

White paper

**Urban VDC - the Beginning of VDC and Integrating Project Delivery**

Vers. 2 – May 2018

MT Højgaard A/S  
Knud Højgaards Vej 7  
2860 Søborg  
Denmark

+45 7012 2400  
mth.com

Reg. no. 12562233

## Urban VDC - the Beginning of VDC and Integrating Project Delivery

vdc@mth.dk

Sitting at a meeting with the client and his consultants and listening to experienced colleagues telling about the value they see in early involvement using Urban VDC can only inspire you to embark on new ways to develop the projects.

### Abstract

The first step in the digital project collaboration is vital to how the collaboration adds value to the parties to building and civil engineering projects. This White Paper will introduce you to how we have used Urban VDC based on several years of taking a collaborative approach to projects both nationally and internationally. Urban VDC as an efficient way to start up digital project collaboration that contributes to a better understanding of the objective of the project and its interaction with the context. Urban VDC accommodates a methodical approach to the project. Urban VDC is a good start to the subsequent collaboration, using Virtual Design and Construction (VDC) and Integrated Project Delivery (IPD). VDC and IPD are described in the book *Integrating Project Delivery* from 2017.

### Involving the right people in time

Urban VDC provides a knowledge-based tool for launching digital project collaboration on the building and civil engineering project. With Urban VDC we convert drawings, documents and data into models, see Figure 1.

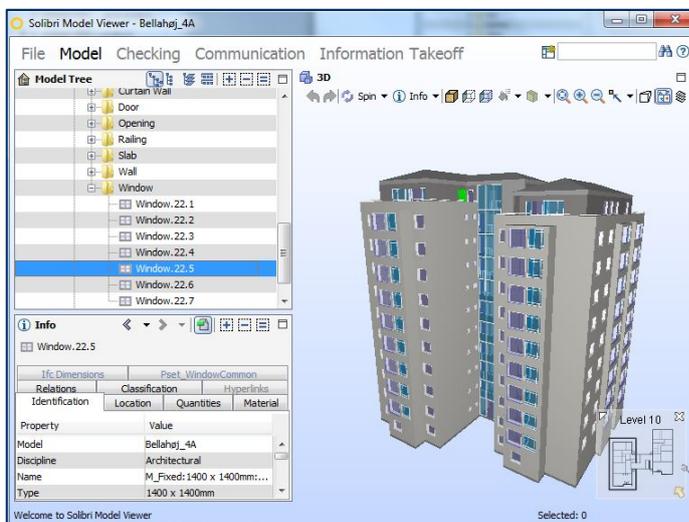


Figure 1 The 2D basis converted into a 3D basis on the Bellahøj renovation project

The starting point of Urban VDC is that all buildings and infrastructure assets are shown in the context they are part of, e.g. decisions made before project start-up, the situation while the building or civil engineering project is being implemented or when the finished building or infrastructure asset is brought into use. It gives an overall context which sets the framework for the project in the form of economy, environment, social context, etc.

When we look at the individual elements in the context of the project, each single element adds value, but the real value lies in the interaction of the elements. The overall view gives a far better insight into the project and the circumstances surrounding the project, and it is a good point of departure for making decisions about the project on an informed basis. Therefore we start up an increasing number of projects using Urban VDC and gain at the same time an insight into what the individual building or infrastructure asset adds to the local area - for instance, a livelier atmosphere in urban space.

The correlation between the project and the context can be created in a 3D urban model of the surrounding urban area. With a preliminary design tool for conceptual design, we can combine existing conditions in the project area such as terrain and, orthophotos, buildings, drain grates and roads. In December 2016, MT Højgaard described the technology behind the tool in the publication *BIM Manual Civil Works and Infrastructure* which provides a review of how the 3D urban model interacts with the design of buildings and infrastructure assets, regardless of whether it concerns existing or new conditions.

In this way, the 3D design of relevant buildings and infrastructure assets is integrated, even when it means that the building must be modelled in 3D based on local surveys or the underlying 2D drawing material. For example, the buildings in the Bellahøj development, which were built in the 1950s in Copenhagen, can easily be converted into 3D building models which can subsequently be used in the 3D urban model, see Figure 1.

Urban VDC also sees the project in a wider perspective and does not merely focus on the building or the infrastructure asset as 3D geometry. The 3D geometry can be used to simulate and analyse the qualities of the building, buildability and the economy of the solutions chosen and thus the realisation of the project. The project is more than just architecture and buildability and consists of a multifaceted interaction with the context of the project. Regulatory requirements are one of the things that provide an overall methodical framework in relation to neighbours, residents and other stakeholders so that the building is seen as part of a whole - a local community rather than a collection of building components and space for people.

