DTU BYG

BIM Collaboration Format

General use and scope

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TITLE PAGE

This particular report contains a review of BIM Collaboration Format and a description of its general use and scope.

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ABSTARCT

This report is produced for a special course created at The Technical University of Denmark. The report investigates BIM Collaboration Format with the aim to explore some of the possibilities with this format.

The aim of the report has been to make a review of the BCF with a project management edge. This has resulted in a two parted division of the report, one part addressing the managerial aspect of BCF and the second part addressing the actual BFC software.

This is concluded by a discussion of the two parts followed by a business model canvas framework describing BCF in a structured manner allowing for a simple overview.

Finally the pros and cons with BCF is explained in a review containing the extract of this report.

MOTIVATION

Building Information Modeling(BIM) is here to stay and will, to some extent, be the standard in all future construction projects. This is the opinion of both authors of this report and it has been the motivation for writing this review. Greatly inspired by the different courses on DTU throughout our study, we have seized the opportunity to do a special course about a supplement to some of the existing software used in building projects. The approach will be formed by theory together with the experience and opinions of the authors.
By using BIM it is possible to unify the delivery process and thus reduce complications in a building project. This prospect is a key factor behind the motivation and why this report is made.

BIM is no longer a new concept, but it still struggles in a conservative construction industry, and is often not fully engaged since different companies have different practices on how to implement BIM. However the potential of BIM stands, the use of BIM means that the project can be managed in a more uniform environment, which allows different stakeholders to collaborate in a shared set of regulations.

The BIM Collaboration Format (BCF) offers an opportunity to engage problems in a more agile approach, allowing on-site management to communicate with all parties involved at any given stage of the project, potentially saving time and errors which is a huge asset in today's construction practice. The goal of this review is to shed some light on the pros and cons of applying BCF in a construction project.

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1 INTRODUCTION

Construction management (CM) has been around since man started to build structures, and project management (PM) in general has been practiced since man got involved in construction, manufacturing and logistics. However project management is not seen as an actual science until the early 20th century. One of the pioneers in within project management, Henri Fayol(1841-1925) a French mining engineer, introduced five functions of management which have proven their test of time, since these five principles are still valid to this day. The five principles are listed in table 1.

Tabel 1 Fayol's Functions of Managemenet

Fayol's Functions of Management
1 To forecast a plan
2 To organize
3 To command
4 To coordinate
5 To control/adjust

These five principles are still the basis in project management today and each holds its own different problems and solutions. The focus in this report will be targeted towards identifying aspects of project management and how new digital formats can aid PM.

1.1 The modern building process

The typical building process can be divided into five different stages, which each takes place at different periods of the building project. The stages can be seen in Figure 1 and represent the entire building project (Anlægsteknikforeningen, 2007).
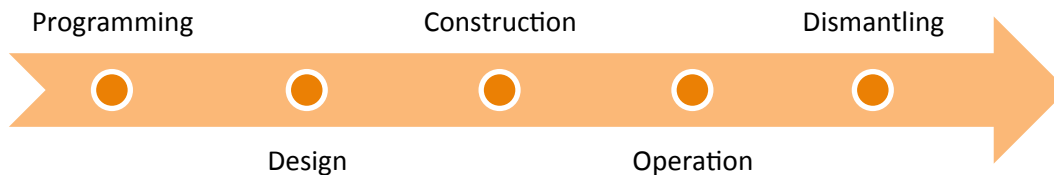
Figure 1 – Five different stages

Figure 1 shows the traditional building process, but recent tendencies shows that further phases exists (BAR, 2013). These extra stages provide a more specific overview of the process and show a more modern perception of the building process. The building process with the added phases can be seen in Figure 2.
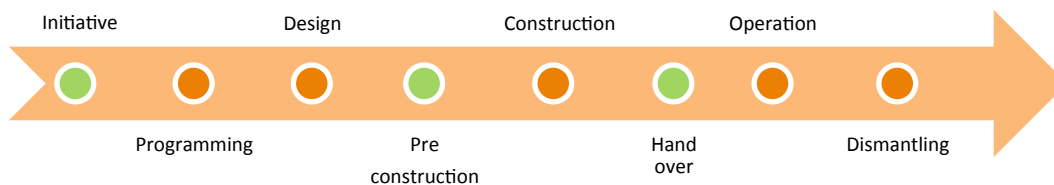
Figure 2 – Building process with added phases

These added phases could be an indication of a general need to prepare for the forthcoming stages in the process. This makes good sense since the lack of proper planning or deviation from the planning, tends to be rather time consuming and thus pose a threat to the original budget. It could seem that some of the problems faced, in modern construction, lies within failure to react to/or resolve sudden problems and changes in the process.

1.1.1 Challenges within construction management

With this brief description of the building project, it is possible to look into some of the challenges within modern construction.

One of the biggest issues in construction is the productivity problem, which has been a problem since the 1970s (Andersen & Spange, 2012). The productivity issue is a global problem and can also be found in Denmark. The development in the Danish productivity is illustrated in Figure 3.
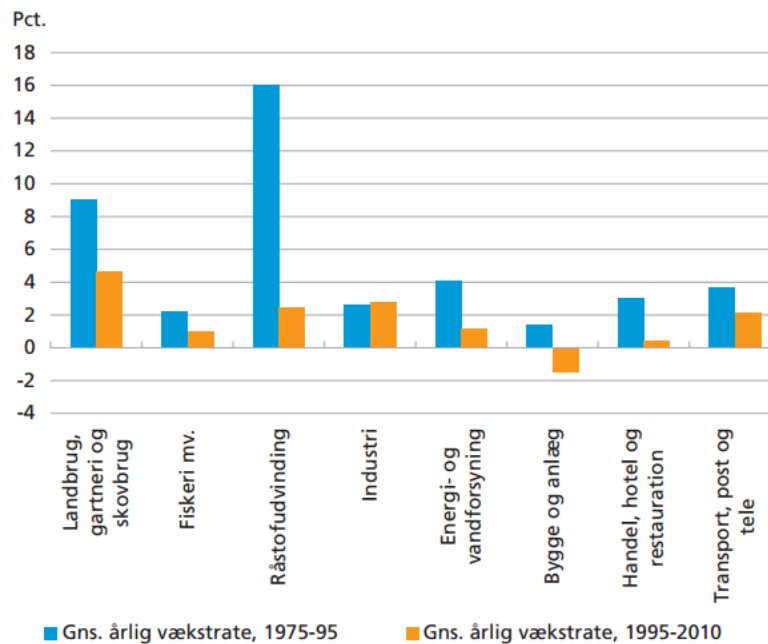
Figure 3 - The development in the Danish productivity

Figure 3 shows the development in Danish productivity within different fields from 1975-95(blue) and 1995-2010(orange). It goes without saying that the construction industry (Bygge og anlæg) is staggering behind to a straight decrease in productivity. The definitive answer to the productivity issue has yet to be found, but it should be fair to assume that several different factors are causing the issues with productivity in the construction industry.

One reason for the lack of productivity is described by BIM consultant Nicolaj Hvid, as a consequence of a general lack of understanding of the new processes within the construction process. He explains that the foundation of productivity exist and proclaims that the problems which occur in the construction process are more related to misunderstandings and miscommunication between the involved parties (Nedergaard & Brunshøj, 2013). Assuming this is one of the real issues in modern construction, one of the reasons could be that the modern industry is highly dependent on the skill set of the planners, rather than the workforce on the site. This would potentially explain the need for the additional phases in the building process.

1.1.2 New takes on solving CM issues

When it comes to BIM, it is the writhers' belief that there is a tendency to underestimate or rather overlooks the importance of the information part. This may be due to a general trend of focusing on process and product rather than cooperation and communication (Dainty, Moore, & Murray, 2006). There are several ways to ensure that information is shared with minimum transaction loss. ICT contracts are one of the aids to ensure a steady course in the construction project.

> *"Many wrong decisions are made in a process and the amount of time and money it costs, will affect the quality ...[] a poor flow will eventually cost, whether it is money or quality" Expertise manager Stig Brinck, NIRAS . (Brinck, 2013)*

The guidelines available today, appreciate BIM and formulate a process revolving around BIM. A testament to this is the guidelines regarding governmental building project exceeding 5 million DKK (Bygningsstyrelsen, 2013), here the guidelines are clear to a point where it is the user who becomes the barrier, rather than the guidelines.

It seems as if the managerial part of a construction project is challenged through the communication in the process, rather than the management of the process. This is why applications like BIM Collaboration Format have been developed. This format aids the building project by enabling for attaching data to various IFC formats thus ensuring less transaction loss in the process. It is tools like BCF that can start fortifying the BIM process, by providing a rigid data sharing foundation, by attaching data to the IFC format.

2 METHODOLOGY

The following section will explain the structure and the execution of the report. Since the report contains a review, some thoughts on the viability of the approach have been included as well.

