Should we move from 2D detailing to 3D detailing for Reinforcement Detailing?

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Learning Objectives

- Explore the capabilities of detailing reinforce concrete in Revit Structure.
- Understand the concept of creating fully a detailed 3D reinforcement concrete model.
- See how you can experience your reinforcement design and detailing before it’s built.
- On conclusion of this class, attendees should have a better understanding of basic reinforcement detailing tools in Revit.

Description

In this class we are going to look at detailing reinforcement in concrete structures and moving from traditional method of 2D detailing, to 3D detailing approach using Autodesk software. We will take a look at the comprehensive tools in Autodesk Revit Structure software and some 3rd party tools, to help accelerate the design and detailing of reinforced concrete structures.

Your AU Expert

Gareth Spencer gained a Higher National Diploma (HND) in Civil Engineering from Wigan and Leigh Technical College, UK. Gareth then went on to work in industry for 13 year starting out at small engineering firm as a Structural Technician, before working for Gifford who then became Ramboll as a Senior Technician/CAD Coordinator. The last 4 year Gareth has been working as an Applications Specialist working for firstly Cadline and now Graitec (both Platinum Autodesk resellers in the UK).

Using his many years’ of experience using Autodesk software such as Revit (Architecture, MEP and Structures), AutoCAD platforms while working on projects in industry and training hundreds of delegates on how to use the software from essentials level all the way up to advanced. I am also a certified Autodesk Revit Architecture 2015 user and able to support all the clients technical needs problems.

Gareth also uses his technical expertise working within the AEC industry to help give his clients and potential clients the solutions they need to develop, implement and execute their BIM (Building Information Modelling) strategies within their organizations.

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Introduction

In 1853 Francois Coignet, a French industrialist in the nineteenth century, was the first to use iron-reinforced concrete as a technique for constructing building structures. He built the first four-story house at 72 rue Charles Michels in the suburbs of Paris, from iron reinforced concrete. Then in 1854, English builder William B. Wilkinson reinforced the concrete roof and floors in the two-storey house he was constructing, which demonstrated his knowledge of tensile stresses. (Information sourced from wikipedia.org)

The way we design, detail and construct reinforced concrete structures has continued to evolve over many years with structural engineers designing the building by hand calculations, and now using powerful design software like Autodesk Robot Structural Analysis. To detailer/technicians using 2D detailing applications such as AutoCAD or other 3rd party applications, and now in applications like 3D Autodesk Revit.

In the beginning – Hand Drawn Drawings

Before computers and CAD was around all drawings were created by hand in a design office. The process and skill of producing engineering drawings meant offices of men and women producing hundreds of drawing which could be used to construct our past structures.
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CAD – 2D Detailing
In the mid to late 1970’s when CAD (computer aided design) systems started to replace the common hand drawn process. They began to provide a more capable way of reproducing manual drawings using electronic drafting tools.

Using such tools would help:
- *Increase productivity.*
- *Quality of design.*
- *Speed: Produce drawings faster.*
- *Efficiency: Make designers/drafters more efficient.*

Or did you just continue doing what you always done?

CAD – Typical Drawing
Producing a reinforced concrete drawing was made easier with the fact you could reference other drawing views into your drawing. This would save time when setting up the drawing and also if it changed there wouldn’t be any scratching out and redrawing again. You could simply use the AutoCAD tools to amend accordingly.
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Pros and Cons of using CAD

**Pros**
- Can be more accurate than hand-drawn drawings.
- Automate the process.
- Faster??
- Easier and quicker to edit.
- Reduce human error(s).

**Cons**
- Slower??
- Cost software and hardware.
- Staff need training.
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CAD – 2D Detailing the Next Level
Even using just AutoCAD is not going to make the process fully automated so other applications are developed to enhance productivity and precise detailing of concrete structures.

- **Autodesk Software**

- **3rd Party CAD Software**

So potentially using these tools should improve the way you detail reinforcement and automate the process. Making users be faster and more efficient.
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**BIM – 3D Detailing**

Most of the standard 2D detailing applications can work or produce a model in 3D of all the reinforcement. So with this new era of BIM (Building Information Modelling) and programs like Autodesk Revit we can now design and build a full 3D electronic model of the building or structure we are looking to construct. So why not do the reinforcement detailing at the same time.

