.





# BIM

(acronym)

## BUILDING INFORMATION MANAGEMENT

is the ORGANIZATION & CONTROL of the business process by utilizing the information in the digital prototype to effect the sharing of information over the entire lifecycle of an asset. The benefits include centralized and visual communication, early exploration of options, sustainability, efficient design, integration of disciplines, site control, as built documentation, etc. – effectively developing an asset lifecycle and model from conception to final retirement.

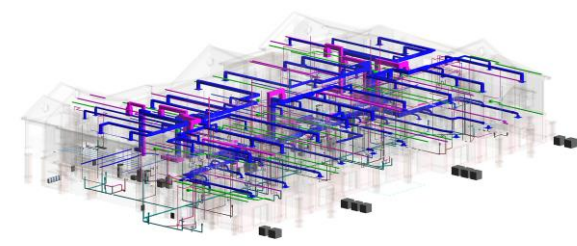
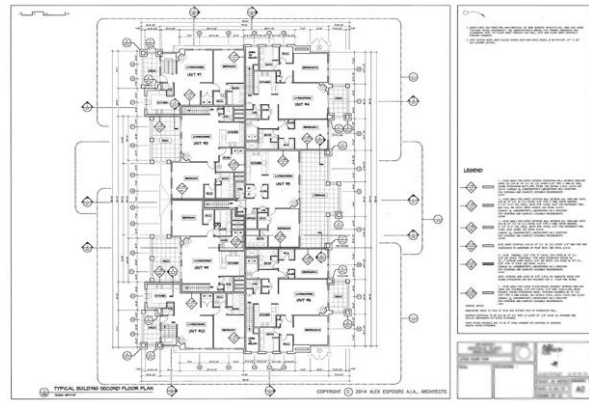
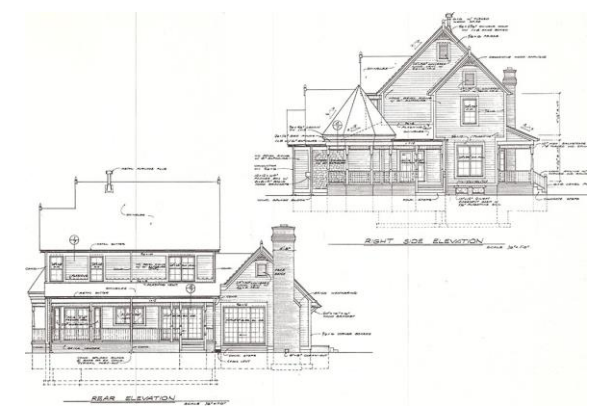


# What BIM is definitely not

- BIM is not a 3D model
- BIM is not ..... (*software name*)
- In BIM, everything is self-contained



# Levels of BIM Maturity



**Level 0 BIM**  
(low collaboration)

**Level 1 BIM**  
(partial collaboration,  
managed CAD,  
2D or 3D)

**Level 2 BIM**  
(full collaboration  
4D, 5D)

**Level 3 BIM**  
(full integration,  
3D, 4D, 5D, 6D, 7D, ...,  
nD)



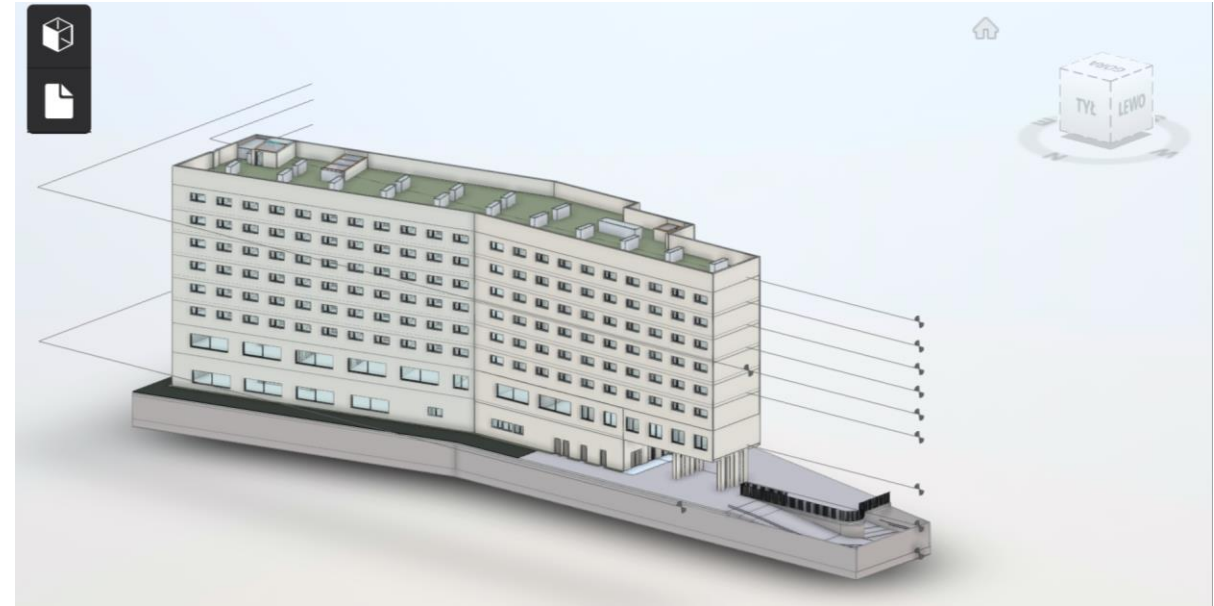
# Multidimensionality of BIM technology

## BIM Dimensions

3D	4D	5D	6D	7D
Geometry	Time	Money	Sustainability	Facility management
3-dimensional (x,y,z) geographical structure	Timeline Scheduling Duration	Cost Estimation Budget analysis	Self-sustainable and Energy Efficient	Facility Management Information