Urban VDC can be perceived as a naive approach to urban space and buildings because it 'merely' is about combining facts in the form of data and observations from the building context with knowledge of the historic development of the area and empirical analyses of the development of space and people in general. As part of the analytic approach to Urban VDC, it is therefore essential to listen to and understand how the area is described in words and data.

Urban VDC contributes to an early clarification and planning of the next steps in building design and architecture and reveals possible challenges in the realisation of the project idea. Involving the consulting engineer helps effectively uncover the risks and thereby optimise the project together with the project parties, including designers, contractors, owners, operations managers and users of the building.

With Urban VDC we can simulate and analyse alternatives and give concrete expression to opportunities and challenges posed by the existing context of building and civil engineering projects. In this way, Urban VDC provides an overall picture of the project which contributes to a common understanding among the project parties who often have their own view of the different part elements "*I knew that already*", but who will also learn about new elements and thereby increase their knowledge and understanding of the project.

### **Urban VDC - good practice with early project initiation**

The white paper focuses on the period before construction works begin on site. Integrating the financial, environmental and social context in Urban VDC provides a better platform for the building or civil engineering project and may contribute to value subsequently being added to the building. Urban VDC helps the different project parties understand the context of the project and consequently makes a good point of departure for the collaboration and the creative process required to realise the building or the infrastructure assets, expertise, creative thinking and incentive to see the possibilities of a realisation.

The team working with Urban VDC on a project is typically manned by 3-5 people with different skills and professional capabilities such as architects, urban planners and engineers as it improves the quality of the Urban VDC analyses.

The common understanding of the project and its context is achieved through a matching of the Urban VDC analyses and insights, where Urban VDC accommodates an integrated process facilitating coordination between the different project parties. *The oil in the engine* of Urban VDC is the value of each individual's professional capabilities and work when it is used systematically in an interdisciplinary methodical collaboration which continuously develops the knowledge and understanding of how the building context can best be used and handled in relation to the project. The comparisons are made continuously in connection with the Urban VDC analyses and contribute to an efficient collaboration and flow in the building or civil engineering project.

The integration of the Urban VDC 3D model into the local area, interacting with the project building or infrastructure asset creates a basis for subsequent Urban VDC analyses and simulations as described in the *BIM Manual for earthworks and roadworks* from December 2016.

Urban VDC takes an active approach to the social context of the project and involves the stakeholders and their objectives of the building in an overall picture of the project. Precisely the insight into the stakeholders' needs and ideas about the building is revealed through the Urban VDC analyses, newspaper articles, etc., demographic analyses based on *big data* and through observations, etc. in the local area. The difficult thing about Urban VDC is to uncover the *false idealisation*. It is therefore necessary to involve people with previous experience of the context of the project and to take a critical stance to the sources used.

Urban VDC follows a structured process to ensure that relevant data and information are collected, validated and compared in a simulation of the project in relation to the project context; in this way knowledge about for instance the road network, site logistics and school districts will together give a better insight. It is therefore important to clarify when what Urban VDC analyses (for example background analysis, simulations and visualisations) add most value. It may be at start-up meetings, workshops or at meetings with the client.

It is a good idea to perform the Urban VDC analyses several times throughout the project. Iterations addressing changes and the development of the project and its context give a better insight and understanding of the building or civil engineering project.

Urban VDC always uses publicly accessible information which can be collected in a few hours via Internet searches or visits to the local area, traffic counts, etc. In recent years, Urban VDC has developed into a systematic approach to the continuous collection and processing of data and information for the Urban VDC analyses. The 3D visualisation, which accommodates relevant financial, environmental and social aspects, is the core clarification that Urban VDC gives the stakeholders of building and civil engineering projects.

Working with Urban VDC on areas and projects has shown that it is quite essential to be asked the question - *Why?* Why is the project here? Why this place and not another? Why these parties? With Urban VDC we seek the answers in the financial, environmental and social context of the project and thus gain an understanding of the aspects most important to the client and the other parties to the project.

#### **Urban VDC in practice**

Practice has shown why Urban VDC is important to building projects, and it has been expressed very precisely in the book *Integrating Project Delivery* from 2017.

*"That's because people need to understand the current state so they can see opportunities and obstacles to change it for the better"* (Source: *Integrating Project Delivery*: 8.4 How Can This Be Done? page 164, location 4946 in the digital version).

Likewise, the strength of Urban VDC is that here all relevant elements of the 3D urban model are combined, which means that what was previously fragmented and out of the reach of the individual project party can now be seen in a context by all parties.