If you were like me a in years gone by I would create a model in Revit, then I would create all the plans, sections, elevation views I would need to create my 2D reinforced concrete drawings. Export them out of Revit into either AutoCAD, ASD (Autodesk Structural Detailing) or one the 3rd party applications. Then I would spend the time detailing all the reinforcement in 2D.

So what potential problems does this cause:

- **Time**: Setup all the views ready to export out.
- **Rework**: You are having to recreate drawings/views again so you can produce reinforce concrete drawings.
- **Coordination Changes**: If something changes in the model, you then need to adjust the views and export them from Revit and then adjust the views in CAD. Then amend the reinforcement.

**Explore the capabilities of detailing reinforce concrete in Revit Structure.**

**History of Rebar in Revit Structure**

I have been doing a little bit of research in reinforcement in Revit Structure. I believe reinforcement tools where added into Revit back in 2006 in the form of an extension add-on tool for subscription users only. So we are looking Revit 8 or 9 if my memory is correct.

I can’t say of any other users outside the UK but the biggest problem using Revit was it couldn’t workout the correct radius for any bend on a bar (See below image for example). Until Autodesk fixed the problem in Revit 2014 it was not worth doing any form of detailing in Revit. Since then Autodesk have improved the reinforcement tools year on year.

![Image of a reinforcement bend with dimensions](image)

**Disclaimer**: The information gathered for the history of reinforcement in Revit was from research and memory and may not be correct.
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Revit Structure 2013 Enhancements

- Area and Path reinforcement hosting structural rebar
- Improved snapping to fillets and hooks
- New Units.
- Welded Wire Meshes
  - New Structural Fabric Area feature
  - Definition similar to the Area Reinforcement
  - Different types of fabric sheets
  - Fabric sheet alignment
  - Lap splice position

Revit Structure 2014 Enhancements

- Rebar shape definition according to European standards
- Reinforcement rounding
- Improved modelling and display of welded wire mesh
- Rebar length calculation and scheduling for UK shapes
- Rebar Placement Constraints customization
  - New types of constraints for rebar
  - New edit constraints option
  - Greater control over rebar placement
- Improve Rebar Tagging
  - New multi-rebar annotations
  - Rebar set description with a single tag

Revit Structure 2015 Enhancements

- Reinforcement for parts
  - Surface part elements can host rebar
  - Rebar follows parts’ shapes and changes
  - New parameters ‘Can-host-rebar’ for parts and ‘Host category’ for reinforcement.
- Reinforcement numbering
  - Numbering automation & customization
  - Annotation for shop drawings
  - Rebar scheduling
  - Pouring sequencing
- Single fabric sheet placement
  - New tool in the Reinforcement panel
  - Manual positioning
  - Ability to extend outside of the host cover and edges
- Presentation for rebar sets
  - Showing a representative subset
  - Different bar presentation for a rebar set in each separate view
- Enhanced multi-rebar annotation
  - Grouping and sorting
  - Annotation update
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Revit Structure 2015 R2 Enhancements
- Rebar placement in 2D views
  - Single view for multiple rebar sets definition
  - Use any plan, section, or elevation view to place rebar
  - Placement Plane panel

Revit Structure 2016 Enhancements
- All 2015 R2 enhancements

Revit Structure 2016 R2 Enhancements
- None

**NOTE: Revit Template**

*Having a good company template set up before you start work is really important. It’s going to improve efficiency, quality and consistency on your projects. Once the template is created it can always be amended or updated accordingly when and where necessary.*

Why should we detailing in Revit Structure
Well firstly you have just spent weeks or even months producing a 3D model of the structure in Revit, so why then create all the plans, sections and elevations to export into AutoCAD format to then produce your reinforce concrete drawings?

We can still provide our contractors and fabricators with the 2D information they require in the form of 2D drawings and bar bending schedules.