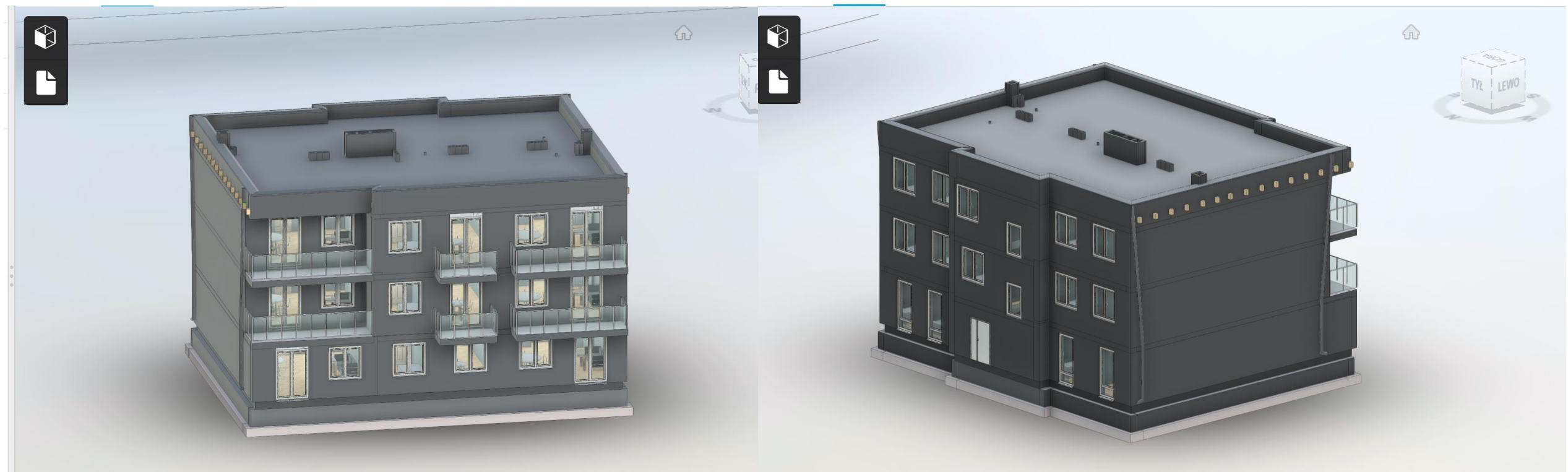
# BIM Dimensions 3D – Geometry



hotel building



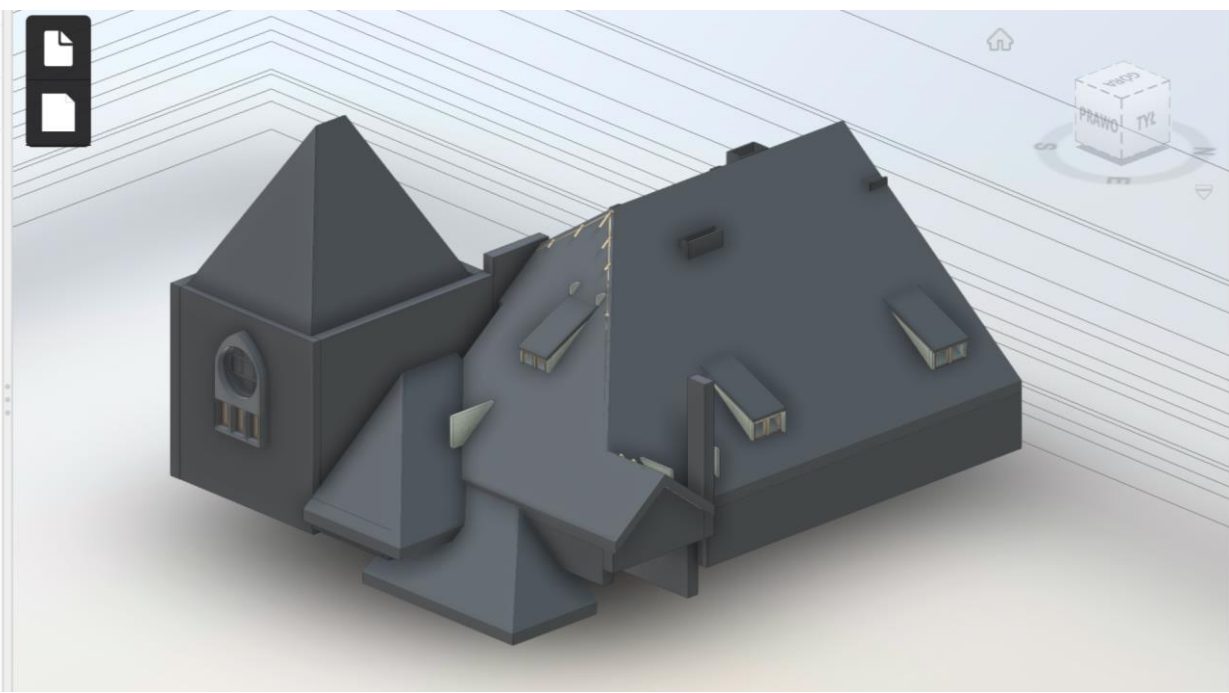
# BIM Dimensions 3D – Geometry



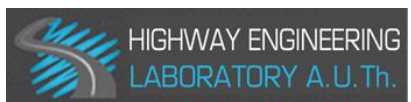
## Multi-family buidling



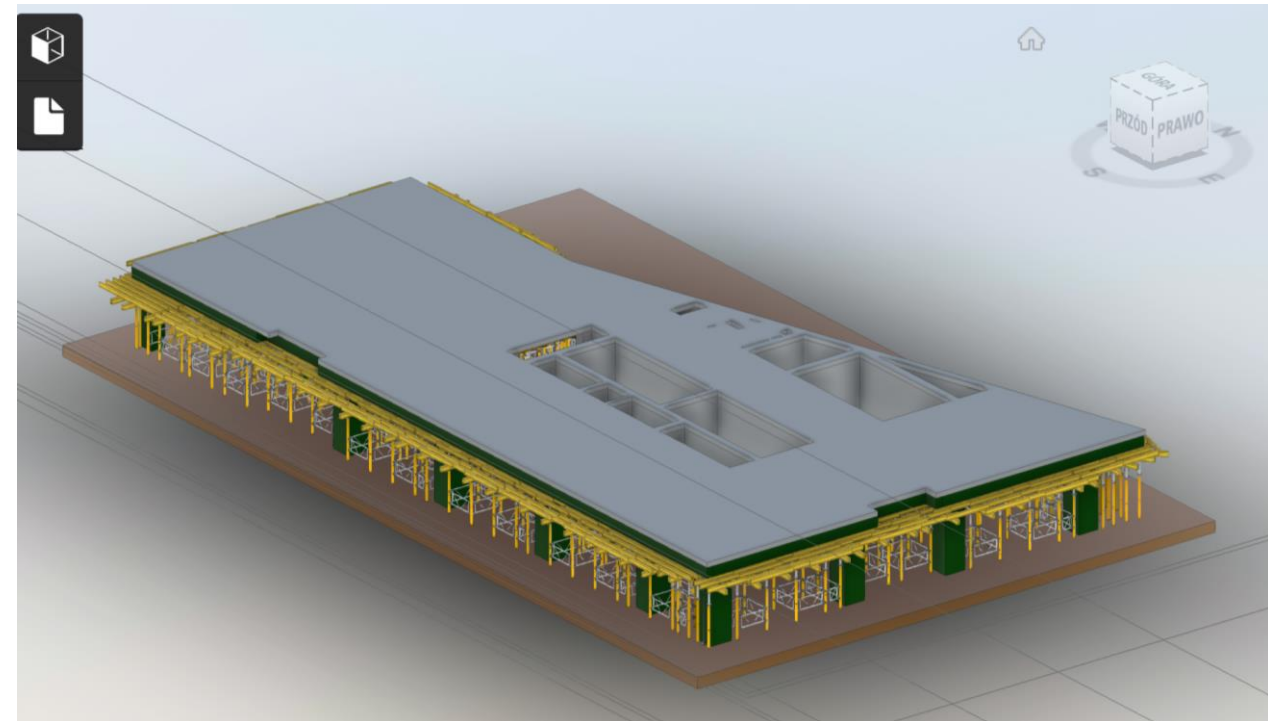
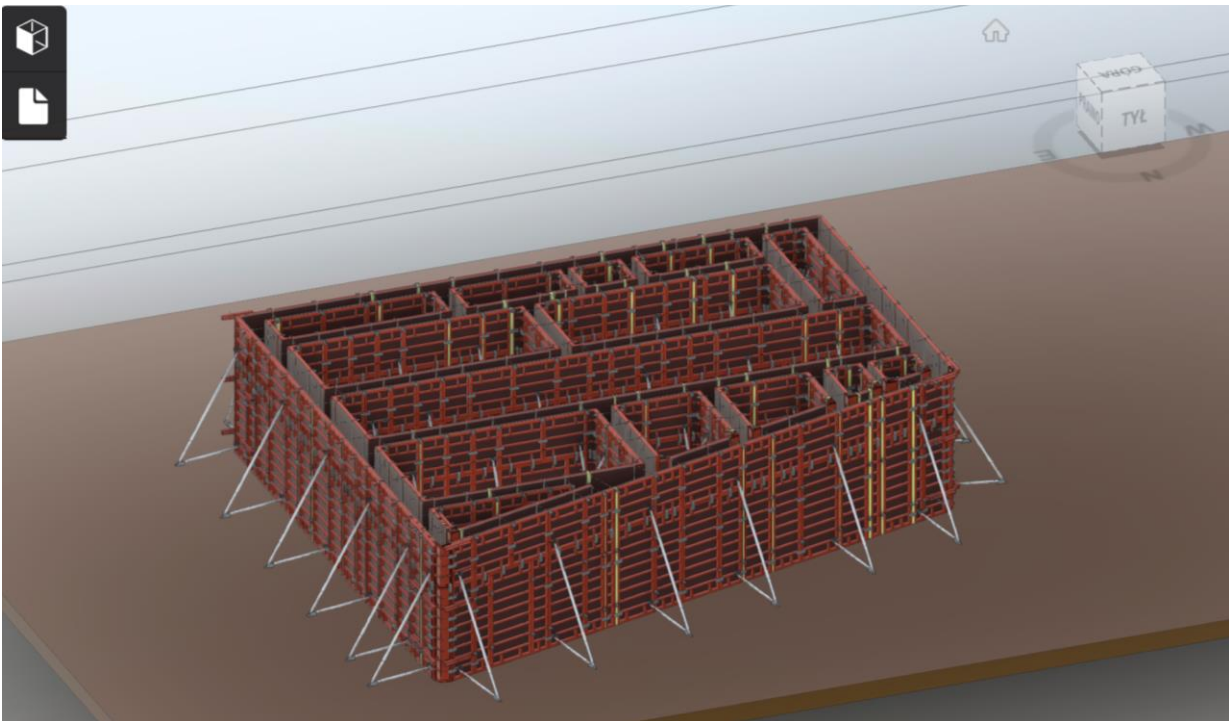
# BIM Dimensions 3D – Geometry



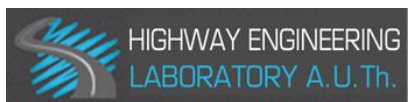
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# BIM Dimensions 3D – Geometry