**Figure 2 Visualisation of the length of a traffic jam based on simulation of traffic pattern**

Once the 3D urban model is gathered with road network and data on e.g. traffic in the local area, we can simulate traffic flow. Based on traffic counts and observations in the local area, we can simulate the traffic and possible adjustments can be tested, using visualisations of the length of traffic jams at intersections, see Figure 2.

### **Methodical approach to Urban VDC**

Urban VDC analyses and simulations using the 3D urban model give concrete expression to opportunities and challenges and become the focal point of a subsequent dialogue about the project. Integration of knowledge and data thus gives the project the relevant information and a solid basis for decisions through the use of Urban VDC. The coordination ensures a constant focus on what will help you realise the building project.

Urban VDC in practice often includes:

- Background analysis contributing to a fundamental shared knowledge
- The 3D urban model accommodates the knowledge and forms the basis of the subsequent analyses
- Urban VDC scenario analyses with related visualisations and simulations.

The 3D urban models also create a platform for visualisations of the view from the building and the view of the building from the outside, i.e. how the building looks to surroundings and how light and shadow fall on the building. More critical processes in and around the building project such as crane lifting, exclusion zones, interim measures, health and safety and scaffolds, can also be visualised and simulated to shed light on carriage roads and the interaction with other road users so as to increase safety. The visual analyses of both buildings and infrastructure assets are also part of the Urban VDC analyses.



**Figure 3** The 3D urban model with blue mark-up of places with traffic data

Simulations help create transparency and understanding of optimisation opportunities using the geometric representation and quantity and material analyses by giving the client a better basis for making decisions on light and soil balances and traffic, see Figure 3.

### **Example of Urban VDC in practice**

In the example below, Urban VDC is applied to the project to renovate the Bellahøj development in Copenhagen well before the works begin.

#### *Urban VDC - background analysis*

In connection with the background analysis of the Bellahøj project, we gain insight into the story behind Bellahøj. The architectural competition was decided in 1944, and the buildings were erected in several stages in 1950s as a number of tower blocks. The main reason for building tower blocks was that the square form would be easier to fit into the falling terrain at Bellahøj than parallel blocks of flats. In 1950, the final plan for the Bellahøj development was approved by the authorities and the clients. After the completion of the design stage, the Bellahøj development consisted of 28 high tower blocks (see Figure 4). The buildings were built using reinforced concrete, including precast concrete panels. The Bellahøj development was an experimental project that introduced new construction methods and processes being utilised by contractors and represented a step towards industrialisation of the Danish construction sector.



**Figure 4 Bellahøj - October 2017**

The early involvement using Urban VDC is key to understanding how the contractor can best address the existing conditions, including the context of renovation projects in the Bellahøj development.

#### *Building the 3D urban model*

By building the 3D urban model of the local area, we get a picture of the environmental context. To experience the social context, we must visit the area and conduct interviews and analyses of publicly available material such as the book *Bellahøj - Stories about a building complex*,

from 2015 (available in Danish only), which expresses in words the objective of the upcoming renovation:

*"The two concepts of the vision - 'identity' and 'pride' - served as a guide for the ambition of the competition to recreate the Bellahøj blocks using architectural analyses and physical renovation and turn the development into a place people are proud to live in and with which they can identify themselves. The identity must be able to accommodate new trends and the different needs of changing times, and it must be possible to change details without altering the overall identity. Conversely, it is equally important to base the identity on both the physical elements of special architectural and historic interest and the values and ideas on which the Bellahøj development was originally designed."*

(Source: *Bellahøj - Stories of a building complex*, page 133)

#### *Urban VDC - scenario analyses*

The Urban VDC analyses should be performed as early as possible and subsequently be updated as the project progresses. In this way, all parties can be aligned when the ideas about site logistics are incorporated in the 3D urban model as shown in Figure 5, and the parties' understanding of the context and their knowledge increase.



**Figure 5 Construction site at Bellahøj 4A and B**

An interview with the residents of the Bellahøj development gives us insight into how previous renovation projects have affected life in the dwellings. The book *Bellahøj - Stories of a building complex*, from 2015 contains examples and interviews where the Bellahøj residents share their thoughts on the upcoming renovation of façades, installations and other parts of the buildings.