**Reinforcement Categories**
- **Structural Rebar** - Allows users to place a single or multiple bars.
- **Structural Area Reinforcement** – Gives the users the tools to place large numbers of reinforcement evenly spaced across floors/slabs, in foundations and walls, and other concrete families which can host reinforcement.
- **Structural Path Reinforcement** – Gives users the tools to place reinforcement along a path, for example along a slab edge.
- **Structural Fabric Area** – Places lapped fabric sheets of reinforcement into structural floors/slabs, walls and foundations.

*All these tools can be found on the Ribbon on Structural tab > Reinforcement panel.*

[Image of Reinforcement Panel]
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**Reinforcement Settings**
When detailing any reinforcement there are set guidelines to following and certain rules you need to use when detailing.

- Reinforcement Cover.
- Reinforcement bar length rounding method tolerances.
- Radius of bending to suit bar bending codes.
- Set the reinforcement numbers.

*All these tools can be found on the Ribbon on Structural tab > Reinforcement panel dropdown.*

**Reinforcement Cover Settings**
Placing bars into elements such as columns, beams, slabs, etc. you need to know cover distance from the face of concrete.

So in Revit you can use the default cover settings or customize to suit your general needs.
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**Reinforcement Settings**

General reinforcement settings to host rebar within Area and Path reinforcement, adjust the reinforcement rounding increments to both rebar and fabric. Set the rebar presentation in views and sections to show all, just the middle bar or first and last. The setting location of bars in Area or Path reinforcement.

**Placing General Reinforcement (Structural Rebar)**

Placing structural reinforcement is pretty straight forward in the sense you can just select the family you wish to detail and start adding bars.
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There is two ways to start adding reinforcement:

1. From the Ribbon select **Structural tab > Reinforcement panel > Rebar**.
2. Select the family in either a plan, section or elevation and select **Modify|Structural Foundations tab > Reinforcement panel > Rebar**.
   
   Please note that you will only be able to place reinforcement in a plan or elevation view from Autodesk Revit 2015 R2 release.

Revit allows you to place reinforcement in a number of ways:

1. You can select which placement plane which will select which face or work plane to use when placing.
2. Then the placement orientation again to either work plane or if it’s parallel or perpendicular to cover. You also have the option to sketch the bar shape manually.
3. The layout of the rebar set, single bar placement or multiple with fixed number, maximum spacing, number with spacing or minimum clear spacing.

**Rebar Shape Codes**

One great thing about Revit is that the standard shape codes are already setup for you, so all you need to do is either select from the options bar or rebar shape browser the shape you require.
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**Rebar Types**

In the properties dialog box you will have the option to select the bar size which you require from the type selector. Also in the instance properties select the partition it’s going to be part off. Revit will automatically assign a mark number for each bar and highlight the currently dimensions. Which may be changed if required.

The type properties control the bars rounding lengths, bar material, general bar, bending and hook dimensions.
Reinforcement Numbering

Revit has the capability to set the rebar numbering of each element whether it be a foundation, wall, column, beam or floor. As you will see in the below image you can see all the elements which have been added so you can easily organize the bar number. This should potentially stop any duplicate bar marks.

Scheduling Reinforcement in Revit

You have been able to model reinforcement in Revit for a number of years now, but the biggest problem has been not been able to schedule the information the correct bar lengths. This was due to Revit not working out the correct radii of the bends on bars. So reinforcement would just be something you could see in a model but wasn’t usable, especially for the UK or European market. In Revit 2014 release this was corrected and ever since Revit has gone from strength to strength.
The next issue was the parameters in the schedule not being able to get the correct number of bars for each member out of the Revit. This also made the users think should everything be detailed.

Note: If you are using the ‘Host Mark’ Parameter I have found sometimes if you don’t add the mark before you add the rebar, it won’t update host mark to the rebar. (See above image)

So there is no need to now have a separate drawing/model and a schedule created in excel or word, where is general scope of errors to be made, as you may update the drawing but not the schedule. If it’s all in one place you can’t go wrong apart from human error, which makes both incorrect.

