



INCUBE  
sustainable building innovations

# Building Information Modelling for Building Renovation

Van Wijnen and New Energy Coalition

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Groningen, The Netherlands



# Introduction to Building Information Modelling (BIM)?



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# WHAT IS BUILDING INFORMATION MODELLING (BIM)?

- Collaborative working approach
- Digital representation of a building
- Manage construction works throughout the whole lifecycle
  
- Allows to create and manage building assets
  
- Building Execution Plan (BEP)

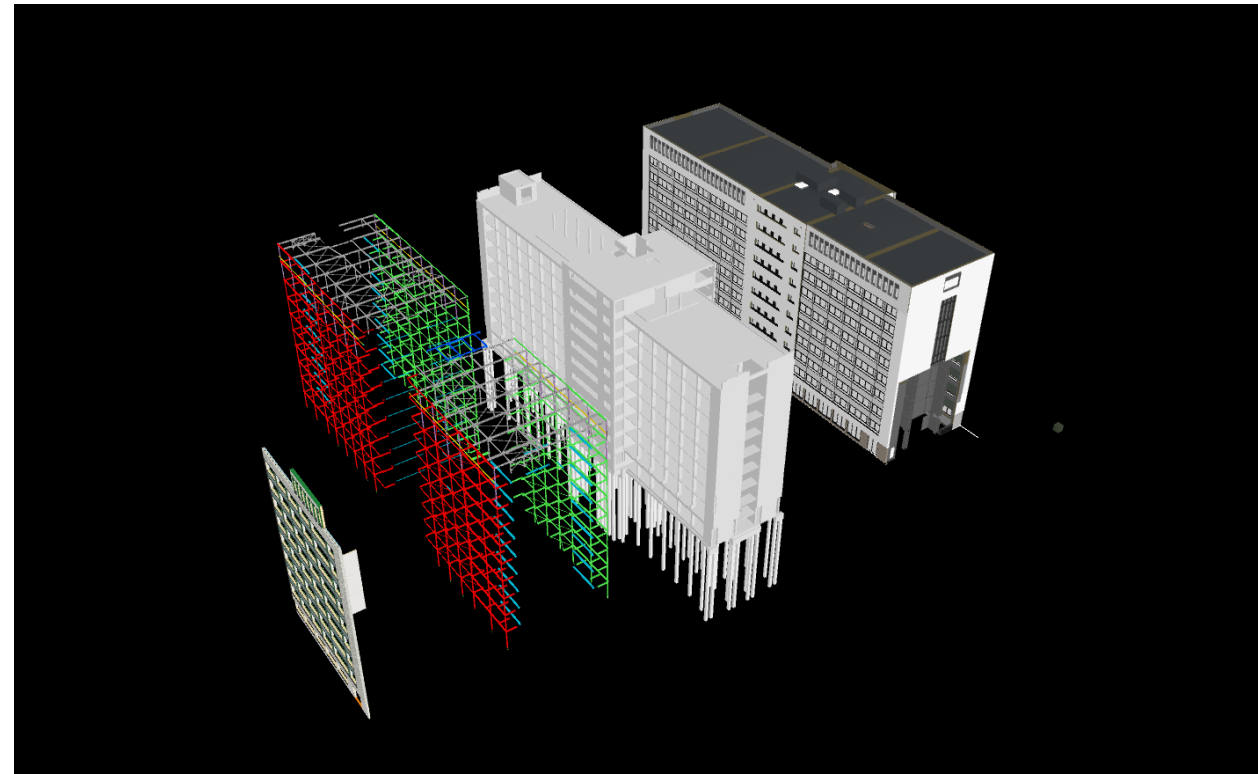
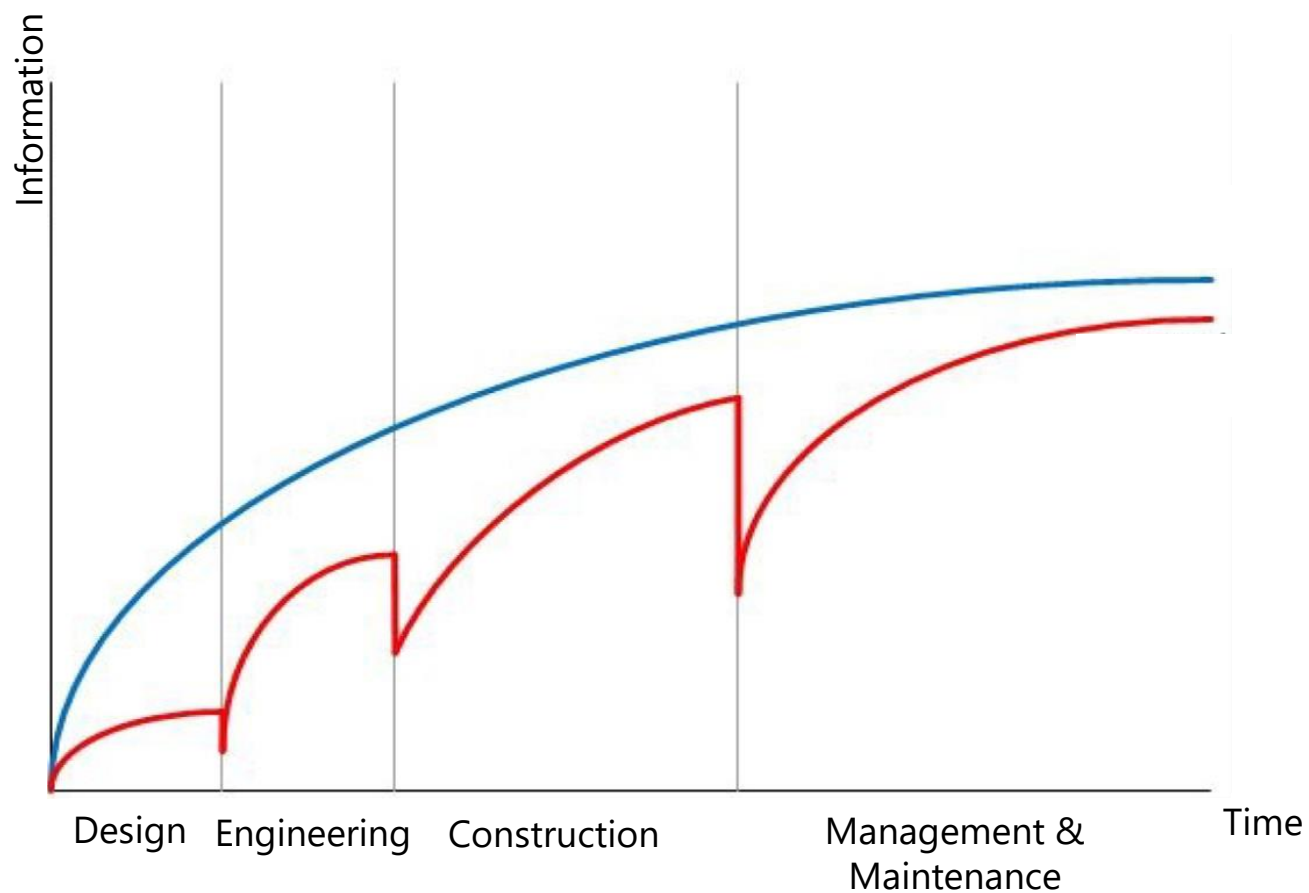