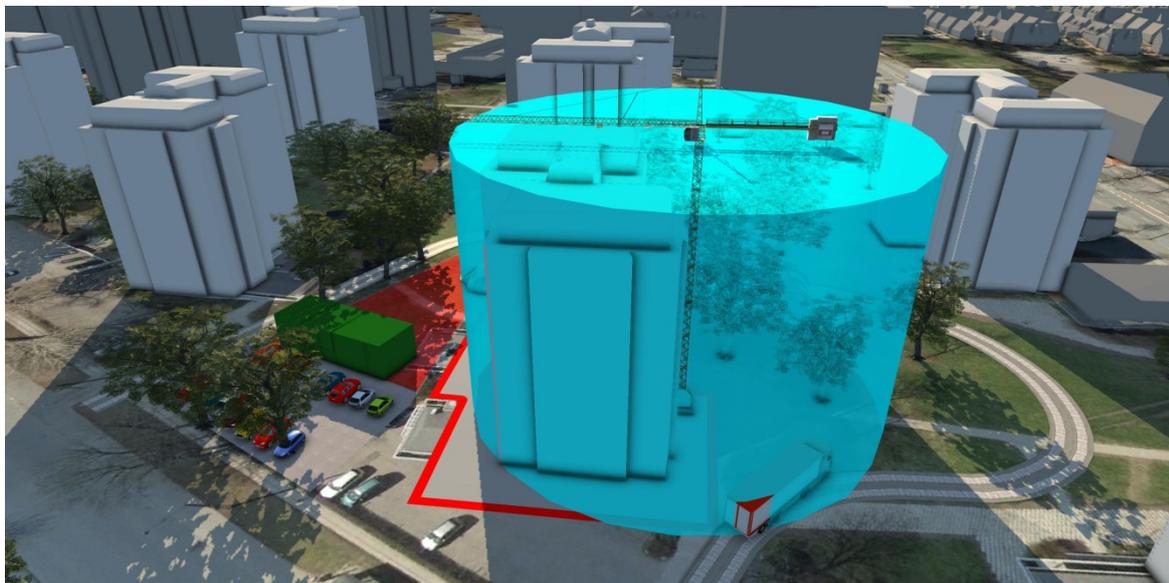
*"When we had new windows, and the balconies were enclosed, we stayed in our flats while the work was being carried out. It was really not that bad because we were prepared, and the timing and organisation of the works were fine."* (Source: *Bellahøj - Stories of a building complex*, page 35)

*"We had a major renovation five years ago where we got new bathrooms, new stack pipes and riser installations, and in some of the blocks windows were replaced. It was a major renovation project where we made a point of telling the residents about the work to be done and when it was to be made." (Source: Bellahøj - Stories of a building complex, page 37)*

*"I know from previous renovation works - for instance when the balconies were enclosed in glass and the windows were changed in 1987 and it was decided to start work on one block to test the expectations we had to the work and not to continue work on the other blocks until work on the first block had been completed." (Source: Bellahøj - Stories of a building complex, page 139)*

*"Now that we talk about the great plans for the renovation of the Bellahøj development, I can put it like this: I do not want any renovation – and you know why? I do not like the thought of us having to live at a construction site for the last years of our lives. We have lived through the renovation in the 1990s. We also had some special heaters in-stalled because the existing heater had been removed while the works were being carried out - and of course it was in the winter." (Source: Bellahøj - Stories of a building complex, page 271)*

The use of Urban VDC provides a basis for a good and effective collaborative culture on the project where the above interviews can be used in relation to communication, methodology and site logistics.



**Figure 6 Location of crane at the site at Bellahøj 4A and B**

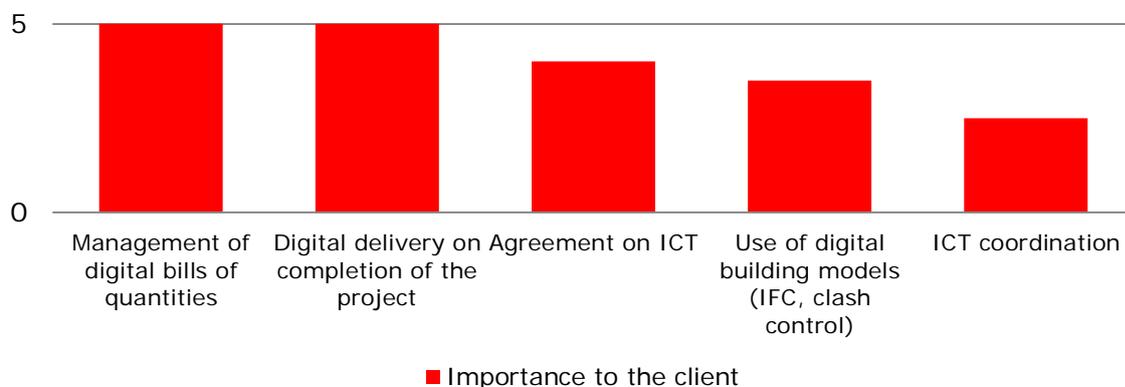
For example the location of the crane may be very important to several parties to the project, and visualisation and simulation using the 3D urban model can give all parties the same picture of the renovation, see Figure 5. The location of the crane is related to site logistics and thus traffic and the local area, and integrating all these elements as part of the Urban VDC analyses therefore adds value, see Figure 6.