**Area Reinforcement in Revit**
Detailing large areas of reinforcement in your structure is easier with the Area reinforcement tool for floors, foundation slabs and walls.
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**Path Reinforcement in Revit**
Using the Rebar to add the reinforcement to elements will use the cover set within the family. So if you need to add large amounts of reinforcement along a path, the Path Reinforcement tool will allow you to place multiple same length and type bars along a selected line/path (i.e. edge or face).

![Plan](image1)

**Fabric Area Reinforcement**
Structural Fabric reinforcement creates a layer of fabric in floors, walls and foundations slabs. The tools built-in to Revit will work out how many standard size sheets are required and any cut sheet will automatically workout.

In the properties you have the tools to select with type of fabrication sheet you require, its location the lap splice positions and its major and minor lap splice length. See example image below.

![Section](image2)
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Reinforcing Parts

Precast Elements
Parts has been around for a number of years now in Revit but probably one of those things just like adding reinforcement in your Revit model you have just never got around to looking at.

So say you’re creating the model and it’s going to have precast elements in such as walls or floors you can use the parts tool in Revit to split them down and add reinforcement to each part.

Once the element has been split down into parts, they retain the functionality to host reinforcement, area reinforcement, path reinforcement, and fabric reinforcement.

The only families which can be reinforced are parts which are foundation slabs, floors and walls.

Revit Extensions Tools

Reinforcement
The extension tools for Revit has been around for a long time now with tools like the following:

- Integration with Autodesk Robot Structural Analysis (Now part of the Structural Analysis tools)
- Reinforcement Modula
- AutoCAD Structural Detailing (Now Discontinued)
- Simulation
- Civil Structures (Now separate application on exchange apps)
- Steel Connections
- Timber
- Modelling
- Import/Export
- Miscellaneous
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The reinforcement tools on the Revit extension are a great way to add the reinforcement quickly to elements like columns, beams, foundations, floors and many more elements with Revit. It’s a faster way to add the reinforcement to your model.

Although these tools make detailing quicker there is a problem with the tools for UK users. When the preferences are set to UK profile it doesn’t select the shape code it creates a new one. For example placing a stirrup (Link) it should be shape code 51 and the extension calls it up as Stirrup – 31. When you start changing the shape it doesn’t always change the shape correctly. See below image.
Graitec Advanced PowerPack for Revit

Tools
GRAITEC PowerPack for Revit® is a broad suite of productivity tools that delivers more functionality, better control and more automation for Revit® users across all industries.

GRAITEC PowerPack for Revit® has been expertly localized for global distribution and includes practical, every-day utilities focused on speeding up modelling, simplifying family management, predefining annotations, dimension and drawings views to better automate documentation, and enhanced external data-links for improved BIM coordination.

GRAITEC PowerPack for *Revit® provides an essential timesaving toolbox for all Revit® Architecture, Revit® Structure, Revit® MEP and Revit® One Box users worldwide.

* Please note it’s only available from 2016 version onwards.

If you are already a get your subscriptions through Graitec this is FREE to all Graitec customers. You need to have an active subscription with us to use these tools.

Coming Soon!
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Reinforcement Detailing
A set of tools enhance productivity of reinforce concrete detailing in Revit with more functionality and automation the process further. Be the first to see these new tools first hand while in this class.

- Rebar Visibility
- Transversal Distribution
- Explode, Split, Isolate and Unite Rebar Sets
- Copy Rebar
- Delete Rebar
- Trim and Extend Rebar to face
- Area to element
- Cut Openings in Rebar set or Area
- Assign to sheet
- Set rebar number
- Renumber reinforcement
- Browse Reinforcement
- Select and delete by rebar number
- Bending detail
- Symbol and dimensions
- Dimension rebar
- Tag rebar
- Show rebar
- Automatic symbols

Visit the Graitec website for more information:

www.graitec.com

Find us on our YouTube channel Graitec Ltd and watch the latest Revit playlists:

Advance PowerPack for Autodesk Revit

Please note that all the features and tools being used are in Autodesk Revit 2016 R2 version and may not be available in previous releases of the software.

DON’T FORGET ABOUT REVIT TEMPLATE

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