2.1 Goal of the report

The main goal of this report is to do a review of the BIM Collaboration Format. The background for the review is a wish to shed light on new possibilities in the BIM process. BIM is not a new approach anymore, and still some issues exist regarding the IFC's and the different platforms operating with them. This is one of the reasons for reviewing BCF, since one of the problems with this new software could be the lack of collaboration between the BCF file and the different platforms.

2.2 Angle of approach

The approach will be based upon observations made in construction management, theory of project management, and some testing of BCF. Furthermore a Business Model Canvas will be made on BCF, in order to get an overview of its usage.

2.3 Method criticism

As with most reviews, the approach is rather reliant on observations and assumptions made by the authors. This serves the purpose of exploring a given subject, and gives a brief overview. This said a more thorough analysis, should made in order to get a more accurate picture of the subject. A way of improving the review could have been user interviews, this would have ensured that the review would generate a more generic picture of the subject.

3 THEORETICAL BACKGROUND

In order to approach BCF and its usage, a general set of theoretically founded assumptions must be determined. For this review the following theory will serve as backbone regarding BCFs relevance and as means of explanation.

3.1 Project lifecycle

The Project Management Book of Knowledge (PMBOK) (PMI, 2008), has been used for generally describing a generic project life cycle, which enables for a more general description of a project. In order to assess BCF and its traits, a valid baseline must serve as reference.
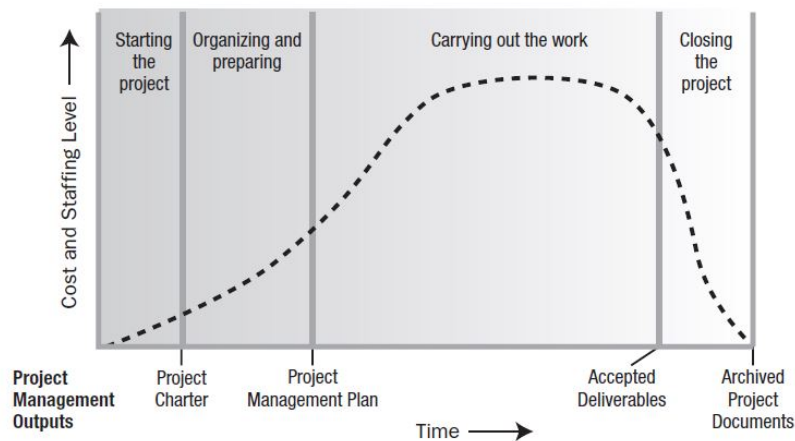
Figure 4 - The generic project life cycle

The generic project life cycle, in Figure 4, shows how cost and staffing increases as the project evolves. Figure 4 also shows the importance of planning, since this is the part of the building project with less involved thus less expanses. This could also explain the tendency to add extra planning steps to the traditional construction process as shown figure 2, since the cost of planning is roughly one third of the construction cost. Figure 4 shows where the resource consumption for the building project is highest, but it does not hold any information about the cost of changes. This will be necessary in order to decide if BCF holds a spot as a valid aid in a construction project.

The structure of the generic project life cycle is also illustrated in PMBOK, and this shows the impact of variables based on project time. The generic life cycle structure provides an overview of the stakeholder influence, risks, uncertainty and the cost of changes throughout the project duration, Figure 5. This is a more thorough picture of the generic project life cycle, since it enables us to identify where in the process the variables are, and how they affects the project.
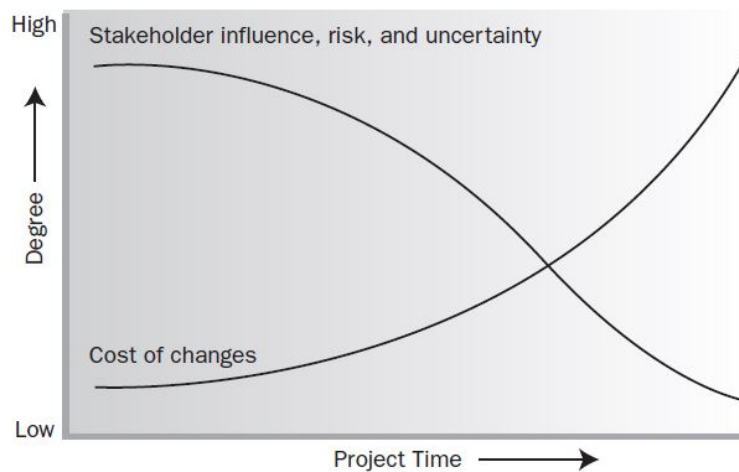
Figure 5 - Stakeholder influence declines as the project moves on

Figure 5 leaves the same impression as figure 4 in regards to the observations on the traditional building process, but what this figure shows is the stakeholder influence declines as the project moves on. This could be seen as a normal consequence of contracts being signed post construction, and this is probably one of the main reasons for the decline. But if you consider the data flow in the construction process, it is easy to imagine that the amount of digitally transferred documentation could lack legally binding aspects. The scenario where a flaw is detected in the foundation on site, of course the contractor responsible for the foundation is obliged to deliver the right foundation, but there might not be a specific outline on how to solve the issue. The correspondence between the foundation contractor and the on site construction manager might cause delays in the construction due to non-legal binding agreements.

The considerations regarding the generic project life cycle will help determining BCFs appliance in the construction project and is a rather straightforward way of approaching project structure.

3.2 Business model canvas

The business model canvas is an easy way of describing/identifying/realizing the potential of a product. This is why the canvas will be used to describe the usage of BCF in the review. The following section will be a general description of the canvas.

A business model describes the rationale of how an organization creates, delivers, and capture value.
(Osterwalder & Pigneur, 2010)

With the description of a business model, a business model canvas approach might seem a bit off, but if you consider the description and substitutes organization with product, you get a rather thorough description of a product, and how it fulfills its purpose.

The business model canvas can be considered as a business map consisting of the following locations, shown in Figure 6:

Key partners	Key activities	Value propositions	Customer relationships	Customer segments
Some activities are outsourced and some resources are acquired outside the enterprise.	*The main activity.*	*It seeks to solve customer problems and satisfy customer needs with value propositions.*	*Customer relationships are established and maintained with each Customer Segment.*	*An organization serves one or several Customer Segments.*
	Key resources		**Channels**	
	Key resources are the assets required to offer and deliver the previously described elements .		*Value propositions are delivered to customers through communication, distribution, and sales Channels.*	

Cost structure	Revenue streams
The business model elements result in the cost structure.	*Revenue streams result from value propositions successfully offered to customers.*

Figure 6 - Business model canvas

While some of the aspects of the business model canvas might not be as relevant as others regarding BCF, it is still a preferable way to considering its traits. If you consider the value proposition (VP) it is highly relevant to outline just exactly how BCF contributes to the building

project. Areas like cost structure (CS) is also a good way to ensuring that the amount of efforts BCF requires, is taken into considerations.

The business model canvas will be the framework approach in terms of presenting the overall review, and thus further elaboration will follow in the discussion section.

3.3 Risk management.

Risk management is not a managerial aspect only considered in the design phase, it is an ongoing task, which must be acknowledged at all times during a building project. However risk management can be a double-edged blade. This becomes clear in Figure 7 (Burtonshaw-Gunn, 2009), here the relationship between the cost and the effort put into risk control.
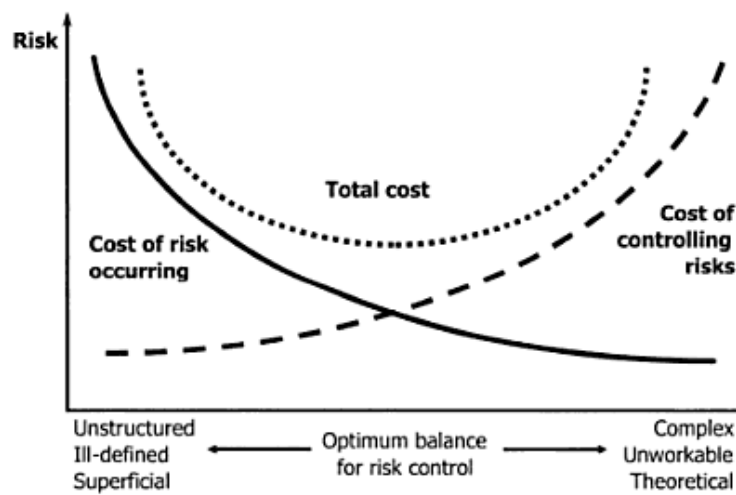
Figure 7 - Relationship between the cost and the effort

It seems that with a proactive risk management you can achieve savings in the budget. It is also rather clear that with too much planning you might see a negative effect in the budget. It should be added that where lots of effort is put into risk management (right side of the figure), the result will be a more expensive planning phase resulting in fewer complications throughout the project furthermore the timeframe for the project will be more likely to stay on schedule. It is necessary to point out that a proactive approach like this is far from adequate in relation to the risks apparent throughout the entire construction project. To determine where the risk management aspect the BCF contributes to a more smooth process, further investigations must be made in terms of usage of the application.

