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Niall Brady

Woolgoolga to Ballina Upgrade - Portion C

WINNER: CUSTOMISATION

Name:	Niall Brady
Position:	Senior Engineer
Company:	Arup Cardno Joint Venture (ACJV) (support provided fr
Name Project:	Woolgoolga to Ballina Upgrade - Portion C
Client:	Pacific Complete

Category:

- ☒ Design & Visualisation
- ☐ Survey & Construction
- ☐ Drainage, Sewer, Utilities & Rivers
- ☒ Customisation
- ☐ 12d Synergy

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Description of Project:

- The Woolgoolga to Ballina Upgrade (W2B) involves 155 km upgrade of the Pacific Highway to a dual carriageway configuration including major grade separated interchanges and upgrade of existing local roads dissected by the project.

- Arup-Cardno Joint Venture (ACJV) has been engaged by Pacific Complete to carry out the design of Portion C which comprises of Sections 7, 8 and 9. The extent of works extends from Devils Pulpit in the south to Broadwater in the north. The project includes a four lane divided carriageway for a total length of approximately 34 km. Grade-separated interchanges will be constructed to provide access to the Woodburn and Broadwater townships from the highway.

Description of problem faced / task undertaken:

- As part of our delivery ACJV are required to implement Digital Engineering (DE) processes during detail design as part of Roads and Maritime's initiative to use modelling (BIM) technologies to create and manage the delivery of the project and future maintenance of the asset.

- The deliverable for naming (tagging) elements within the design to the Pacific Complete BIM naming protocol included;
    - Highway design including an accurate 3d model of all pavement layers, earthworks, kerbs, line marking and safety barriers with the model sliced up into 100m intervals for tagging individual attributes.
    - Drainage design including an accurate 3d model for all pipes, headwall, culverts, basins and drainage channels with tagging provided for grouped elements.

- The Pacific Complete BIM naming protocol contained over 100 components to be tagged with these components subdivided into location, direction, family and number. i.e. LA-N1 for lane 1 northbound

How the problem was solved:

- ACJV had to approach the design for this project unlike any other highway project due to the complexities with the modelling, tagging design elements and slicing the alignment into 100m sections. Prior to commencing the highway and drainage design ACJV completed a review of the available software between Bentley OpenRoad, MX, 12d and AutoCAD Civil 3d to complete the task. Following the review it was agreed that 12d would be the best solution for the project given the latest developments with 3d trimeshes, use of snippets to standardise naming and chains to standardise processes.

- To ensure the design protocols were adhered to a 12d Project Plan was developed with the alignment divided into individual 12d project with strict naming conversion for models and strings to ensure clean collaboration between sections and disciplines and consistent naming for BIM tagging (Figure 1). A workflow for creating the NWC files from 12d was developed to assist with setting up the project (Figure 2)

- Smart snippets were used throughout the highway design to name stings and create trimeshes automating the BIM tagging (Figure 3). The smart snippets have drop down menus for the creation of different pavement types and pavement layers, unique BIM tags were applied to all pavement layers i.e. C-15-RA-2Z-N1 (Figure 4).

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- Another requirements for the project was to label and schedule all kerbs, barriers, line marking and water quality basins. Trimeshes for all these elements were created and labels in 12d, these labels were output on the AutoCAD plans and to excel spreadsheet for scheduling. The modelling of these elements ensured consistency with naming and removing human error in AutoCAD labelling the elements. The labels were also added to the 12da and GENIO output for the surveyors setting out on site.

- One of the more difficult process on the project was to slice the model into 100m sections and apply chainage attributes, this process was complete by setting up a new 12d project for the BIM modelling. New functions were create for each 100m interval using smart chainages and the MTF files from the original working project. These smart chainages references a computated super alignment and ran between "Cuts." Bridges were removed from the BIM model as these were detailed separately by the bridge team (Figure 5).

- Chains were used with parameter files to make the process of updating the model more efficient, the chains recalculated all the function, moved them to a new model then applied the attributes including chainages using a parameter file. The parameter file was used as it allowed flexibility when the locations of the cut chainages changed. (Figure 6 and 7)

- Trimeshes for safety barriers and line marking were created using Trimesh from 12d Object using the extrusion library.

- Once all the attribute tagging was complete the IFC Express Writer was used to write out IFC file for import into Navisworks, a NWC file was then created from Navisworks as part of our delivery for the project. Due to the file size the IFC files were divided into 1km block for exporting, this process was added to a chain. A master chain was used to run all these chains together (Figure 8). Examples of the 3d model are included in Figures 9, 10, 11 and 12 below.