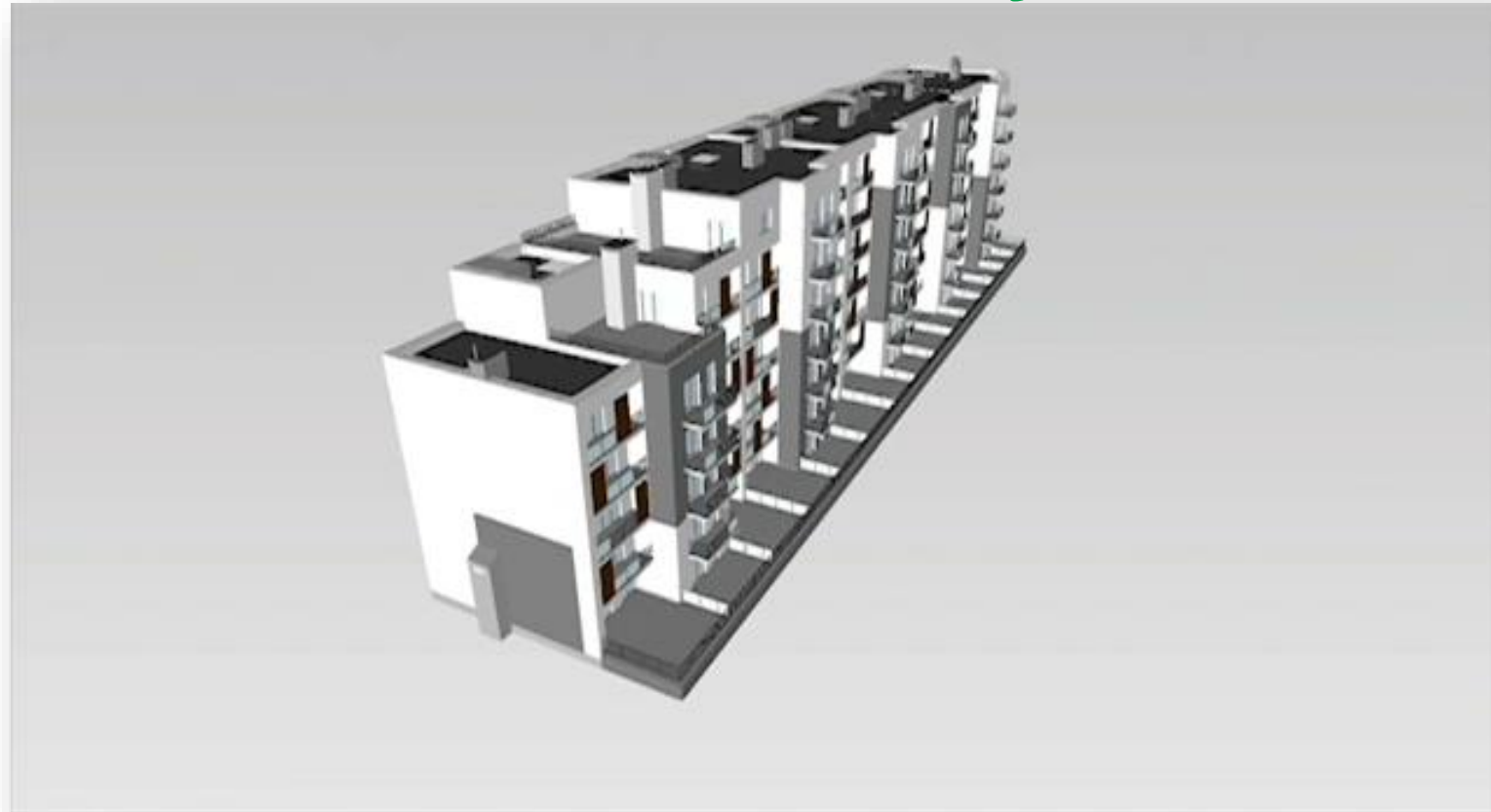
## formworks





# BIM Dimensions

## 3D – Geometry



# BIM Dimensions

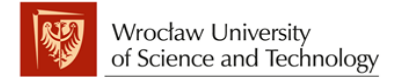
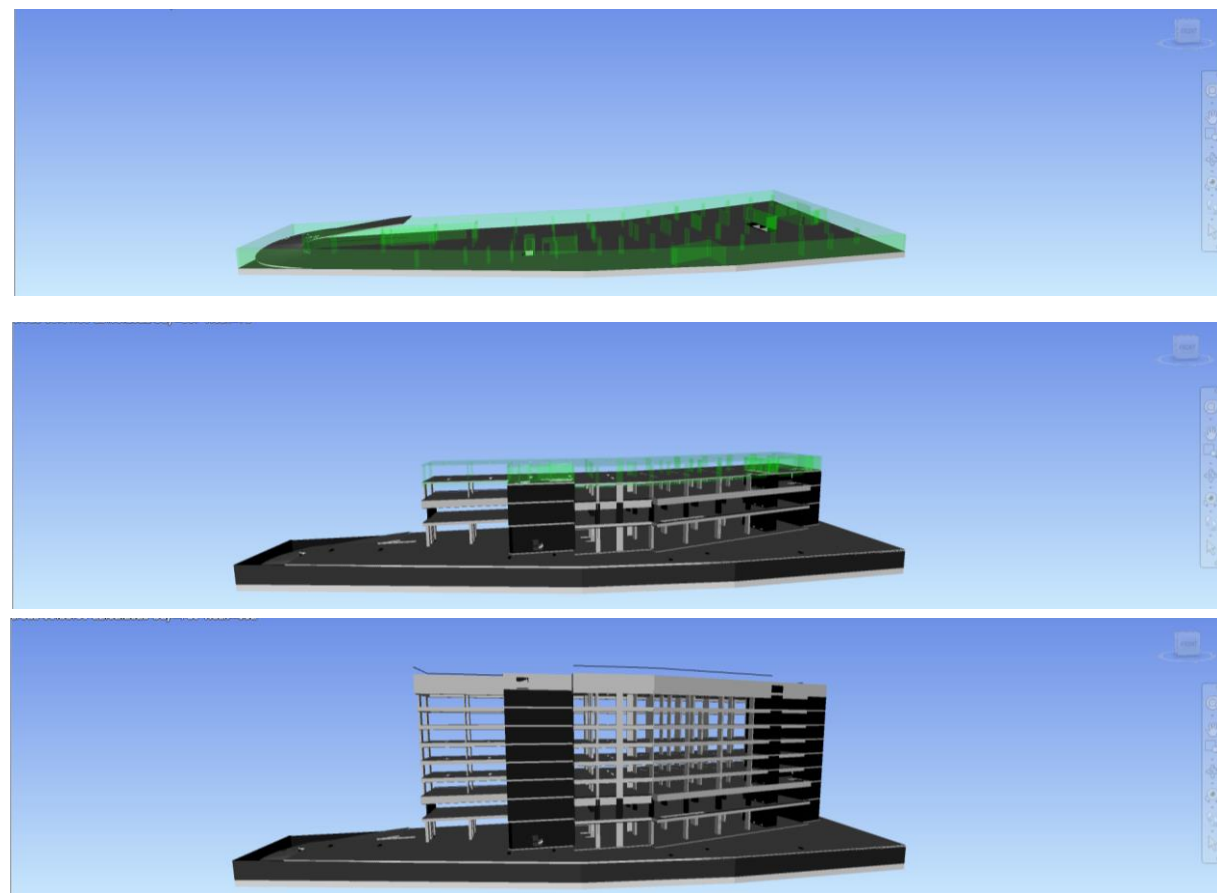
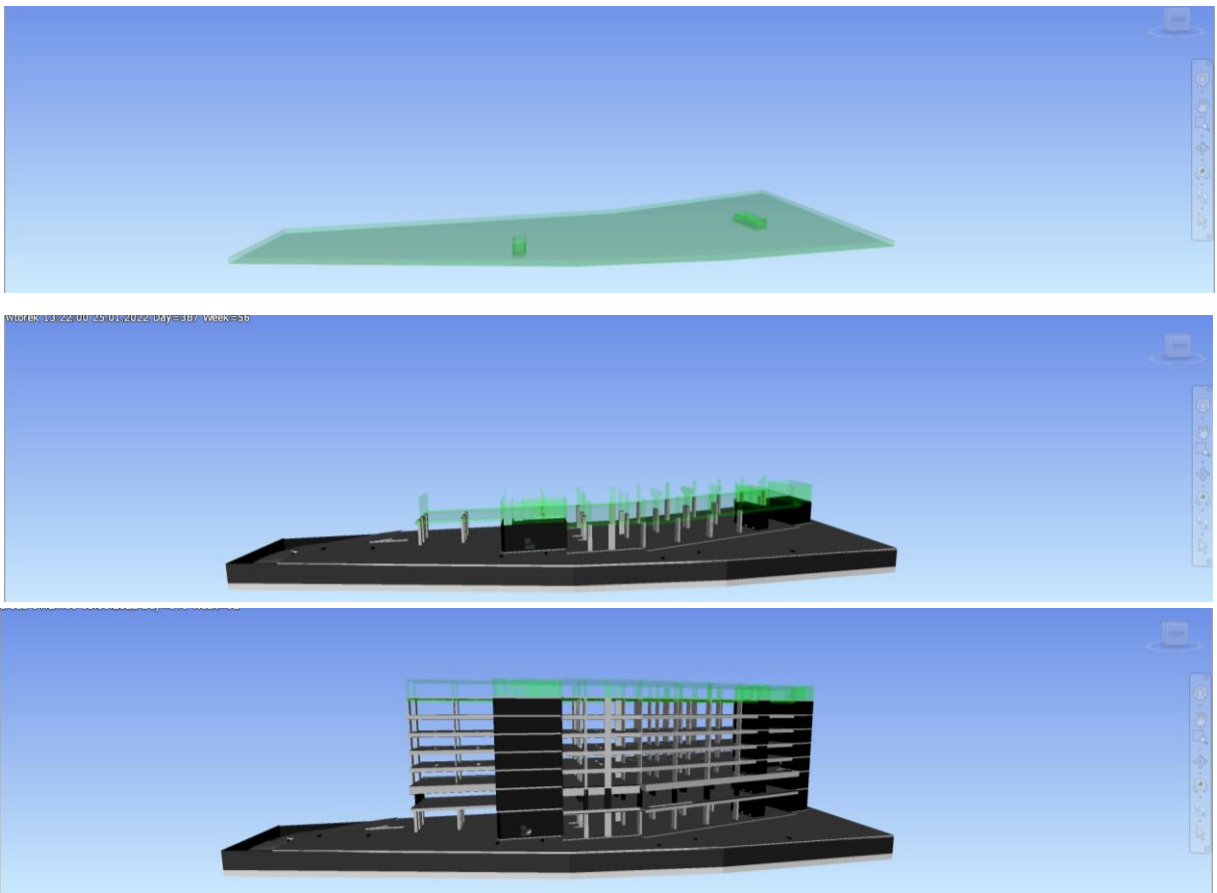
## 3D – Geometry

### Benefits of 3D BIM

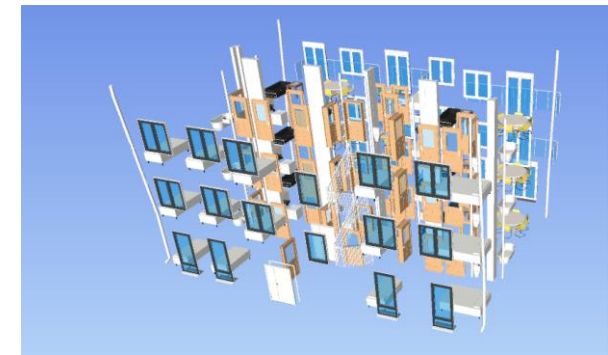
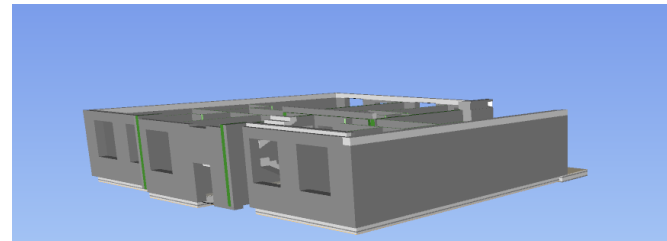
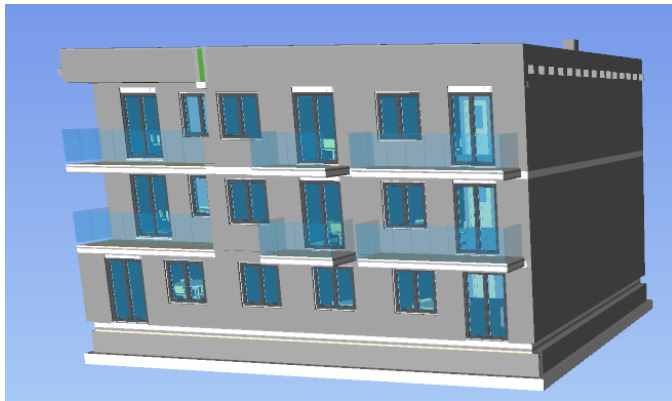
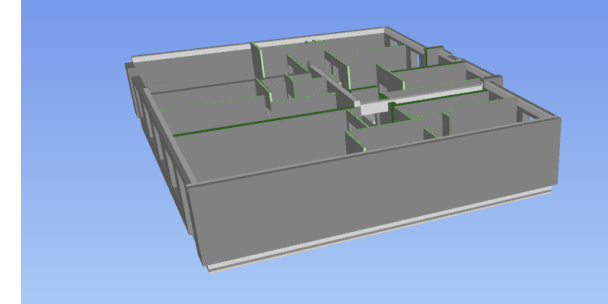
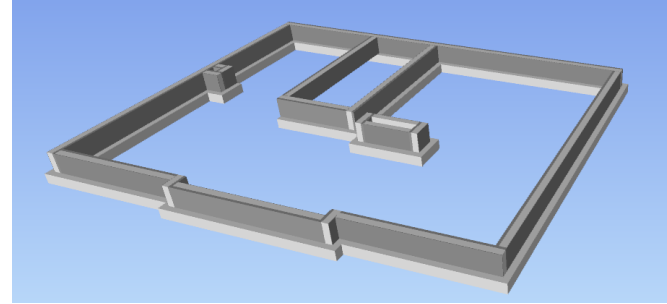
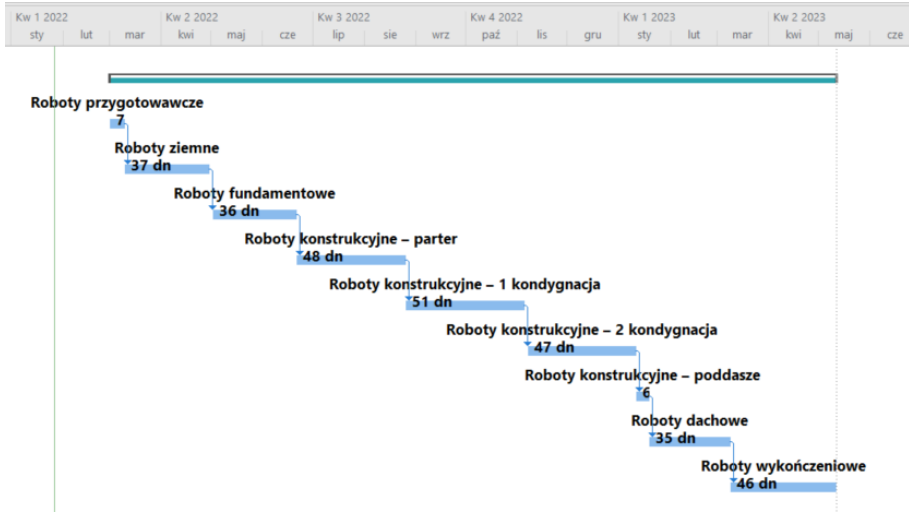
- Enhanced 3D visualization of the entire project
- Streamlined communication and sharing of design expectations
- Easy collaboration between multiple teams irrespective of their area of expertise
- Reduced instances of rework and revisions due to complete transparency from the beginning