4 DESCRIPTION OF BCF

BIM Collaboration Format (BCF) was developed and performed by Tekla and Solibri, and was supported by various other software platforms. BCF was introduced to allow an intelligent communication workflow between BIM tools and a workflow communication capability connected to IFC formats, where the purpose was to separate the virtual communication from the model into a BCF format based on XML schemas (Stangeland, 2012).

BCF makes it possible to effectively and methodically communicate with total transparency since all steps in a BIM related process is visible for all involved parts which all will be combined in several reports with attached messages/comments in all parts of the process (Stangeland, 2012). Users of BIM tools often import IFC models from other disciplines and implement their own discipline into those models. If there are issues regarding one of the models, then the process will be stalled and an investigation of where the issue derives from is conducted, at worst the entire process might stop and the issue has to be fixed before work can carry on (buildingsmart, 2011).

The BCF tool is rather simple to implement and navigate. It is basically to create issues, add messages/comments and allocate them to a component(s) by using the IFC formats Global Unique ID (GUID). This offers the opportunity to find/highlight, because of the viewport and snapshot, the component in other BIM tools (buildingsmart, 2011). The interoperability is focusing on how the various BIM tools are operating together instead of focusing on the single tool(s), this gives a strength to the whole BCF process because it focus to support comments and status of issues across platforms instead of focusing on a single discipline and its own product (Stangeland, 2012).

4.1 The BCF process

To understand how BCF is working and how it collaborates across different platforms, such as Revit, Solibri and Tekla, a general description of the steps are conducted. As an example the process between Revit and Solibri will be utilized, Revit will be used as the 3D modelling tool and Solibri for clash detection.

1. **Examine a model and allocate a message/comment to a given component of interest.**

First of all make sure that the model is available on the platforms that are involved in the collaboration, in this case Revit and Solibri, this will be ensured by using a IFC export from Revit to Solibri which supports both platforms and collaborates with BCF. Then a visual check for clashes of the model will/shall be conducted, all disciplines are coordinated in one view. It is possible to hide and separate individual elements to get an overview of single parts and components, which might conflict in the model. A visual check is made, using the implemented function of rule set in Solibri, to find clashes in order to check the model for issues. These issues can then be recognised and a message/comment can be added to the IFC formats Global Unique ID(GUID) of the component, and this is where the benefit of BCF shines. The BCF is attached to the GUID which makes it possible to export the file from one platform to another and then locate the same actual error. The BCF file can from now on identify the GUID regardless of collaboration, this GUID is kept in the 3D model and exported to file format

IFC, in which makes it possible for the BCF to identify this GUID across platforms. Then the BCF project/report can be saved as a BCFzip file.

2. Send the BCF report to other involved parts

The BCFzip file can then be distributed between the different involved parts of a project and it is possible to open the BCF report directly in Revit. With an "add-in" the BCFzip file can be read and the different issues become accessible, the messages/comments can be read and the components can be located in the model for a better understanding of the issues thus clarifying the nature of the issue.

3. Open message/comments, located the component and take action

To understand the issue that is created by the other part, a message/comment is attached. This provides a fast and unique method to eliminate comprehension problems and helps to realize and identify the issues that has appeared in the review/clash detection. Furthermore to comment back and take action of the issues either by explaining the situation or to correct it physically in the 3D model. Finally the corrected file will be overwritten or saved as a new BCFzip file. This can then be send back, to the other part, for a quick review in order to see if the issues are properly corrected in regards to the involved parts.

5 PRACTICAL APPROACH ON BCF

The following section will be a principle practical approach, on how to use BCF across different templates. Solibri will be used to implement the IFC files and from there distributed after having created and added issues to the relevant platforms. This is done to ensure that the same data is available for each platform, and to make sure that the model is checked for exhaustive clash detection across the different disciplines involved in the project. The drawings are a real-life and raised building at DTU, building 118, where there is an architectural-, structural- and HVAC model. First step in the process of using BCF across different BIM tools in this particular case, Revit, Solibri, DDS-cad viewer and Tekla BIMsight. DDS-cad viewer and Tekla BIMsight is two freeware programs that supports IFC and BCF, these programs are included to get a contribution from a free program and how they can have a positive contribution to a building process. The real-life approach is very important to ensure and propagate the use and comprehension of BCF to the outside world and to contribute to an improvement of the construction industry as a whole.

Tabel 2 Program survey and usage

Programs:	Usage:
Autodesk Revit	Drawing of 3D model, Import of BCF file
Solibri Model Checker v9	Clash detection, Export of BCF file
DDS-CAD Viewer	Import of BCF file from Revit, investigation of BCF file
Tekla BIMsight	Import of BCF file from Revit, investigation of BCF file

5.1 Principle approach on BCF across platforms

To ensure a realistic workflow and a structured approach, a predefined workflow has been chosen because of the following reasons:

1. To gain a structured knowledge about the use of BCF
2. To construct a BCF file, so that it is clear and transparent what has been done throughout the whole process of creating it from the first platform to the last.

Revit
- Open model
- Export to IFC format

Solibri
- Import IFC format
- Check for clashes
- Add/create issues
- Create report
- Export report as BCFZIP

Revit
- Open original model
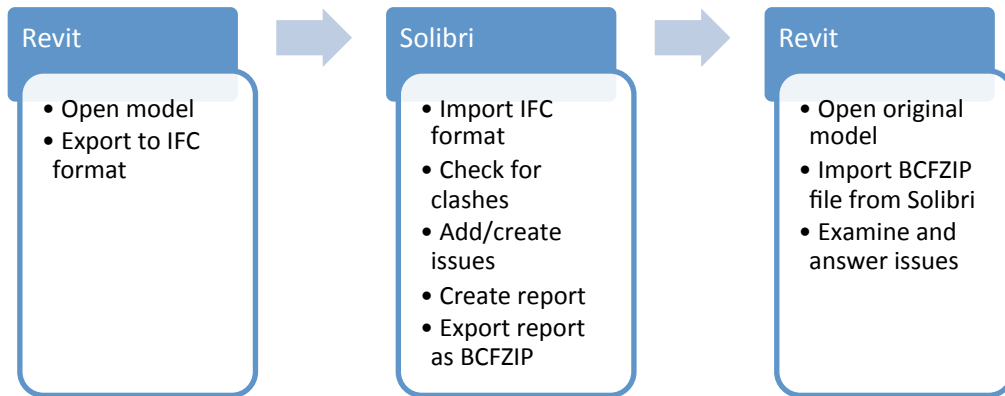- Import BCFZIP file from Solibri
- Examine and answer issues

Figure 8 - Process line of using BCF

The process will be exporting the original model from Revit into an IFC format to ensure collaboration, between Revit and a given platform that support the BCF format. In addition to the IFC converted original model a IFC format of the structural- and HVAC and Ventilation model will be included in the model. This is done to make the model and the approach of using BCF so close to real-life use as possible, The work process can be seen in Figure 8.

Solibri will be used to check for a clash detection of the model and then add/create registered issues, where a comment and a picture, of the concerned building component, will be included on the issue in a report, which will be save as a BCF file. This BCF file will then be obtainable for every chosen BIM tool. When the BCF report is created it will be imported into the original Revit file, where the BCF will be used to identify the issues in the Revit model. Here an examination of the concerned issue and an answer will be implemented as an addition to the BCF file, created in Solibri, and again the file will be saved as a BCF file, for further investigation with the freeware programs DDS-cad viewer and Tekla BIMsight.

DDS-CAD viewer
- Open IFC format created in Revit
- Import BCFZIP file from Revit
- Examine and answer issues

Tekla BIMsight
- Open IFC format created in Revit
- Import BCFZIP file from DDS-cad viewer
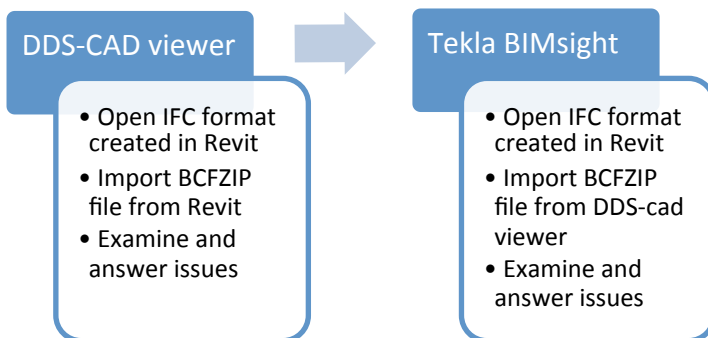- Examine and answer issues

Figure 9 - Freeware platforms that supports BCF

DDS-cad viewer and Tekla BIMsight will be used, as shown in Figure 9, to import the BCF file and add/create comments and then observe how these issues will be registered in the BCF file by opening them in Revit. It is important to incorporate this final link of the freeware programs to involve two freeware programs. Because the freeware programs is most likely to be used by consulting engineers, contractors and drawing offices since they recognise the use of modern

technology, but might be reluctant to spending a lot of money on software they are not familiar with. or might not see the potential in.