Fig. 1 Overlay of elements in BIM [1]



# DIFFERENT PROCESSES OF PROJECT DESIGN



- These curves showcase the difference between traditional processes of project design and BIM

Fig. 2 BIM versus traditional processes of project design [2]



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# BIM PROCESS vs. TRADITIONAL PROCESS

BIM is used during the engineering and construction phase

## Traditional use

- Information stops after each phase
- Potential for data loss between phases
- Can lead to faults during construction

## BIM

- Information flow is continuous between phases
- One source for information limiting potential information loss

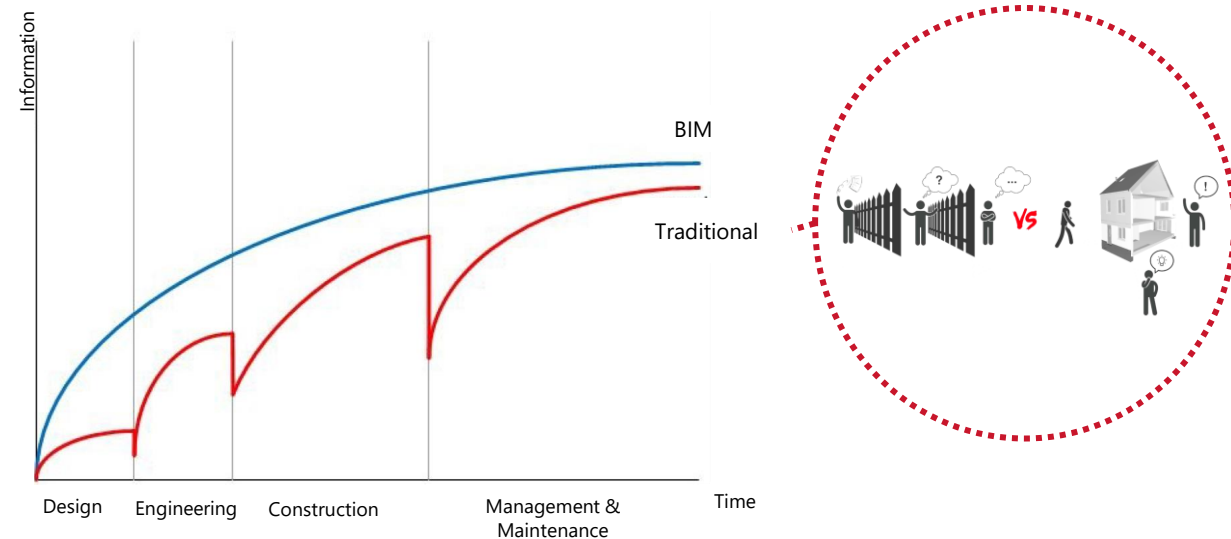


Fig. 3 BIM versus traditional processes of project design (adjusted) [3]



# BIM ADVANTAGES



BIM offers a variety of advantages:

- A coordinated approach
- Better communication
- No data loss
- Better visual control and many more

Fig.4 Advantages of BIM [4]



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# Application of BIM to renovation projects

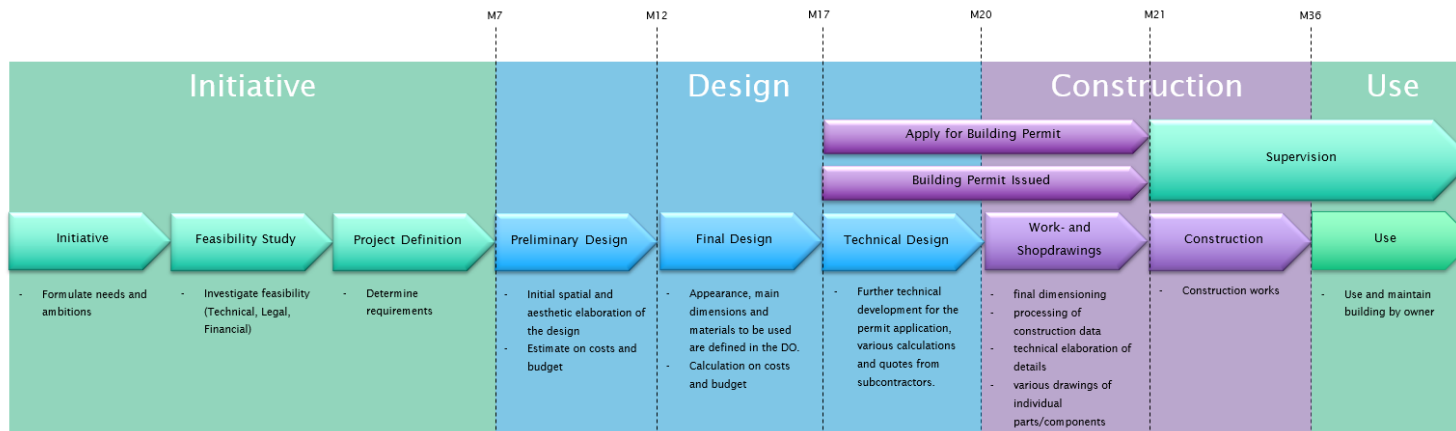


Fig.5 Phases within the construction process [5]

## Design phase

- Start with a Pointcloud design+ 3D model
- Development of a structural design and 3D models during the design phase
- Based on structural design, collaboration between different disciplines is undertaken
  - Partners: steel frame company, façade producer

## Construction phase

- Use of 3D models to detect differences/ flaws between different parties



# Application of BIM to renovation projects

- Different materials/products/elements can be placed over each other in BIM
  - Stripped building hull
  - Placement of steel structure
  - Facade elements