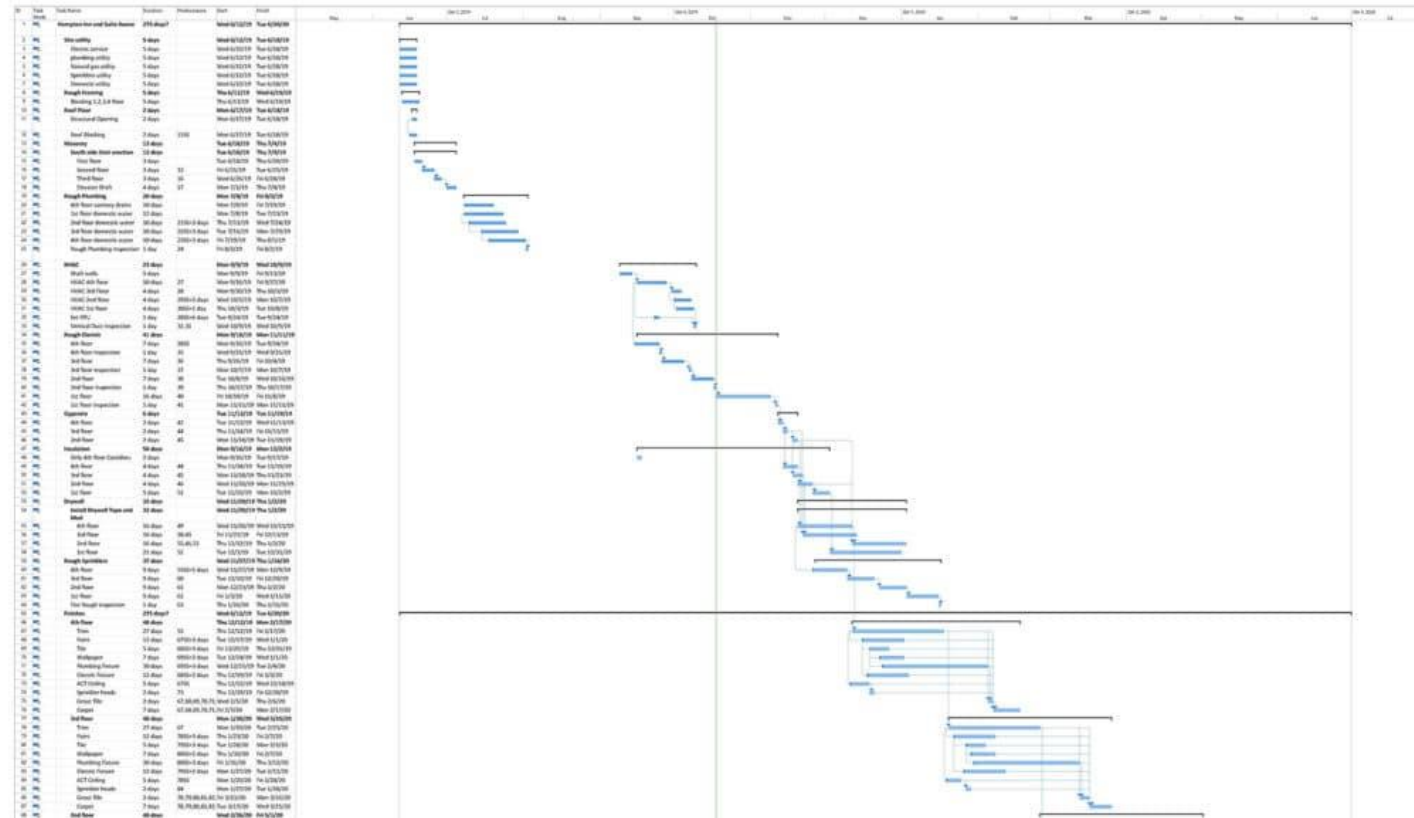
# BIM Dimensions 4D – Time



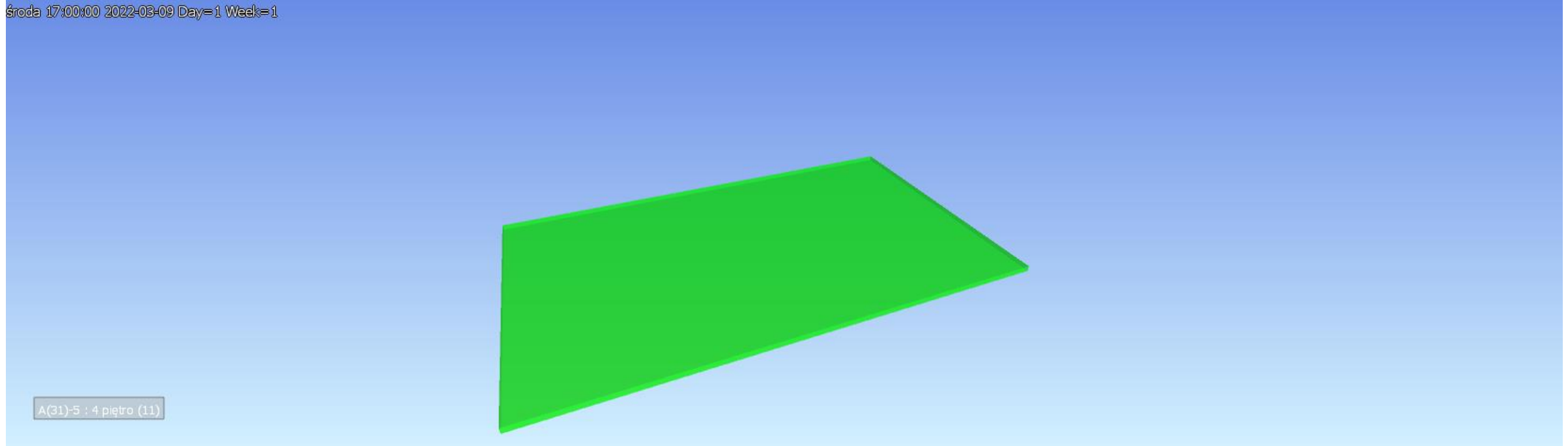
# BIM Dimensions 4D – Time



# BIM Dimensions 4D – Time



# BIM Dimensions 4D – Time



# BIM Dimensions 4D – Time

środa 17:00:00 2022-03-09 Day=1 Week=1



# BIM Dimensions

## 4D – Time

### Benefits of 4D BIM

- Improved site planning and scheduling optimization
- Seamless coordination among architects, contractors, and on-site teams
- Better preparedness in terms of next steps during every construction stage
- Enhanced information sharing related to timeline expectations helping to avoid costly delays
- Enhanced safety and efficiency due to documentation of an entire plan with specific timelines





# BIM Dimensions

## 5D – Money

The screenshot shows a BIM software interface with a 3D model of a building on the right and a data table on the left. The table lists various construction elements and their quantities.