6 THE ACTUAL APPROACH AND USE OF BIM ACROSS PLATFORMS

The original model is created in Revit and is provide by the supervisor, see Figure 10, and is only used to create/export an IFC file and optimise the BCF file, this is done by locating the GUID from the BCF file developed in Solibri. To implement and use a BCF file in Revit a plug-in must be installed, this plug-in is created by Matteo Cominetti, who works at Software Development Intern at CASE Design.
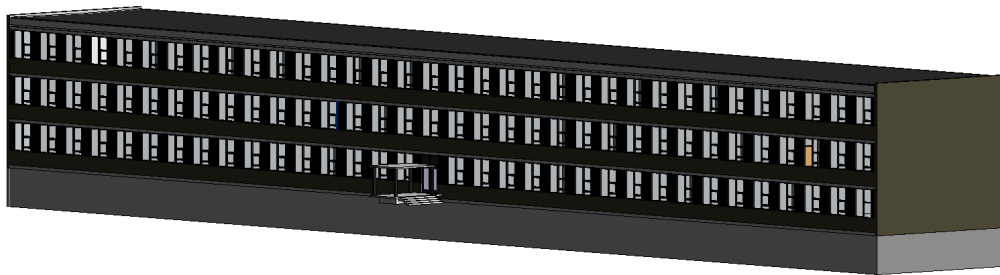

Figure 10 - View of the original Revit model

The original model is then exported from Revit into an IFC format to insure collaboration between the different platforms. The IFC format is imported into Solibri for clash detection and to establish a BCF file for future use in Revit, DDS-CAD viewer and Tekla BIMsight, see Figure 11 and Figure 12.
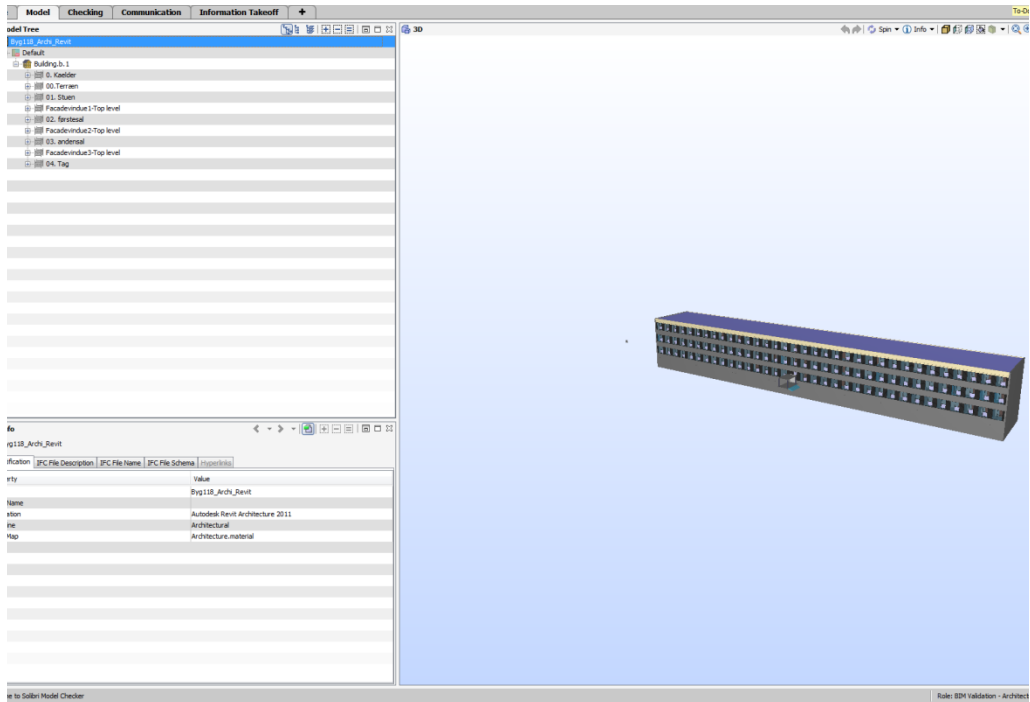
Figure 11 - IFC is imported into Solibri for clash detection and establish a BCF file
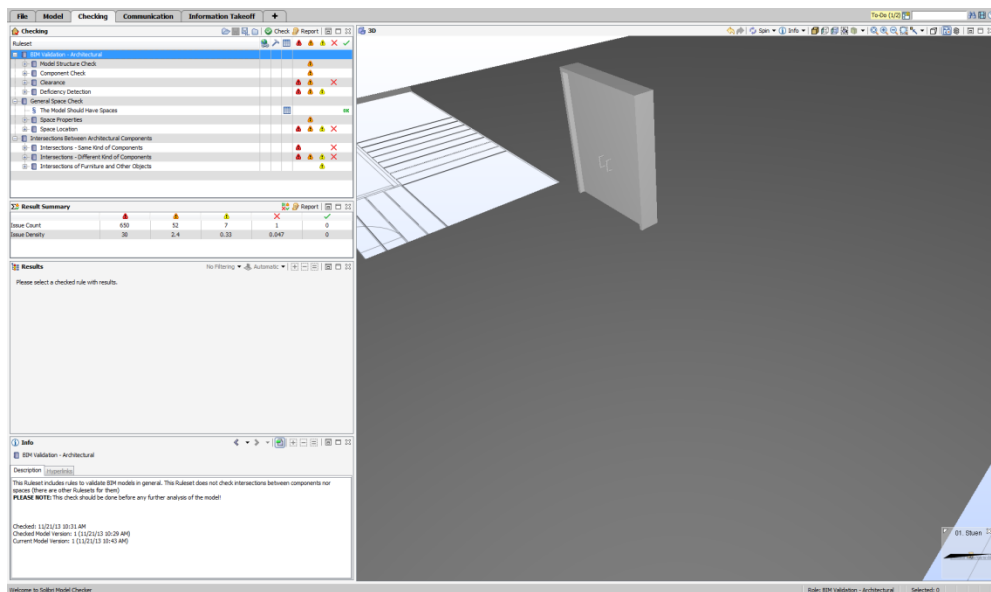

Figure 12 - A clash detection is performed, to identify issues

The different errors, observed in Solibri, is exported into Revit, by using the plug-in mentioned above, and is now ready for further investigation.
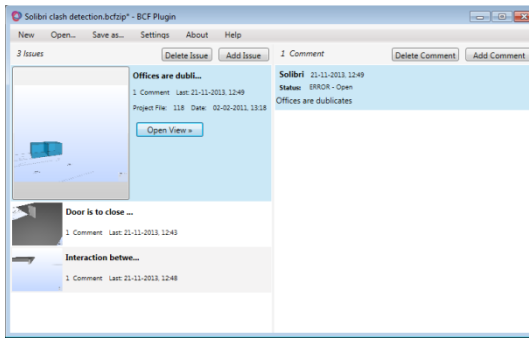
Figure 13 - BCF plug-in in Revit

The first error "offices were duplicated" was unable to locate error in Revit, see Figure 14, this can be because of different reasons such as, Unable to identify GUID, Problem by hiding walls and conflict between Solibri and Revit.
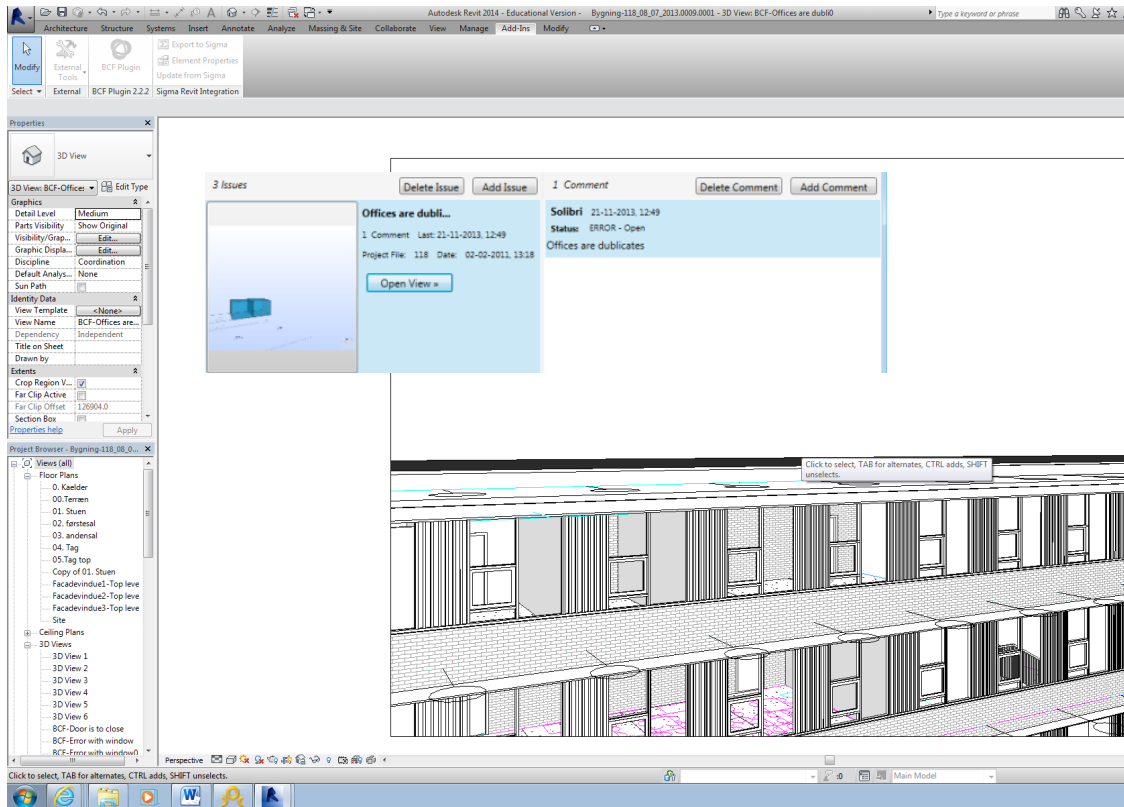

Figure 14 - First error - unable to located in Revit.