- The workflows developed by ACJV with the assistance of EXDS saved time and cost to the project, the use and flexibility of 12d to automate and standardise the processes to create a BIM model to the requirements of Pacific Complete BIM protocols was a huge success on this project.

Relevant 12d screenshots and/or data attached:

	W2B - Portion C			
	Section 7	Section 8	Section 9	Comment
WORKING DESIGN PROJECTS	W2B C 70 RD MAINLINE	W2B C 80 RD MAINLINE	W2B C 90 RD MAINLINE	*Mainline alignment working project*
	W2B C 71 RD SIDE	W2B C 81 RD SIDE	W2B C 91 RD SIDE	*Side road working project*
	W2B C 72 RD SIDE	W2B C 82 RD SIDE	W2B C 92 RD SIDE	*Side road working project*
	W2B C 73 RD M CLASS			*M Class road working project*
	W2B C 74 RD STAGING	W2B C 84 RD STAGING	W2B C 94 RD STAGING	*Construction staging working project*
	W2B C 75 RD EARTHWORKS	W2B C 85 RD EARTHWORKS	W2B C 95 RD EARTHWORKS	*Earthworks for basins & channels*
	W2B C 76 SM LONG MAIN	W2B C 86 SM LONG MAIN	W2B C 96 SM LONG MAIN	*Mainline Long Drainage working project*
	W2B C 77 SM LONG SIDE	W2B C 87 SM LONG SIDE	W2B C 97 SM LONG SIDE	*Side road Long Drainage working project*
	W2B C 78 SM CROSS	W2B C 88 SM CROSS	W2B C 98 SM CROSS	*Cross Drainage working project*
	W2E C 79 SM HYDROLOGY	W2B C 89 SM HYDROLOGY	W2B C 99 SM HYDROLOGY	
	W2B C 00 RD MAINLINE W2B C 01 SM FLOOD TINS			*Global Alignment Control Project* *Global Flooding tins Project*
EXISTING DATA PROJECTS	W2B_C_U_00_Utilities			*Digitised WAE and proposed services*
	W2B_C_P_DESIGN			*Preliminary design project*
	W2B_C_E_00_SURVEY			*Global survey with project-wide boundaries*
	W2D_C_E_01_ALS HYDROLOGY			*Wide area ALS data (Bigfoot License Req.)*
	W2B_C_E_71_SURVEY	W2B_C_E_81_SURVEY	W2B_C_E_91_SURVEY	*Ground Survey data*
	W2B_C_E_73_SURVEY_RASTER	W2B_C_E_83_SURVEY_RASTER	W2B_C_E_93_SURVEY_RASTER	*Raster image per section*
	W2B_C_E_74_SURVEY_ALS	W2B_C_E_84_SURVEY_ALS	W2E_C_E_94_SURVEY_ALS	*Aerial Laser Survey data*
	MASTER EXPORT PROJECTS			
CAD	W2B C 07 MASTER CAD	W2B C 08 MASTER CAD	W2B C 09 MASTER CAD	*Export section data for CAD*
BIM	W2B C 07 MASTER BIM	W2B C 08 MASTER BIM	W2B C 09 MASTER BIM	*Export section data for BIM*

Figure 1 - 12d Project Plan

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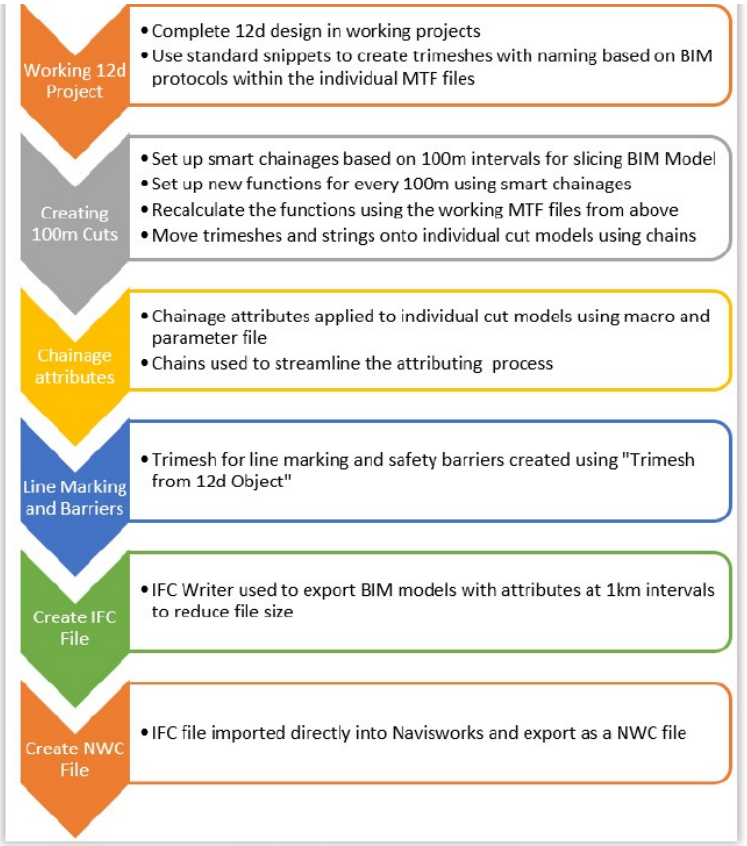