Lp.	Model	Nr	Podstawa	Opis robót	J.m.	Ilość
1			Kosztorys	Obiekt hotelowy		
2	1		Rozdział	Roboty budowlane		
3	1.1		Lokalizacja	Warszawa ul. Suwak 7		
4	1.1.1		Grupa	Grupa		
5	1.1.1.1		Grupa	-1		
6	1.1.1.1.1		Element	Lawy i stopy	m2	
7	1.1.1.1.1.1	1		Płyta fundamentowa: Płyta fundamentowa 100 cm	m2	3 090,16
8	1.1.1.1.1.1	2		Płyta fundamentowa: Płyta fundamentowa 500mm	m2	37,17
11	1.1.1.1.1.2		Element	Ściany	m2	
12	1.1.1.1.2	1		Ściana podstawowa: Multiłp 5 7cm	m2	74,05
25	1.1.1.1.2	2		Ściana podstawowa: Multiłp 5 12cm	m2	58,66
33	1.1.1.1.2	3		Ściana podstawowa: Ściana gipsowo-kartonowa 12cm	m2	18,92
37	1.1.1.1.2	4		Ściana podstawowa: Ściana monolityczna 150mm	m2	45,63
45	1.1.1.1.2	5		Ściana podstawowa: Ściana monolityczna 150mm	m2	3,22
46	1.1.1.1.2	6		Ściana podstawowa: Ściana monolityczna 250mm	m2	1 234,05
74	1.1.1.1.2	7		Ściana podstawowa: Ściana monolityczna 700mm	m2	21,93

Rodos 7 - [kosztorys vol 1.4]

Numer pozycji	Podstawa	Opis	Jm	Ilość	Cena	Wartość	Suma r-g	Suma m-g	MS Project
<b>Kosztorys: kosztorys vol 1.4</b>						<b>23.221.300,53</b>			
<b>Roboty budowlane</b>						<b>23.221.300,53</b>			
<b>1. Przygotowanie placu budowy, roboty ziemne</b>						<b>443.263,79</b>			
1	KNR 2-25 0102/01	Montaż obiektów kontenerowych	kontener	10	215,18	2 151,80	16,3	8,1	
2	KNR 2-25 0102/02	Demontaż obiektów kontenerowych	kontener	10	73,47	734,70	6,5	4,6	
3	KNR 2-02 1804/03	Ogrodnienie z siatki o wysokości 1,5m na słupkach żelbetonowych 18x12x350cm obsadzonych w gruncie	m	340	125,29	42 598,60	569 636	1 768	
4	KNR 2-02 1808/02	Typowe wrota o szerokości 3m (na gotowych słupkach) z furkami o szerokości 1m z siatki w ramach z kątowników, bez pasa dolnego, o wysokości 1,5m	kpl	2	1 548,04	3 097,28	24,16	0,04	
5	KNR 2-01 0126/01	Usunięcie warstwy ziemi urodzajnej o grubości do 15cm za pomocą spycharki	m2	3 090,16	0,58	1 823,19	16 378	7 725	
6	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
7	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
8	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
9	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
10	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
11	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
12	KNR 2-01 0126/02	Usunięcie warstwy ziemi urodzajnej za pomocą spycharki - dodatek za każde dalsze 5cm grubości humusu (ponad 15cm)	m2	3 090,16	0,19	587,13	5,562	2,472	
13	KNR 2-01 0207/05.3	Roboty ziemne w gruncie kategorii II wykonywane koparkami podsiębiernymi o pojemności łyżki 2,50m3 z transportem urobku samochodami samowyładowczymi 15-20t na odległość do 1,0km	m3	13 442,196	12,97	174 345,28	1 172,159	892,561	
14	KNR 2-01 0214/01.4	Nakłady uzupełniające do tablic 0201-0213 za każde dalsze rozpoczęcie 0,2km odległości transportu gruntu kategori I i II samochodami samowyładowczymi 15-20t na odległość ponad 1km po terenie lub drogach gruntowych	m3	13 442,196	15,95	214 403,03	564,572	1 169,471	
<b>-1</b>						<b>6.368.286,33</b>			
<b>Lawy i stopy</b>						<b>3.241.328,58</b>			
15	KNR-W 2-02 0205/01.2	Płyty fundamentowe żelbetowe z układaniem betonu z zastosowaniem pomp	m3	3 090,16	473,39	1 462 850,84	1 390,572	216,312	
16	KNRKB 2 0210/02	Zręcznie żelbetonowych elementów budynków i budowli prętami stalowymi okrągłymi zebraowanymi	t	328,34	5 362,16	1 760 611,61	14 079,219	5 680,282	

# BIM Dimensions 5D – Money

Panel nawigacyjny - Działy

- 3. Oczyszczenie terenu z po...
- 4. Ogrodzenie z siatki wysok...
- 2. ROBOTY ZIEMNE
  - 5. Usunięcie warstwy ziemi u...
  - 6. Pomary przy wykopach i...
  - 7. Roboty ziemne wykonyw...
  - 8. Wykopy oraz przekopy w...
- 3. ROBOTY FUNDAMENTO...
  - 9. Stopy fundamentowe bet...
  - 10. Ławy fundamentowe be...
  - 11. System na styropianie (...)
  - 12. Przygotowanie i montaż...
- 4. ROBOTY KONSTRUKCY...
  - 4.1. Parter
    - 4.1.1. Strop parteru
      - 13. Tynki elewacyjne m...
      - 14. Izolacja z płyt lub m...
      - 15. Nadbeton stropu FL...
      - 16. Izolacja ciepła z pl...
      - 17. Zakładanie hydroizo...
      - 18. Gładź cementowa
      - 19. Podłogi drewniane z...
    - 4.1.2. Ściany
      - 20. Ściany nośne zewnętrzne...
      - 21. System na styropia...
      - 22. Tynki wewnętrzne c...
      - 23. Ściany nośne wew...
      - 24. Tynki wewnętrzne c...
      - 25. Ścanki działowe z bl...
      - 26. Tynki wewnętrzne c...

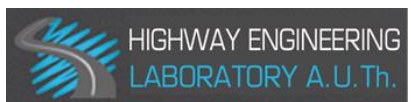
Lp.	Podstawa	Struktura	Lista	Notatki	Obmiar	
224.		Drzewo	Typy	Systemy	Worstwy	Klasyfikacje
4.1.2	Sca					
20 KNR K-02	Sca					
d.4.1.2.0103-06						
115.						
21 KNR AT-38	Syst					
d.4.1.2.0601-01						
115.						
22 KNR 13-12	Tynk					
d.4.1.2.0801-01						
115.						
23 KNR K-02	Sca					
d.4.1.2.0103-09						
43,8						
24 KNR 13-12	Tynk					
d.4.1.2.0801-01						
43,8						
25 KNR K-02	Sca					
d.4.1.2.0105-01						
158,54						
26 KNR 13-12	Tynk					
d.4.1.2.0801-01						
158,54						

PROJEKT POMIAR

Przełącz widok: Powierzchnia, Precyzja (3)

Nazwa	Obmiar
Ściany	Powierzchnia
0_Silka 8 + tynk	158,545 m2
K_Silka 24 + Styropian + tynk	115,673 m2
Ściana podstawowa:K_Silka 2...	17,326 m2
Ściana podstawowa:K_Silka 2...	9,106 m2
Ściana podstawowa:K_Silka 2...	10,849 m2
Ściana podstawowa:K_Silka 2...	33,925 m2
Ściana podstawowa:K_Silka 2...	8,706 m2
Ściana podstawowa:K_Silka 2...	2,736 m2

Właściwości	Wymiary	Materiały	Klasyfikacja	Lokalizacja	Wartość	Wartość
Powierzchnia					115,673 m2	
Objętość					40,670 m3	
Długość					55,450 m	
Grubość					0,360 m	
Liczba					7 szt	
Powierzchnia2					96,688 m2	
Długość2					46,940 m	



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# BIM Dimensions

## 5D – Money

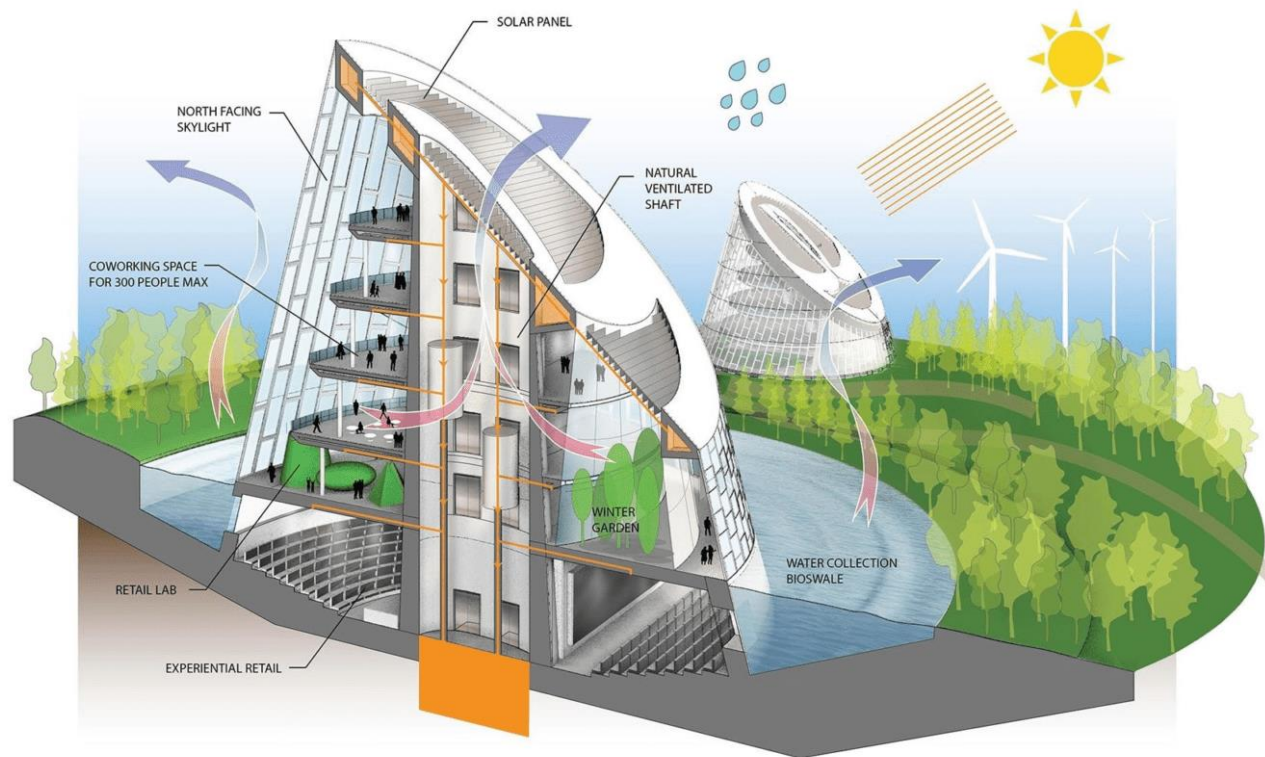
### Benefits of 5D BIM

- Real-time cost visualization with notification on changes in costs
- Automatic count for components/system/equipment associated with a project
- Simplified cost analysis and budgetary analysis with predicted and actual spends over time
- Minimization of budgetary overshoot due to regular cost reporting and budgeting