The second error "Door is too close to the slab" created a BCF plug-in error in Revit, see Figure 15, it seems that the plug-in has some issues in regards to the interaction between the BCF file, Revit and the plug-in, these issues have to be solved in the future to optimise the overall usage.
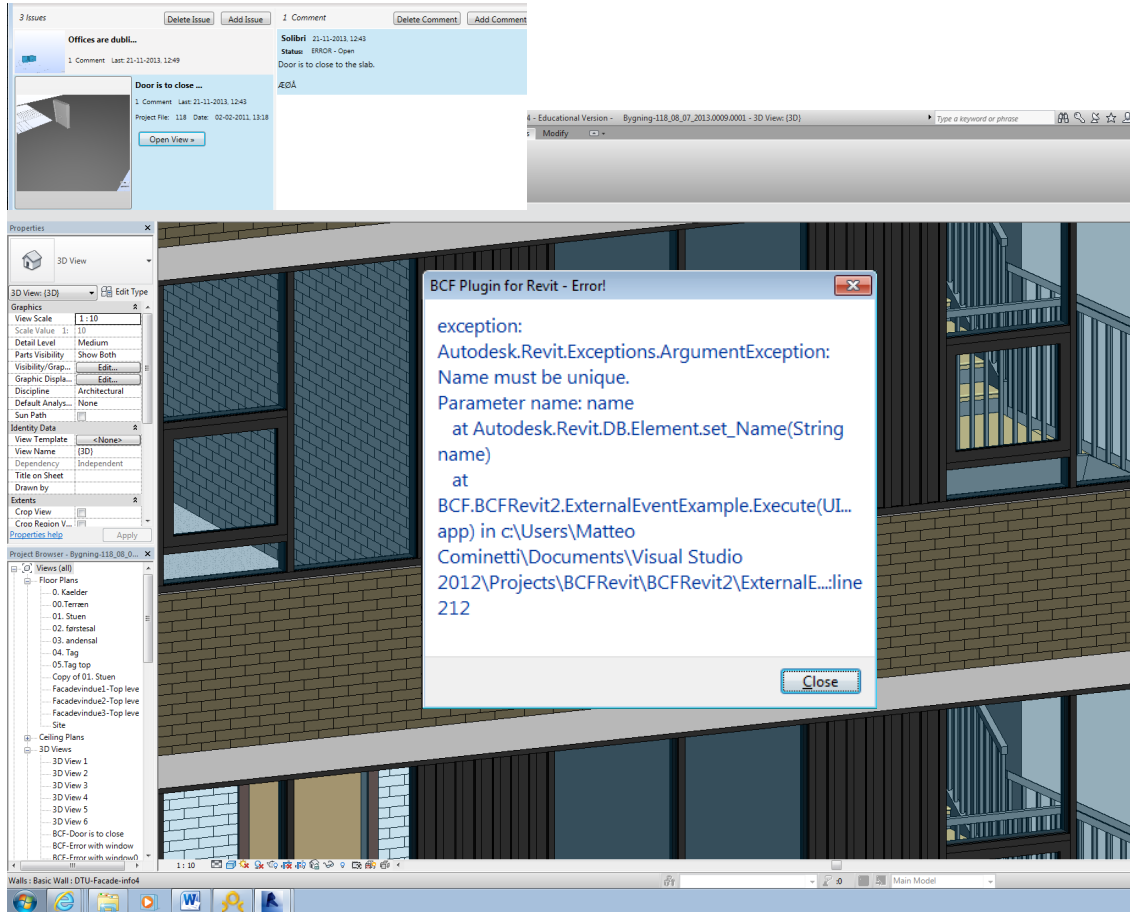
Figure 15 - The plug-in create an "BCF Plug-in for Revit - Error"

Revit was able to locate and understand the last created error "Intersection between slab and beam", see Figure 16. This location enables us to use the interaction between Revit and Solibri fully, and the BCF can be used properly with regards to this issue. A comment is created and added to the BCF file, see Figure 17, so it can be carried further to the next platform, which will be DDS-CAD Viewer. The character ÆØÅ, where implemented in the error to see if a transfer across Solibri and Revit would include them. This turned out to be the case, which enables a fully Danish use.
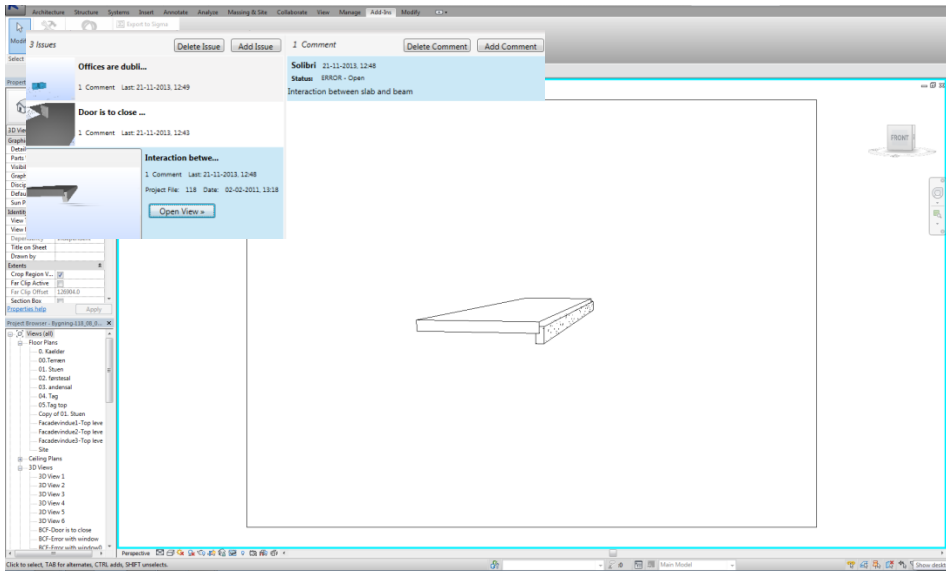
Figure 16 - Error is located in Revit

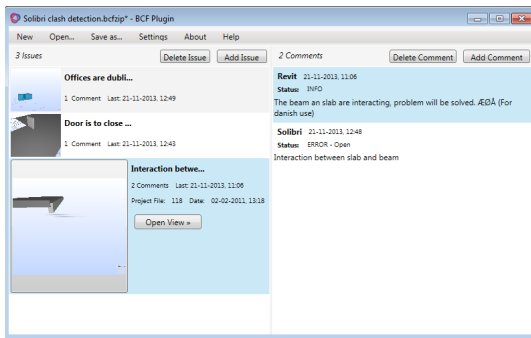**Figure 17 - A comment is created**

6.1 DDS-CAD Viewer

The BCF file created in both Revit and Solibri is imported into the freeware platform DDS-CAD Viewer, to investigate if all the errors and comments are visible and to include some within this platform. The BCF file is containing the expected information, see Figure 18, and will be investigated in the following. The Danish characters are still visible.
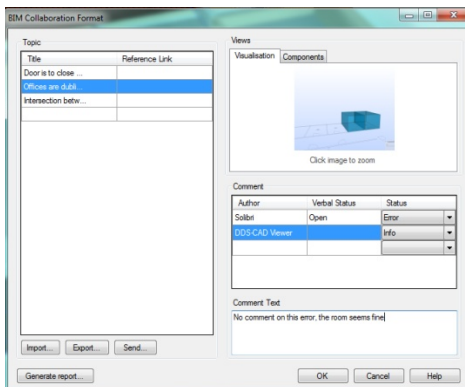
The first error turns out to be unknown in DDS-CAD Viewer on the basis of the visual outcome, see Figure 19. Therefore the comment will be "No comment on this error, the rooms seems fine". This can be because of the classification from either Revit or Solibri.
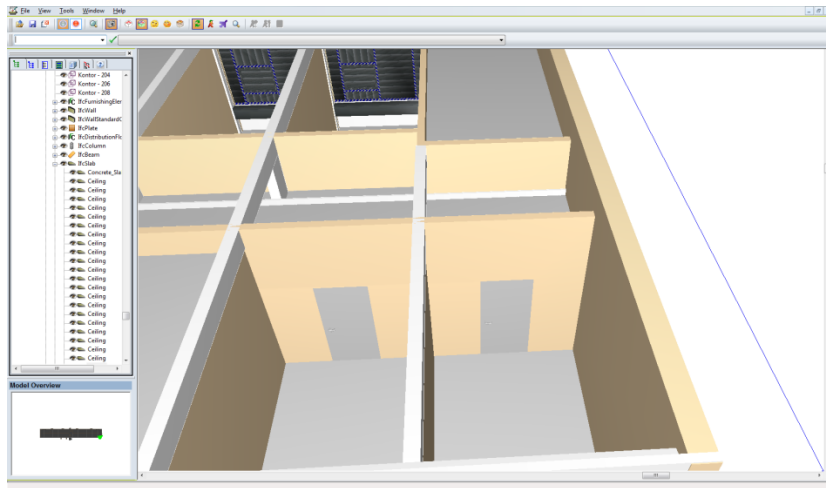
Figure 19 - Duplicated room in DDS-CAD Viewer