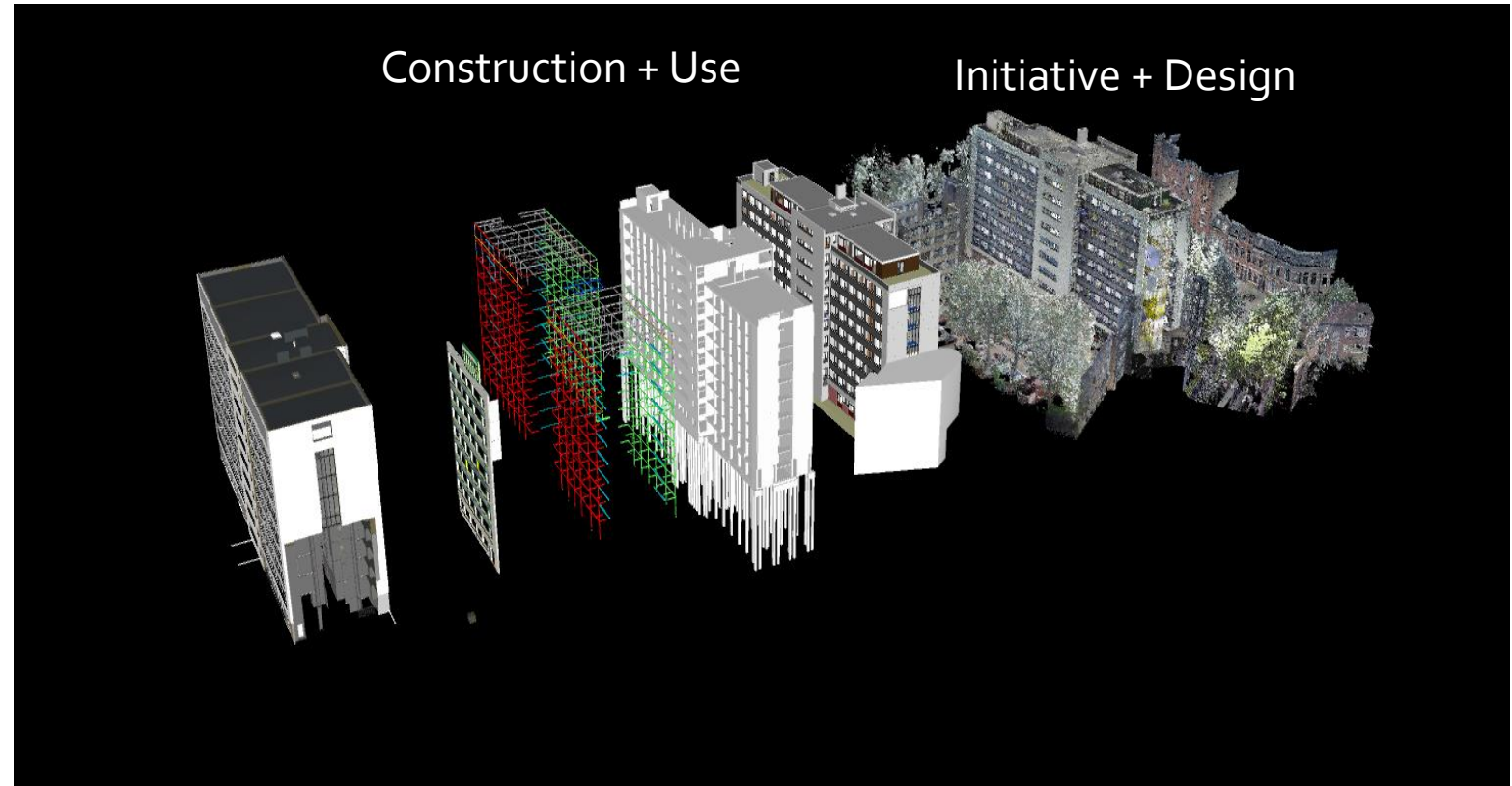


Fig.6 Overlay of different BIM elements [6]





# Applications of BIM



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# Application 1: Model checking via design visual

## Within the Design phase: Model checking via design visual

We will compare two models visually, one based on historical blueprints from the 1960s (architectural) and one based on Lidar scans (Pointcloud model). From our experience, we know that historical blueprints can differ from reality. Therefore, the first step is to compare them visually.