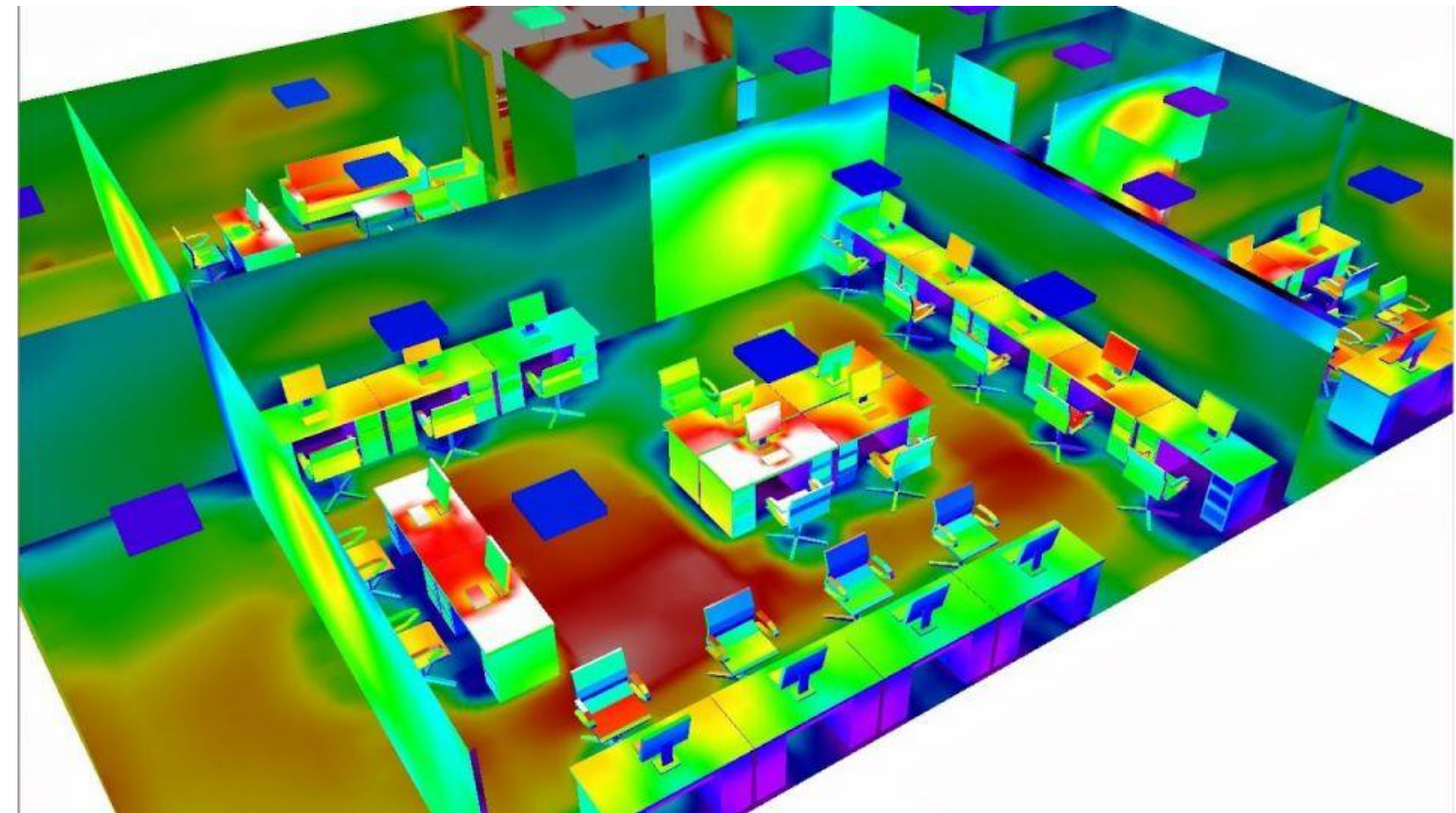
# BIM Dimensions

## 6D – Sustainability

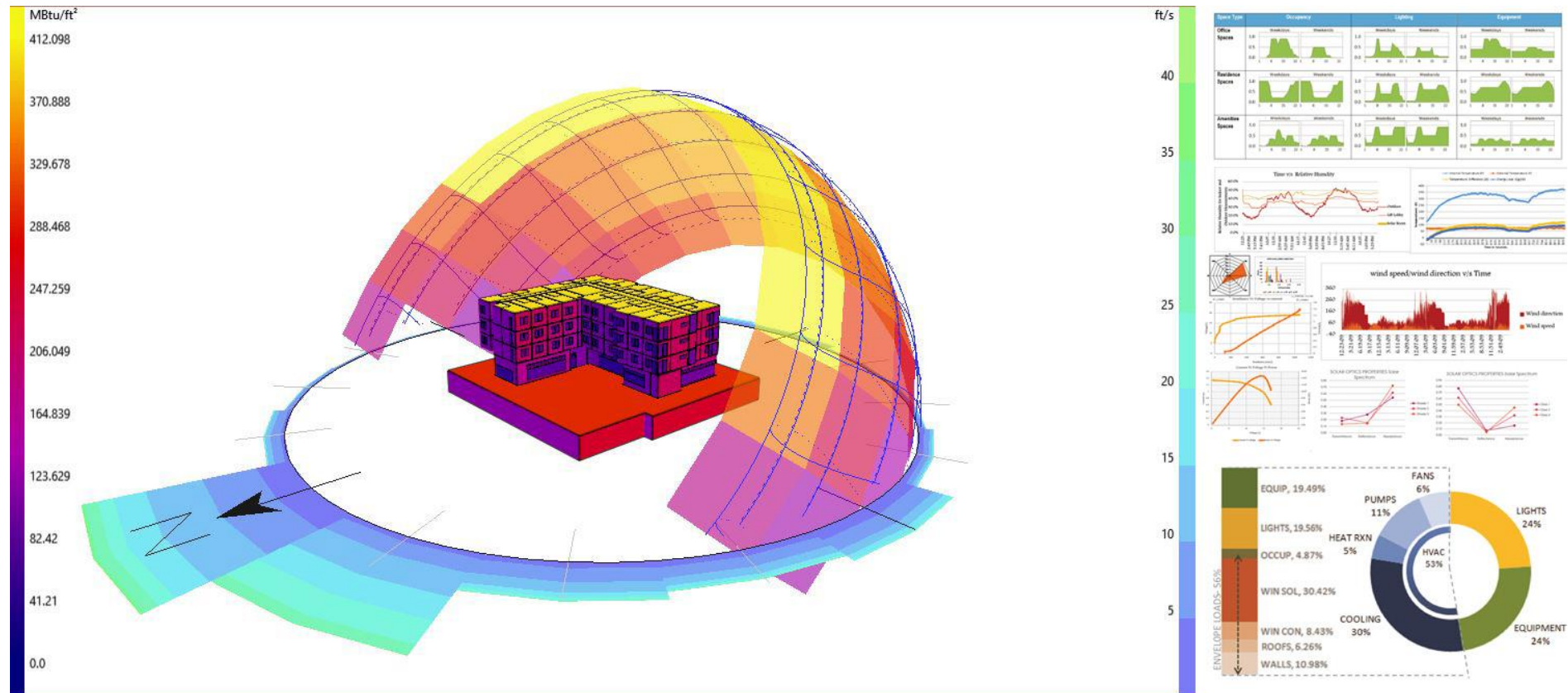


# BIM Dimensions

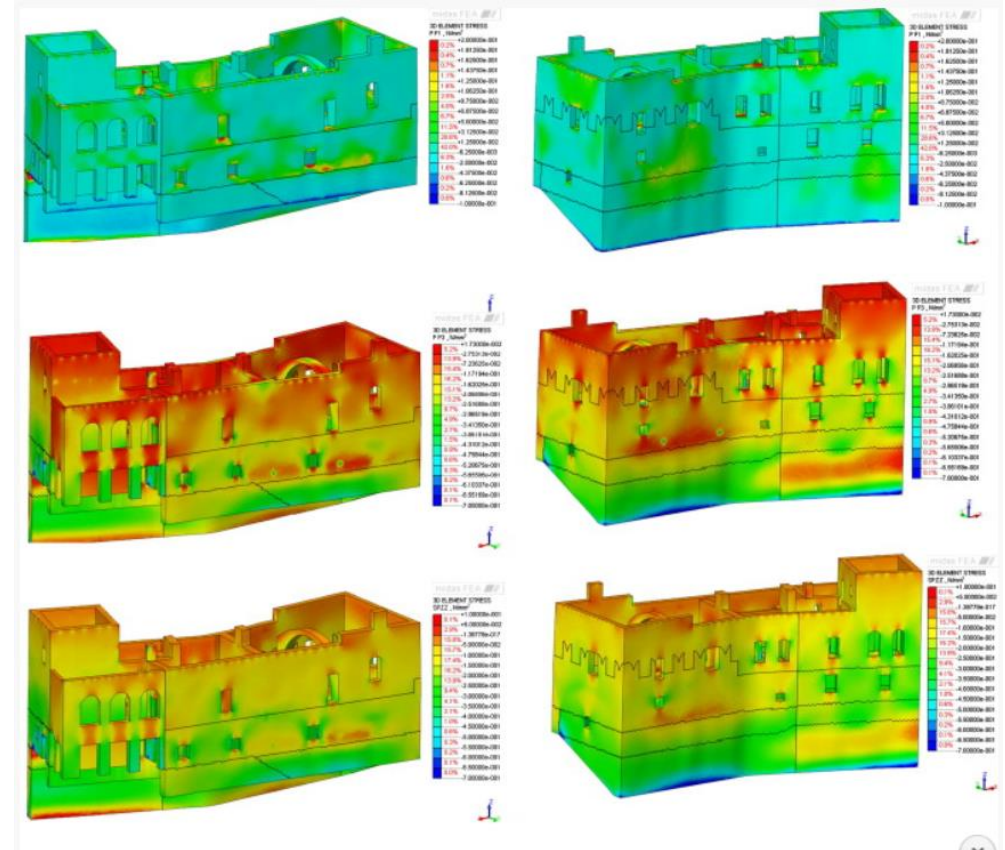
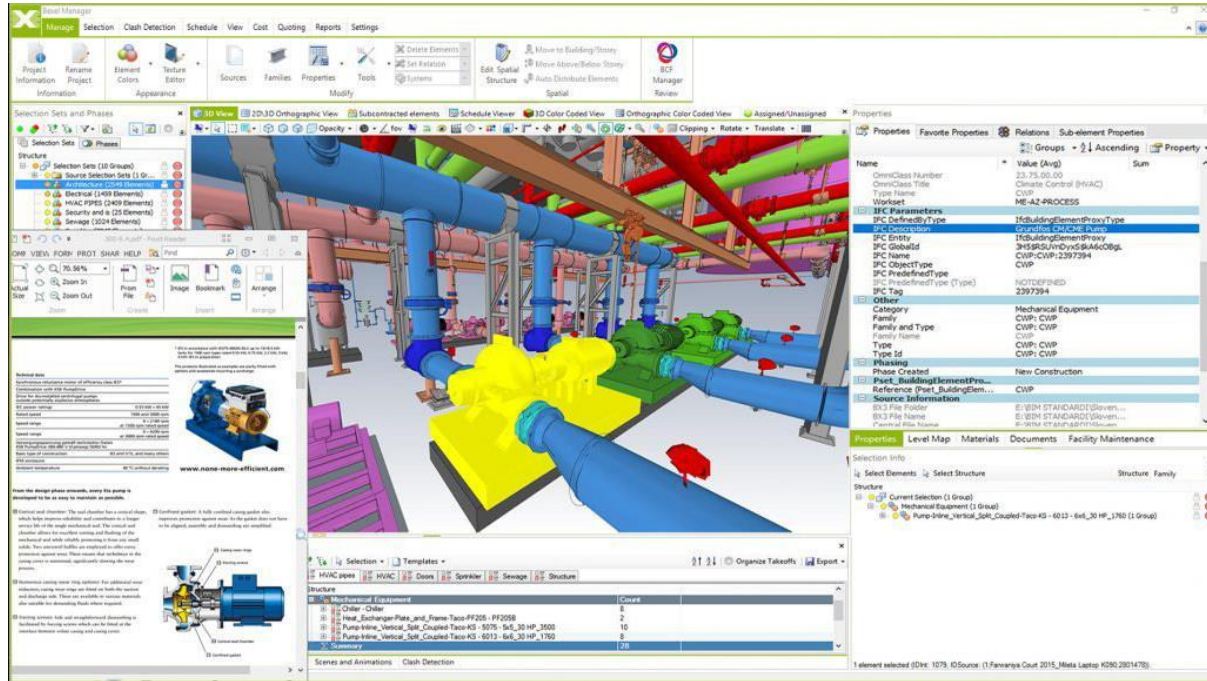
## 6D – Sustainability