The second error, Figure 20, turns out to be impossible to locate directly from the viewer, Figure 21. This could be solved by hiding the elements and thus get a visible view of the error, but this is not the meaning by using BCF, it should find it by the GUID and this will be regarded as a flaw in the interaction between BCF and DDS-CAD Viewer.
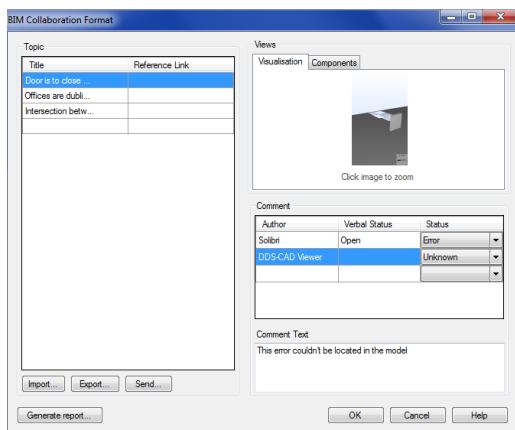
Figure 20 - Second error "Door is to close too slab"
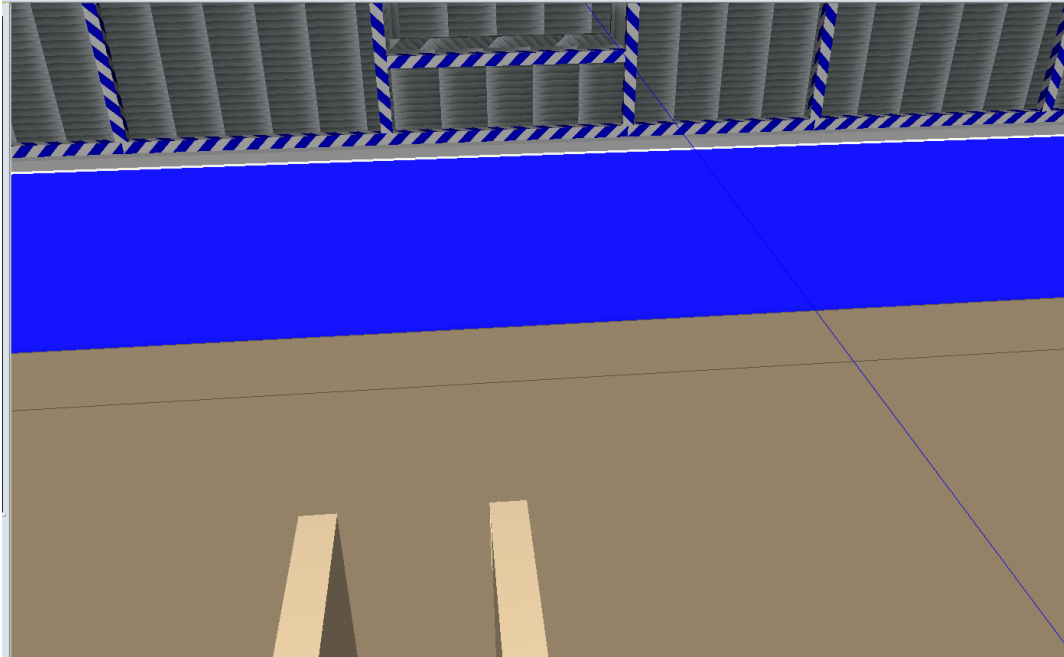
Figure 21 - View wasn't located by the GUID

The last error, Figure 22, was identified and a visual was performed. The intersection between the beam and the slab is not visible in this view. Because it seems to lie in the right order, see Figure 23.
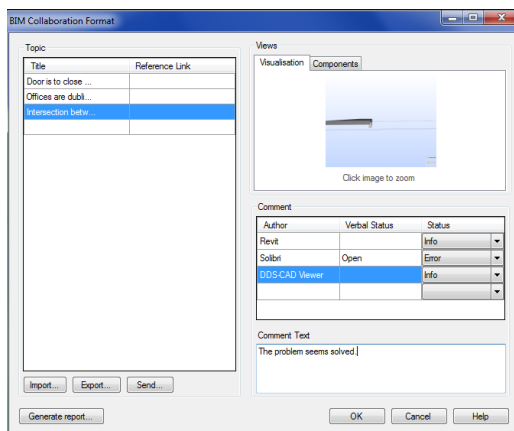
Figure 22 - Last error was identified
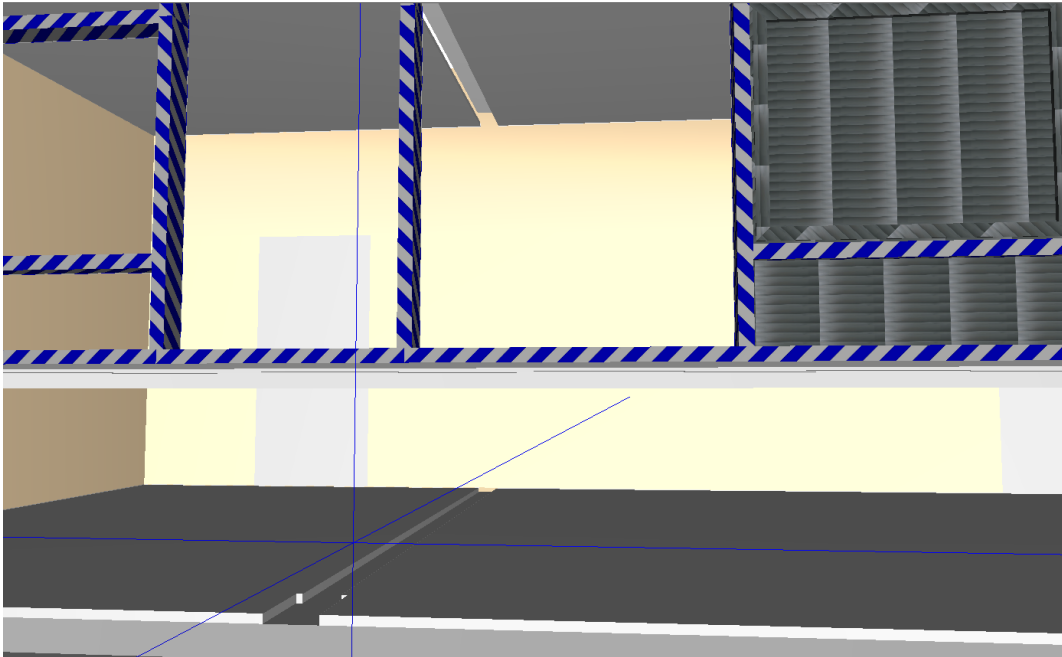
Figure 23 - View of the last error

6.2 Tekla BIMsight

Tekla BIMsight will be used, similarly to DDS-CAD Viewer, to investigate if all errors and comments are visible, and to include some within this platform. The BCF file is containing the expected information, see Figure 24, and will be investigated in the following.