### Urban VDC in perspective

The collaboration between people with different competencies is important in Urban VDC and improves the understanding and knowledge of the way the building project interacts with the local area and the opportunities it offers. With their methodical approach, the Urban VDC analyses provide valuable insight into the factors of the building project which have an impact on design, execution and the subsequent operation. Gathering knowledge in one place adds value to the project parties, not least to the client.

With relevant traffic counts, information on terrain, soil conditions and wiring as well as information about schools and day-care institutions, the 3D urban model, which in an Urban VDC context includes both the construction work and the immediate context, offers a sound basis for making better decisions when integrating it with surface water management, traffic noise, information from neighbours, etc. In this way, Urban VDC contributes to a holistic integration of existing conditions and objectives of new buildings and infrastructure assets.

But if the parties to a construction project cannot articulate their thoughts about the project, the result of the analyses will be an interpretation based on the information underlying our picture of the end result - the Urban VDC analyses. This interpretation entails a risk that we have not seen it all, but it is still far better than nothing.



**Figure 7 Example of the client's most important objectives of the digital collaboration – May 2016**

It can be a good idea to compare the insight into the parties' objectives in relation to the project so that it creates a basis for a common focus in the digital project collaboration. In 2016, a public sector client described what had most important to the client in the digital collaboration, see Figure 7. We compared the things that the client hoped to gain from the digital collaboration with the key objective of contractor in the white paper entitled *The strength of the local BIM efforts in a larger perspective* from May 2016. Similarly, Urban VDC can give more insight into the objectives the parties have for their participation in the project and framework terms and conditions and can thus provide a basis for making decisions on efforts on the project.

### The value to the client of early involvement using Urban VDC

The fundamental precondition of Urban VDC is to understand the project and its context on the basis of the relevant parties' objectives of the project. Using Urban VDC in close cooperation with contractors and the client consequently results in a better insight into the risks and oppor-

tunities associated with the project, which must be handled in the subsequent project work. And this is the exact reason why we should use Urban VDC - giving the parties to the building project an overall insight into what contributes to a good project for all parties, not least the client. In the long view, spreading knowledge of Urban VDC practices will also give input to the definition of several measurable objectives (see *Integrating Project Delivery*, 2017).

### **The maturing of Urban VDC**

Throughout the years, we have implemented practices in the construction industry where the relevant parties do not communicate directly with each other or do it so late in the project process that it is difficult to convert their knowledge into value to the project.

Urban VDC solves by no means all problems in our industry, but it gives us the best start to the project, ensuring a real insight and less risk of conflicts arising at a later stage of the project. Hence, we can hope for an opportunity to avoid that

*"people come to projects as friends and leave as enemies"*. (Source: *Integrating Project Delivery*: 13.1 So What's the Problem?, page 295, location 7977 in the digital version).

The involvement of the consulting contractor and the informed basis for decision-making provided by Urban VDC offer in many ways a better opportunity for realising the potential of a construction project when using VDC. At the same time, it creates a solid platform for the integrated project collaboration – whilst focusing on the realisation of the client's objectives.

### **References:**

- *A Practical Guide to BIM in Construction and Infrastructure Projects*, October 2016, MT Højgaard, ISBN: 978-87-990534-9-0 (printed version), ISBN: 978-87-999360-0-7 (electronic version)
- *Bellahøj - Fortællinger om en bebyggelse* (Bellahøj - Stories of a building complex), Jannie Rosenberg Bendsen, Birgitte Kleis and Mogens Andreassen with a contribution from Hans Kristensen (pages 15-22), © 2015 Arkitekturformidling.dk, Strandberg Publishing A/S, ISBN 978-87-92894-95-3
- *BIM Manual for earthworks and roadworks*, December 2016, MT Højgaard
- *Integrating Project Delivery*, Fischer, Martin, et al., Wiley, 2017, Kindle edition and ISBN 978-0-470-58725-5
- White paper entitled *The strength of the local BIM efforts in a larger perspective*, MT Højgaard A/S, May 2016.