# BIM Dimensions 6D – Sustainability



# BIM Dimensions 6D – Sustainability



# BIM Dimensions

## 6D – Sustainability

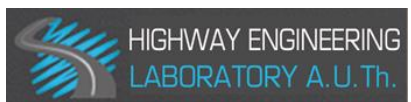
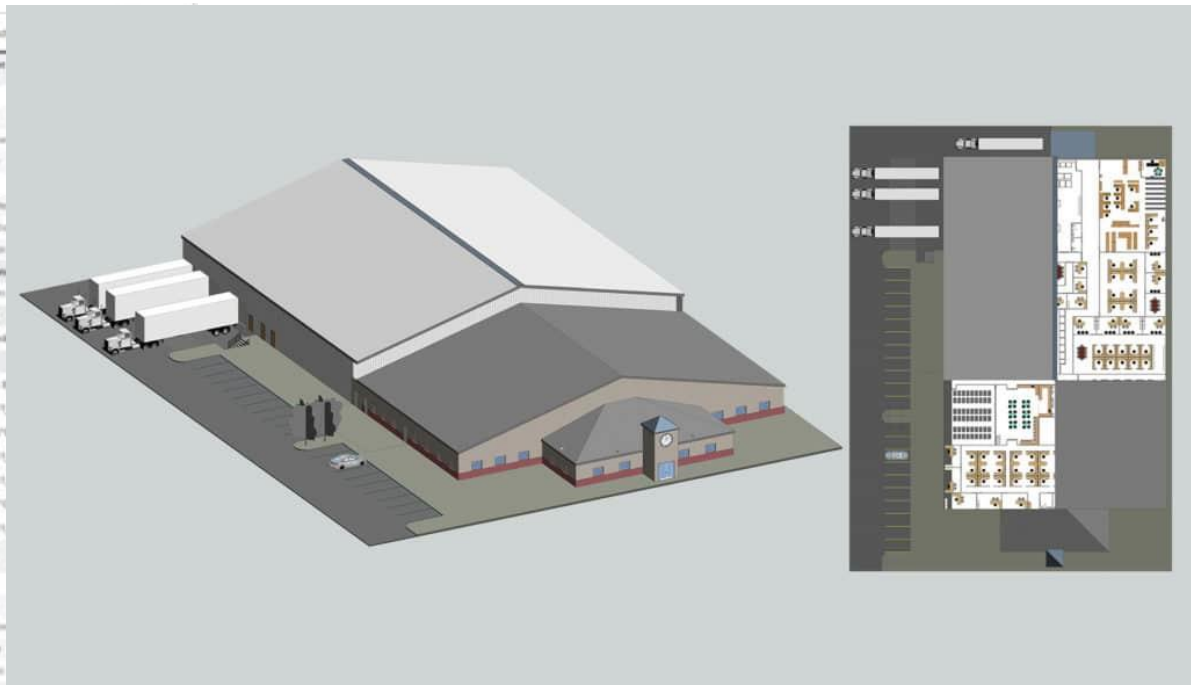
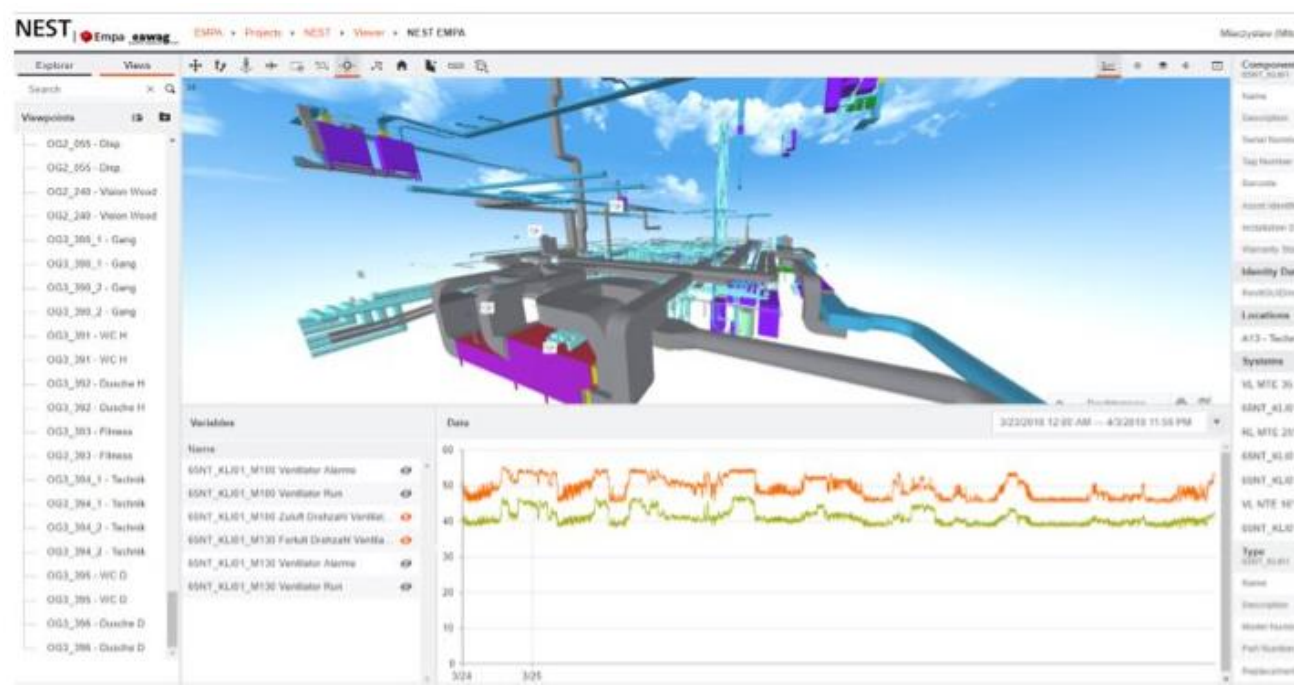
### Benefits of 6D BIM

- Reduced energy consumption in the long run
- Faster and more accurate decision making related to component installation during the design process
- Detailed analysis and impact of a decision on economic and operational aspects over the entire lifecycle
- Better operational management of the building or structure after handover