Figure 24 - BCF file in Tekla BIMsight

The first error was located, but nothing was hided our highlighted, Figure 25. So to show that Tekla BIMsight is able to show the observed error, in Solibri, walls, facades, and etc. was manually hided, Figure 26. This worked, but should not be considered ideal.
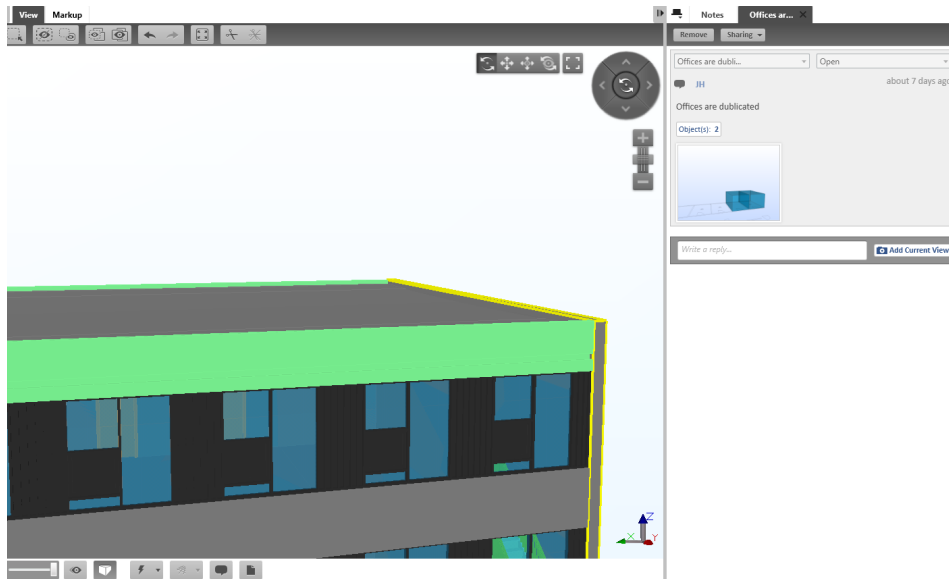
Figure 25 - Duplicated room in Tekla BIMsight
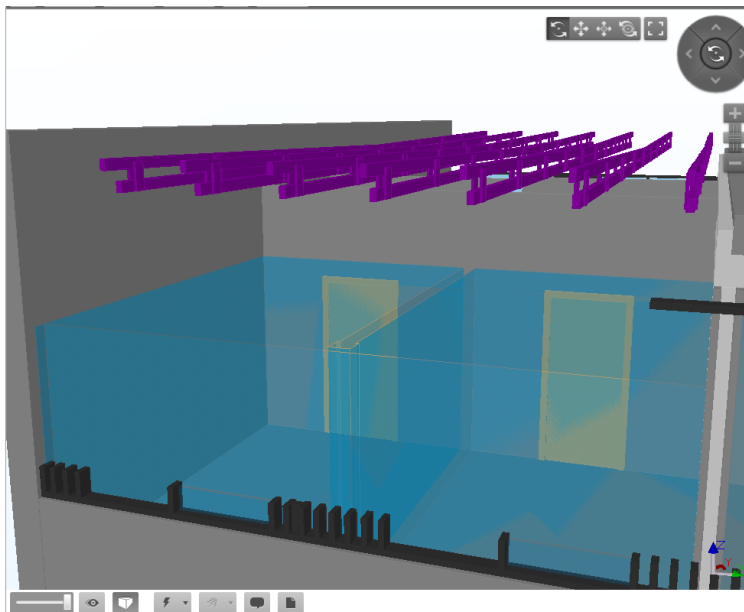
Figure 26 - Duplicated room in Tekla BIMsight with hided wall, facade and etc.

The second and third errors again turned out to be located, but is still not without manually hiding elements in the drawing, see Figure 27 and Figure 28.
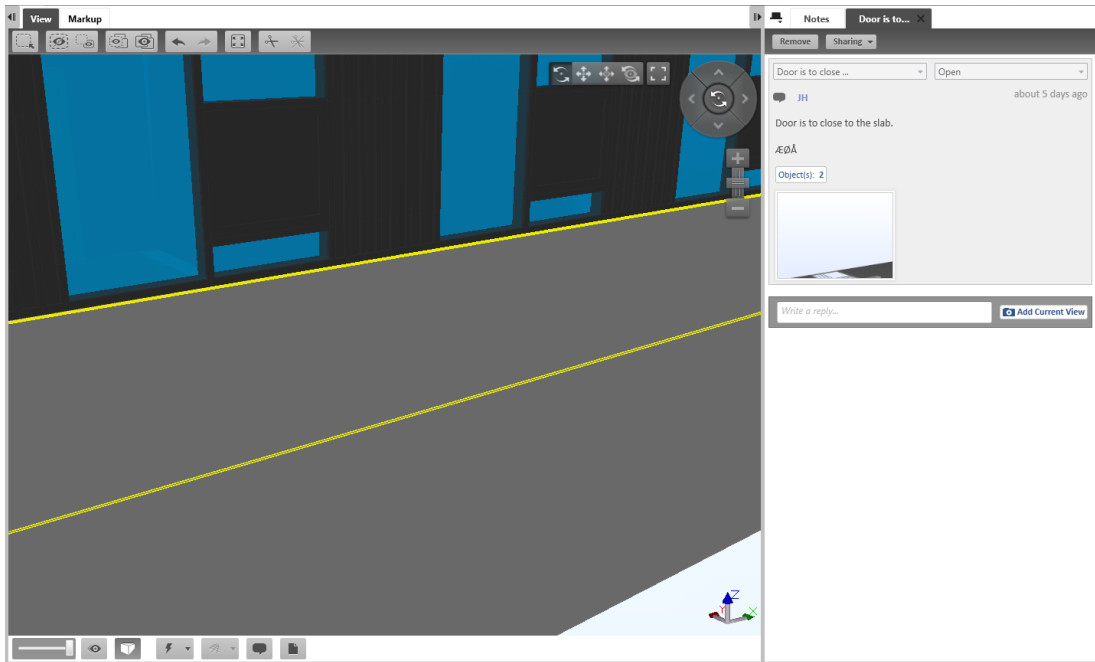
Figure 27 - Second error in Tekla BIMsight
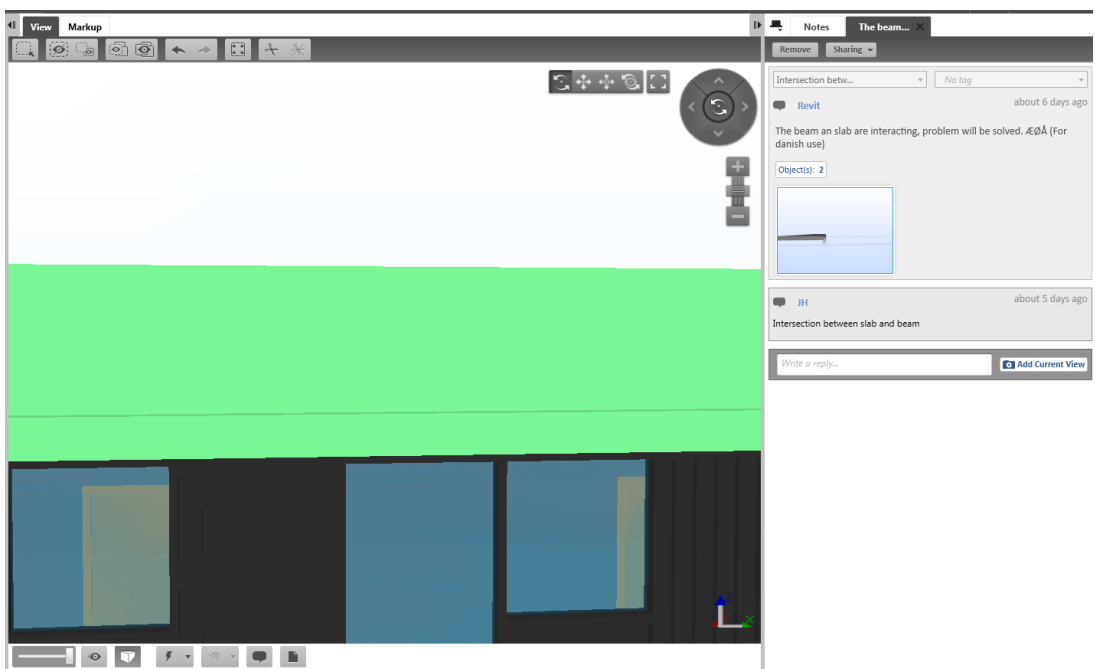
Figure 28 - Third error in Tekla BIMsight

It is a shame that Tekla BIMsight is not able to highlight the wanted building parts, because it is able to locate the GUID. So if it automatically could hide and identify the chosen element it would work after the intension and really help locating problems.

7 DISCUSSION & PERSPECTIVE

In the following an evaluation of the different platforms will be carried out, especially how the actual situation is and a proposal on what could be done differently in the future. It is important to emphasize that it is a writers point of view, based on the knowledge obtained during this review of BCF, and from the study.

7.1 Solibri

Solibri was used to investigate the 3D model, made in Revit, by using clash detection, where all elements were checked for possible clashes. After the clash detection a report with three errors was conducted with the purpose of importing them into the platforms, mentioned in table 2. In Solibri it was rather easy to comprehend, use and create a BCF file. It fully lives up to the expectations and the interaction with the other platforms was good.

Some initiatives to improve the interactions could be:

1. Change the status field so it will be consistent with **Error! Reference source not found.**, to improve the collaboration with for instance Revit and DDS-CAD Viewer, see table3 and table 4.
2. Include more than one viewport, this could improve the understanding of the error, but also make it easier to locate it in the collaboration platforms. In addition is it important at the moment to consider where the viewport is located, since it will be where it is located in the collaborating platforms.

Tabel 3 Status overview from Solibri

Status
Assigned
Closed
Open
Resolved

Even though that Solibri lives up to the expectation, it is still an expensive license with a price around 6000-7000 Euro (Solibri, 2008). With such a price is it very important that it works and produces the data/experience that is expected. The price could intimidate potential buyers from investing. These potential buyers that might be frightened away, could contribute to spread the use of Solibri and BIM tools but also to increase the amount of BCF users. The industry needs to increase the amount of users to maintain and improve the current level of users, but also to get more knowledge and propensity to invest. Solibri could be a key stone in this development, since it is well founded in developing BIM and BCF platforms.