In these images, the difference lies between the openings in the façade on the top floor.



Fig.7 BIM model based on Lidar scans (Pointcloud model) [7]



Fig.8 BIM model based on historical blue prints from the 1960s (architectural) [8]



# Application 2: Identifying clashes in different models

## Within the Design phase: Clashed/ geometrical benefit

We will now look at clashes between the model of the structural engineer and the model of steel structure (left vs. right). The clash can be identified by zooming in.

The clash can be seen within ACC.

Once a clash is identified, the responsible modellers are notified so that the model can be reworked and the clash can be solved.

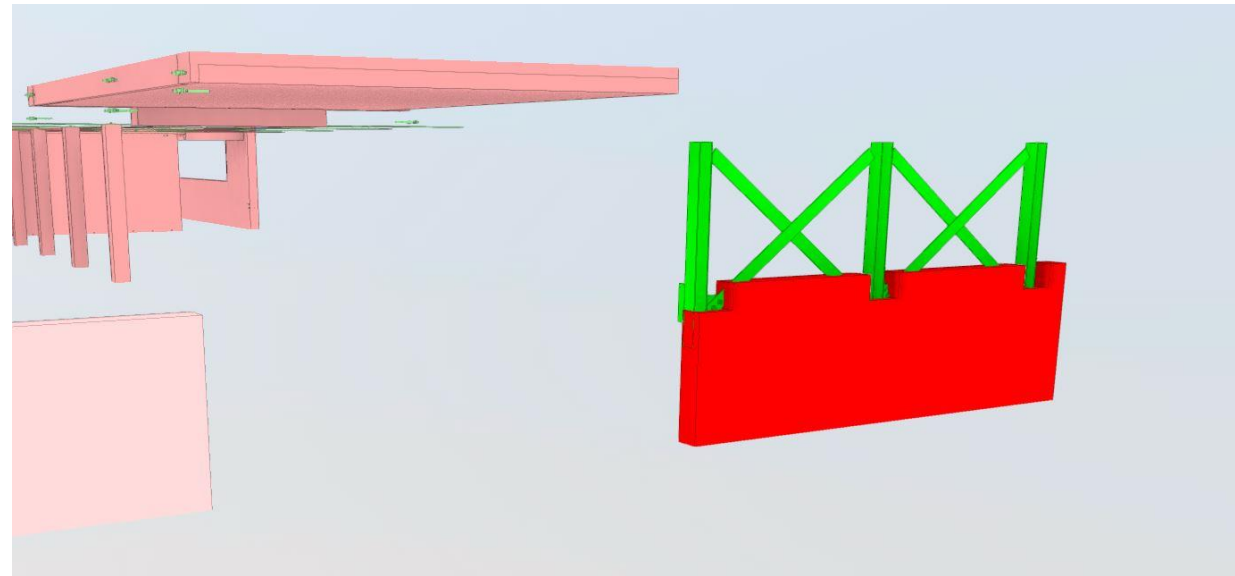


Fig.9 Clashes [9]



# Application 3: Collecting and Storing Metadata

## Within the Design phase:

**Metadata** of various building elements can be added (based on different nomenclatures).

Such data can be used to communicate between different stakeholders working on the project, for planning and execution of the construction and to check the quality on-site.

(For example, to check that the right material or element has been installed at the planned location.)