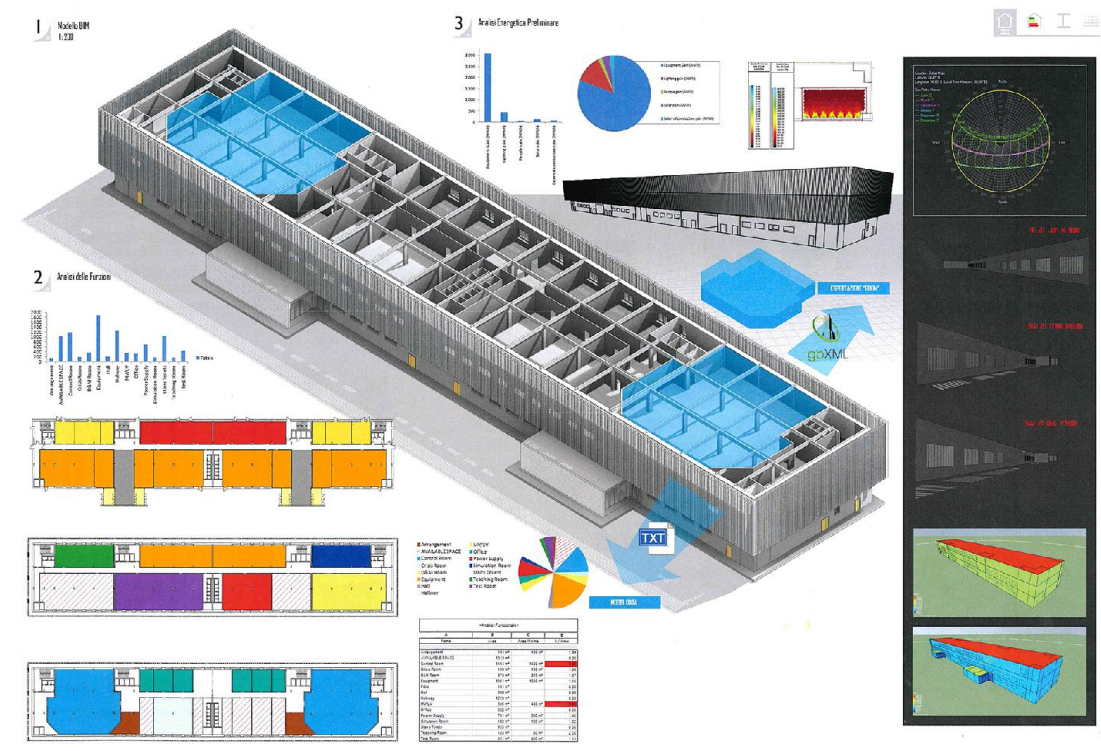
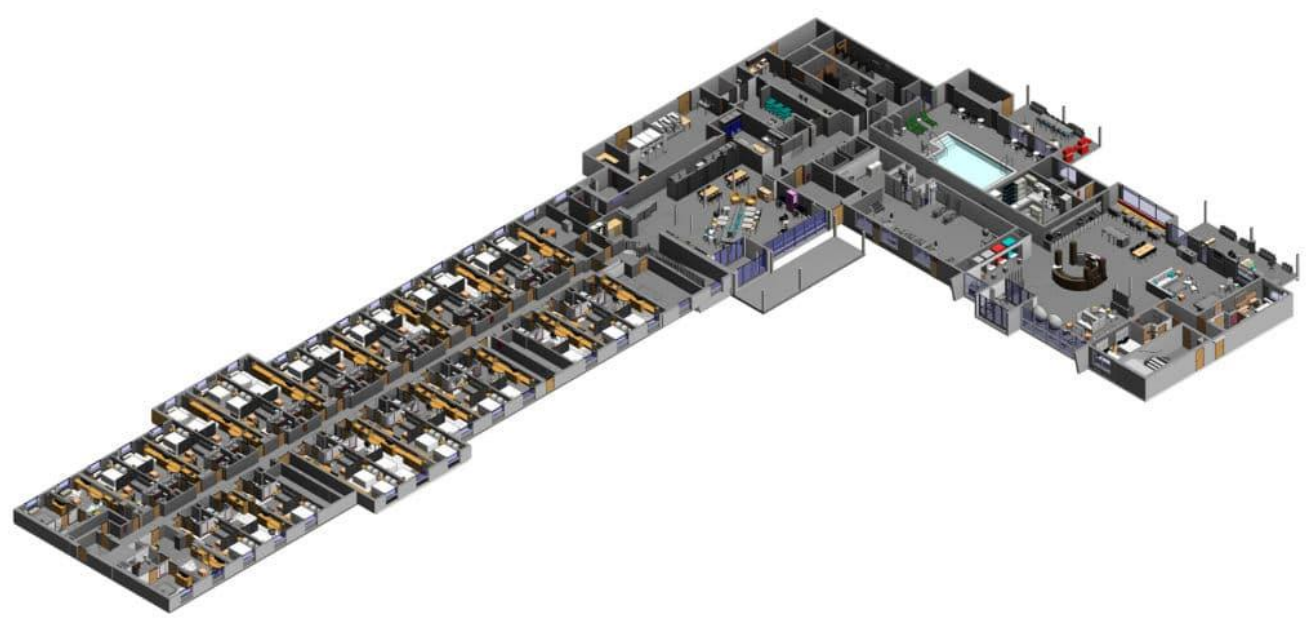




# BIM Dimensions 7D – Facility Management



# BIM Dimensions 7D – Facility Management



# BIM Dimensions

## 7D – Facility Management

### Benefits of 7D BIM

- Optimized asset and facility management from design stage to demolition
- Simplified and easy replacement of parts and repairs anytime during the entire life of a building
- Streamlined maintenance process for contractors and subcontractors



# Efficient exchange of information

- during the design process, information should be introduced into the model only when it is necessary for the further design process,
- information should be taken from the model in a rational and legible manner.

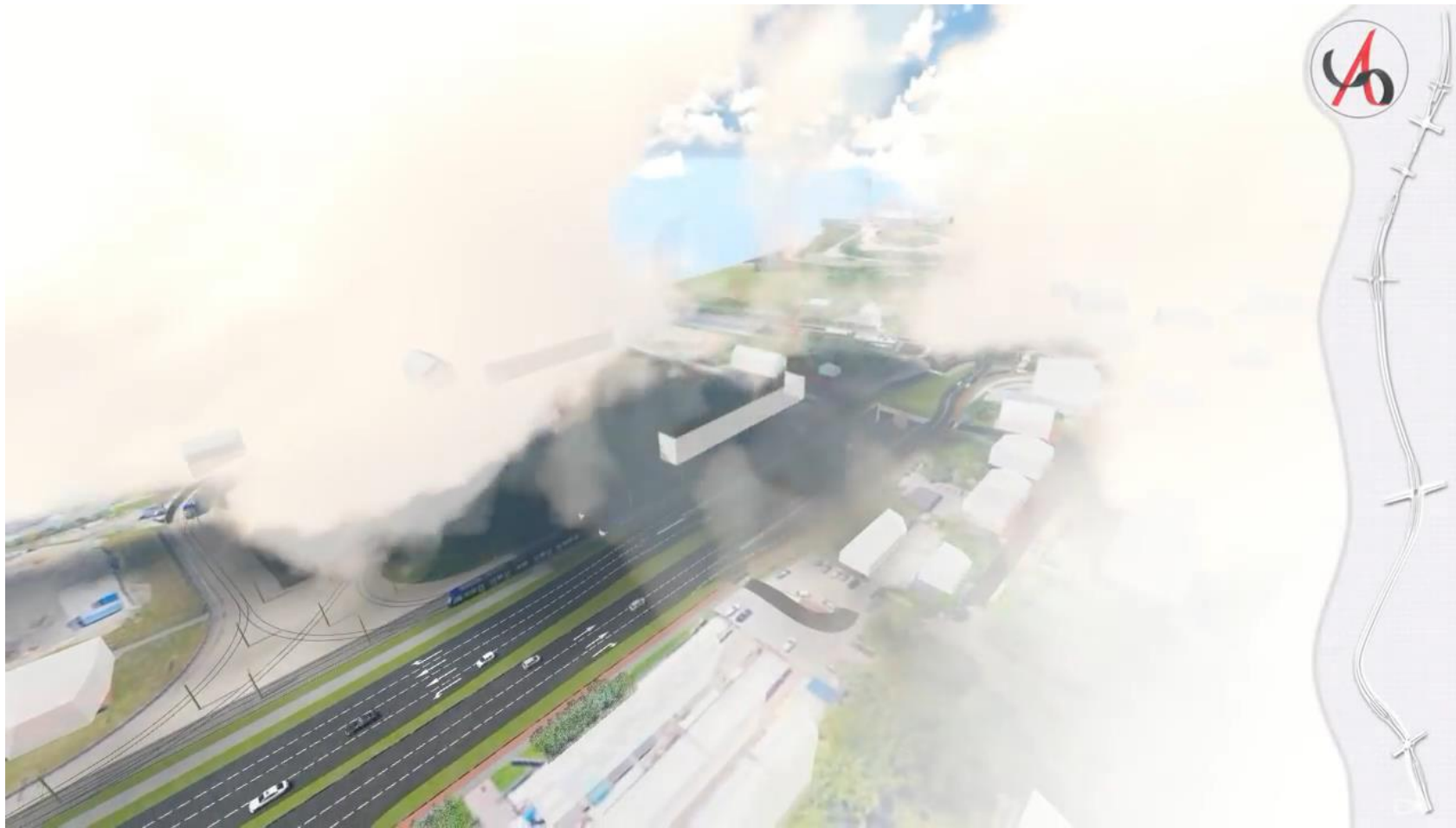


# Features of BIM technology

- interoperability,
- group cooperation,
- communication,
- cross-industry coordination, collision detection,
- 3D modelling, visualization and virtual reality.



# Features of BIM technology



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# Features of BIM technology



# SafeCROBOT

## Virtual reality immersive safety training environment for robotised and automated construction sites

2020-1-UK01-KA202-079176

01.12.2020 – 30.11.2022

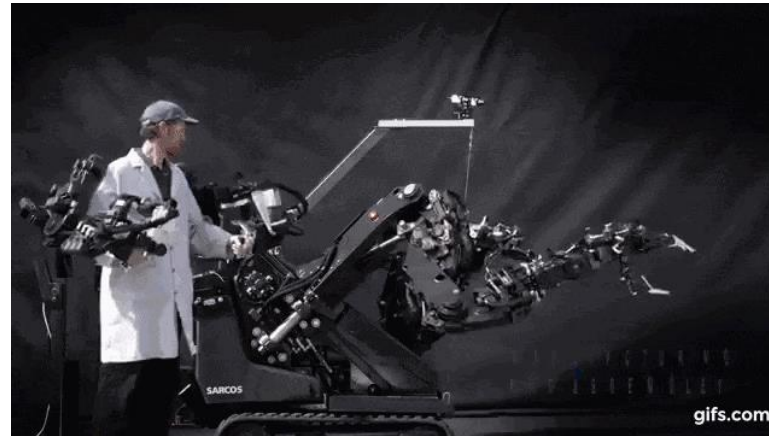
[www.safecrobot.pwr.edu.pl](http://www.safecrobot.pwr.edu.pl)



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# SafeCROBOT: Virtual reality immersive safety training environment for robotised and automated construction sites



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Co-funded by the Erasmus+ Programme of the European Union



# BIM technology, what more?

- levels of model detail,
- platforms for information exchange and cooperation - CDE platforms,
- data exchange standards,
- programs using BIM technology for modeling, planning and management,
- innovative technologies supporting BIM technology: virtual and augmented reality, photogrammetry, laser scanning, drones,
- ...
- and many other issues.





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University of Antwerp  
Faculty of Applied  
Engineering

# Sustainable and Resilient Infrastructure and Buildings

**1 February 2022 – 30 April 2022**

**15 March 2022**

**Lecture 6: BIM - the process of intelligent management of the project information**