7.2 Revit

In order to import the created BCF file from Solibri, a freeware plug-in was needed and this was installed for Revit to be able to manage the file. This plug-in turned out to have some difficulties by understanding and identifying the different issues. In spite of these complications there is a huge potential in the future with this plug-in, if some modification was implemented such as:

1. Opening the error in a 3D view instead of the "*hide/temporary view*"
    a. To improve the interpretation of the error
    b. Realize the context of the elements
2. Improve the different functions about comment/feed back
    a. Make it possible to take pictures and forward them further on
3. Make it possible to see more of the building to improve the understanding of the situation
4. Create an application which makes it possible to take in-situ pictures

Tabel 4 Status overview

Status
Error
Warning
Info
Unknown

It is a shame that Autodesk has not included BCF compatibility in Revit, because then it would be implemented as any other integrate part of the software, which has been tested thoroughly by the developer. This could minimize the amount of software mistakes/errors and improve the collaboration with the other software. Also with the license price, a form of BCF collaboration could be expected so that the software supports BCF.

7.3 The freeware programs

DDS-CAD Viewer and Tekla BIMsight is lacking several aspect compared to Revit. For instance the opportunity to improve and make adjustments regarding the 3D model and the registered errors which Revit contains, even in spite of the problems mentioned about Revit, the free ware still falls far behind. On the other hand DDS-CAD Viewer and Tekla BIMsight are freeware programs, and both the programs leaves a good impression of the current situation/usability, in spite of the limited opportunities. The two programs are both better to identify the created errors in BCF file from Solibri, but have some problems with the hiding and highlight part. If the last part, hiding and highlighting, was improved, the only problem left with the freeware programs would be that they are unable to modify and make small changes in the model. This could be solved by identifying and making solutions for all the errors and then create a BCF file with these error and solve it in Revit afterwards. However this is not ideal, since it involves more steps than intended.

7.4 BCF in regards to the theory

The theory used to regard the potential of BCF, was described in section 3 and will, as mentioned, serve as a foundation for the review. There might have been other relevant ways of evaluating BCF and its potential, however it has never been the intention to fully map all pros and cons about BCF, but rather generate a brief overview of its usage and relevance in the building process.

If BCF is considered in regards to the whole project lifecycle explained in section 3.1, it seems like the BCF will aid the process by allowing faster problem solutions by means of better communication. In Figure 29 of the project lifecycle, the appliance of BCF is considered, and the part of the project in which BCF is used is marked by the dotted line.
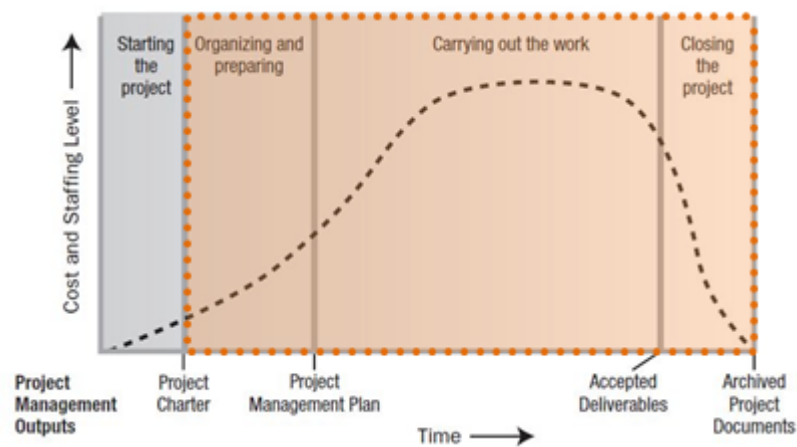

Figure 29 - Project lifecycle

It is clear that BCF can be used throughout the project once it has been fully committed, this means that BCF operates at stages of the project where the cost and staffing levels are highest. So assuming the BCF is applied properly, it holds the potential to generate a better process due to a more agile reporting method.

The ability to quickly respond to problems seems like a keystone in modern construction, and where the general BIM approach is to minimize errors by means of transparency and planning, BCF offers a smart way of communicating errors/problems throughout the entire process.

Considering the productivity issue mentioned in section 1.1.1 the BCF could be a small step in the way of breaking the stagnation experienced in the construction industry. It might not be all it takes, but the BCF addresses some of the issues in construction projects about being able to handle and solve problems as they occur. This should be seen as a positive addition both in regards to the productivity issue, and the extensive need for planning mentioned in 1.1.

The planning will not be of less importance when using BCF, but the consequences of insufficient planning might not have the same negative impact on the project, as when not using BCF. This also allows for a more balanced approach on risk management. While risk

assessments must be conducted throughout the project, a more agile problem handling method as BCF reduces the cost of unexpected problems.

It seems like BCF is a real aid in a building project. It opens up for a faster way of dealing with problems, however there might be some drawbacks in the freeware used for this review, it still seems like BCF will eventually be used as a natural part of a project.

7.5 BCF by business model canvas

The following section is an attempt to map how BCF will contribute to the building process and its general usage. The business model canvas covers many areas, some that hold greater relevance than other in terms of describing the BCF, but the canvas should provide a solid overview of BCF and its usage.

Key partners	Key activities	Value propositions	Customer relationships	Customer segments
Not relevant	*Eliminating flaws and errors in the 3D-model*	*Enables quick problem assessments and presents a visual image from the model.*	*Not relevant*	*All segments involved in the building project*
	Key resources		**Channels**	
	Skilled workforce within each segment in the project with knowledge on BCF		*Communication through IFC format between different software.* *e-mail*	

Cost structure	Revenue streams
Need free ware add-ons or license in order to use BCF	*Potential for improved productivity due to faster response to problems.* *Fewer mistakes.*

Figure 30 Business Model Canvas

By regarding the business model canvas, it becomes clear that the BCF can contribute to the general building process by utilizing faster problem solving and that it can be used as a rigid way of dealing with obstacles in the process.

7.6 The potential of BCF

BCF is still at an early stage of development, and it seems like there are some issues that have to be resolved in order to improve the overall BIM process. However in spite of these issues, the potential seems relative huge and it only a matter of time and improvement before BCF will settle in the industry. The critic in this assignment might seem rather rather negative, which can be a bit misleading since there are many good features and with the right improvements this format could save a lot of money for everyone from the developer, consultant to the building owner and contractors. It is very important to acknowledge that BCF has its justification as a BIM tool and with the benefits that it can bring to a building process such as lowering the mistakes made in the process instead of detecting them on site.

If BCF was considered in the context of renovation, a huge amount of mistakes could also be avoided. This however would put some demands about parts being willing to spend some time to implement and draw the necessary drawings and conduct the collision tests, that are required to achieve the goal. As a start, this could be implemented in the ongoing ICT agreement for public building works, where a digital delivery, by legislation, is mandatory. This could influence and force the involved parts to deliberately demand the use of BCF, perhaps even to a higher extent than it is required at that point.

8 OVERALL REVIEW

The goal of this report was to investigate the possible potential of BIM Collaboration Format, both in regards to some of the software available, and in regards to modern construction management.

Considering BCF it surely holds a potential to reinforce the CM on a building project, since it enables for a more direct approach to problems and issues experienced in the process. BCF contributes with a more visual and direct problem solving approach. This has a positive effect on the overall budget and addresses some of the problems with planning and risk management. The way BCF contributes in a risk management perspective is by offering a solid way of addressing the proper person responsible for a given area, and quickly presenting that person with the problem. Looking at BCF in regards to a business model canvas it has been possible to really point out its usage and appliance. Here it is clear that BCF contributes to many aspects in a modern building project.

With this said there are some limitations and room for improvement in today's BCF. It is still on an early stage and has to be adjusted to be competitive in the future. The collaboration between the platforms holds a huge potential, but there are still a lot to improve such as:

- Implementing more viewports, to increase the understanding of the current issue/error
- Synchronizing the status overviews, so that they are the same in each software
- Improve the localization part, so that it will locate the actual GUID but also highlight the actual component. This part is very significant, because this is the foundation of a proper communication across the different disciplines
- Include the BCF in the ICT agreement, to evolve as much as possible

These improvements have to be carried out, before BCF can be realized and trusted in a real-life building project. But with this in mind it is very important to use BCF as much as possible, because it really presents a beneficial way to address issues and thus improving the construction industry, which the business canvas model also shows. The following table is a list of pros and cons regarding the use of BCF and what we has experienced during the preparation of this review.

Table 5 - Pros and Cons regarding BCF at the current stage

Pros	Cons
Create high level of communication across disciplines and companies	The platforms has got some issues regarding locating, hiding and highlighting components
Contribute to an easier construction phase	The status fields is not synchronized
Avoid issues and errors in the model	The license price is relative high
direct issues to the responsible person	Many different platforms, with different goals

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