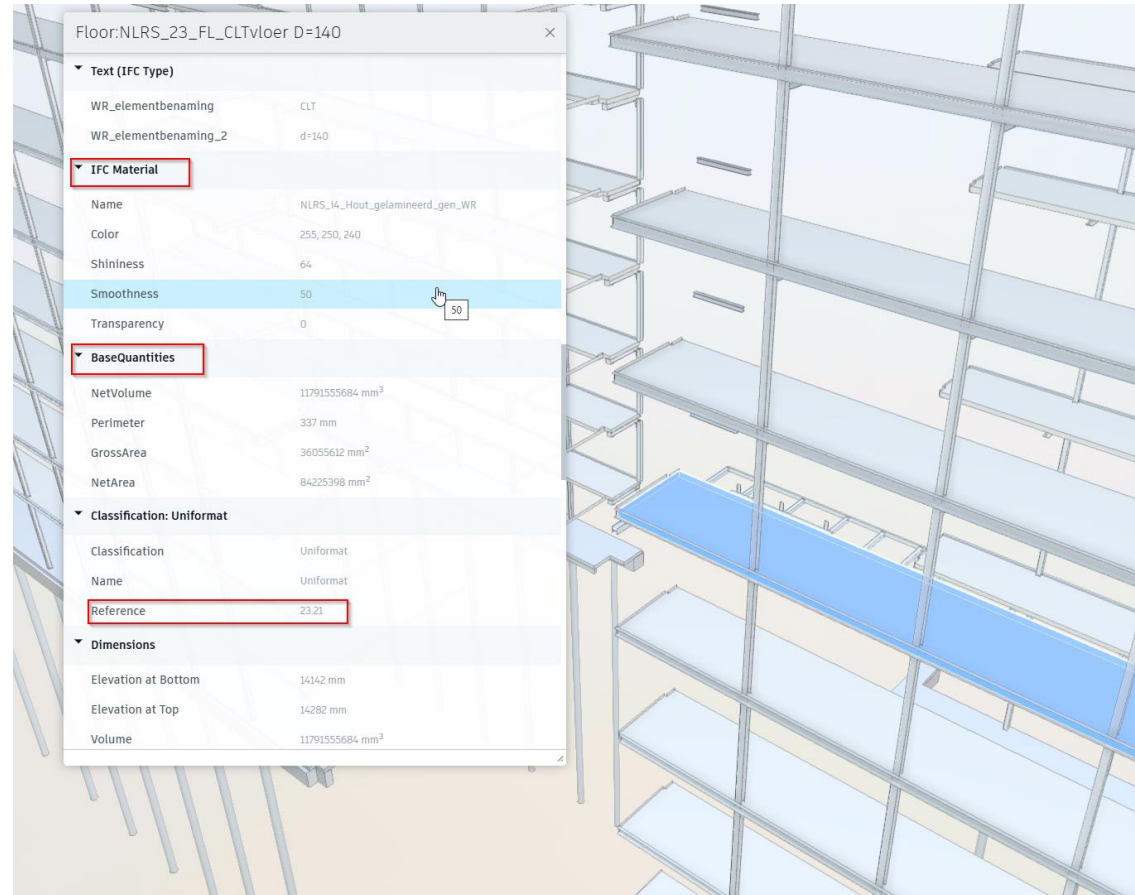


Fig.10 Metadata exemplified on a floor element [10]



# Application 4: 2D/3D Check

## Within the Execution phase: 2D/3D check

A 2D/3D check can be conducted by overlaying the 2D over the 3D one. This overlay allows for a visual check to spot any deviations between the models.

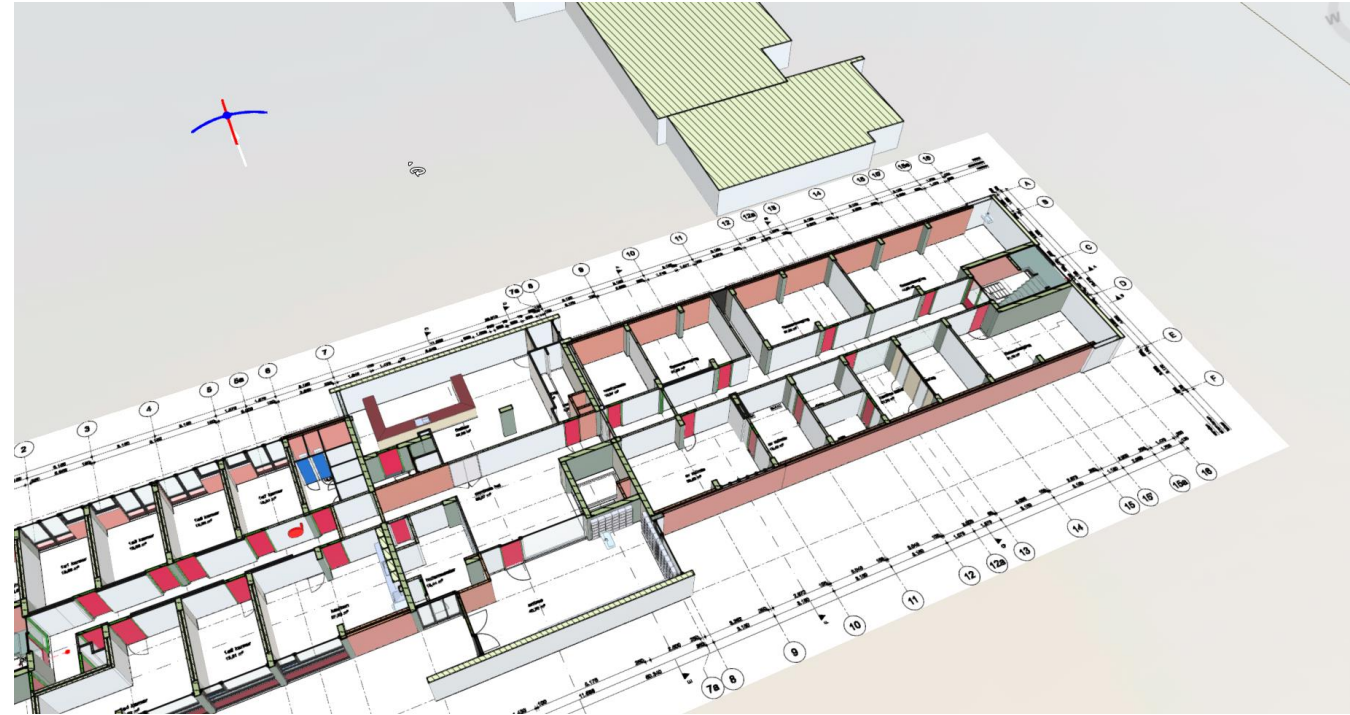


Fig.11 Overlaying the 2D over the 3D model [11]



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# Application 5: Combining BIM with Augmented Reality (AR)

## Within the Execution phase: AR during the execution

On the construction site itself, programmes such as Gamma AR allow for a visual quality check of the correct placement of elements. With the aid of Augmented Reality (AR), a 3D visualisation of BIM models can aid workers whilst moving around in the building/ at the construction site itself.



Fig.12 Visualisation of façade elements with the aid of AR [12]



# Application 6: Final Checks

## Within the Execution phase:

### Final check

As a final check, BIM can be utilized as a means to control/ check whether elements have been built as designed. This allows for a assessment and initiate still correcting measurements, if needed. Also knowledge gained from the assessment functions as learning moment for prospective projects.

The screenshot displays a web-based quality check list interface. The main window shows a checklist of construction items with radio buttons for 'Ja', 'Nee', and 'n.v.t.', and buttons for 'Foto's', 'Meldingen', and 'Opmerking'. A 'Meldingen (1)' section is expanded, showing a report item: '#2 - Coördinatie van Basic Wall:NLRs\_21\_WA\_betonwand d=200mm' by 'D Feitsma'. To the right, a 'Meldingnr. 2' detail window is open, showing a 3D model of a wall section, the title 'Coördinatie van Basic Wall:NLRs\_21\_WA\_betonwand d=200mm', status 'Open', type '01 Kwaliteit > Kwaliteit ontwerpfase', and description 'Concrete wall clashes with steel frame'. The interface also shows a sidebar with navigation options and a top header with the project name 'INCUBE GA Groningen'.

Fig.13 Quality check list within BIM [13]



# Key Takeaways

- More than just a 3D representation of the project
- BIM offers a variety of opportunities to be implemented during renovation projects
- Ensures a correct project transfer from phase to phase
- Different benefits throughout different phases
- Allows for a collaborative approach
  
- Increasingly integrated within different processes and phases, and with new technologies
  - During engineering
    - 3D modelling by all parties involved
    - Clash detection
  - During execution
    - Connection with robotic systems
    - Quality check on site
  - Engineering and construction phase
    - Combined with Augmented Reality (AR)
      - Visualize buyer's options in a more appealing manner
      - Quality check on site



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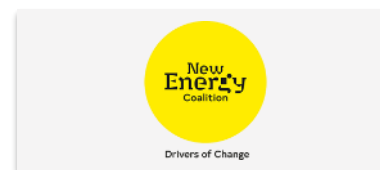
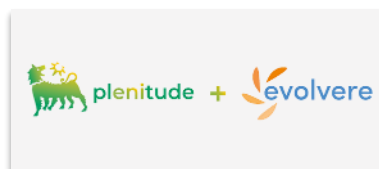
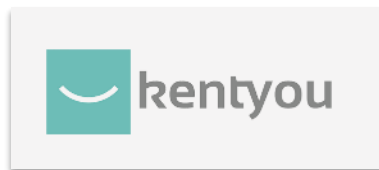
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