Figure 2 – BIM Modelling Protocol

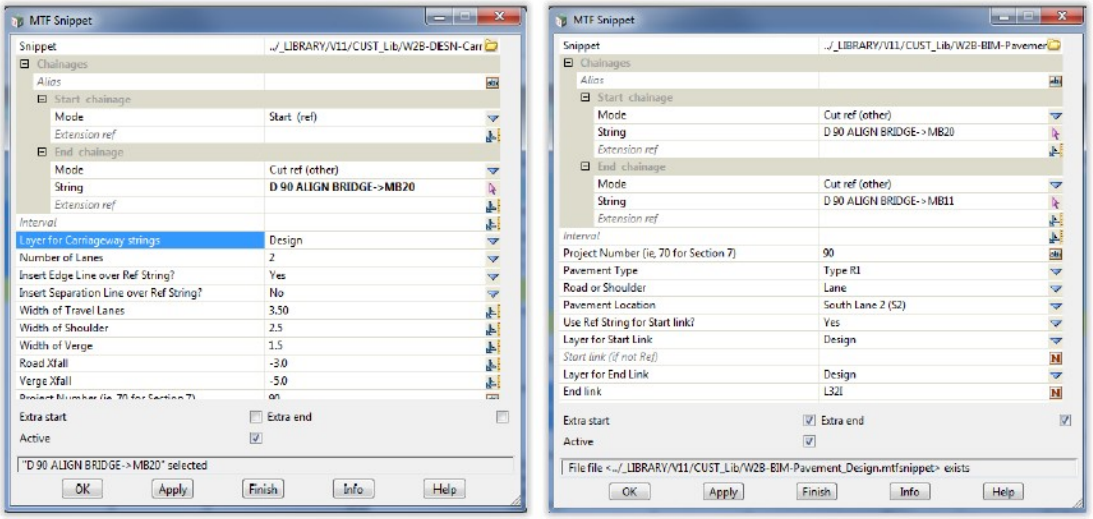

Figure 3 – Smart Snippet for Mainline Design and Pavement Trimeshes

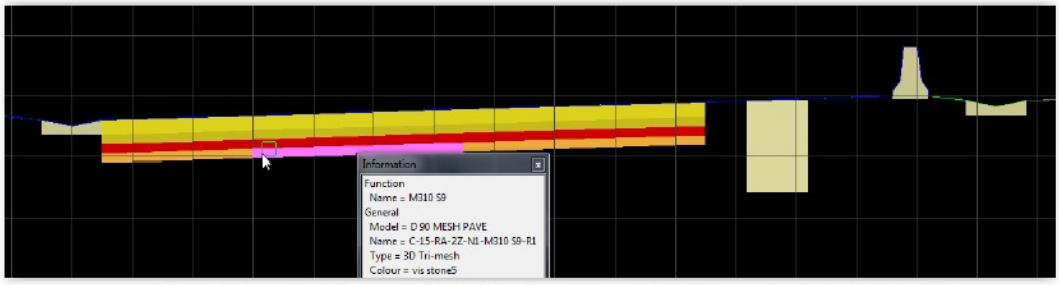

Figure 4 – Example of pavement, barriers, kerbs, and anchor blocks trimeshes cross section

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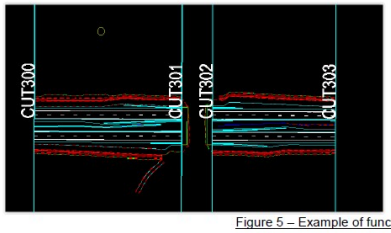


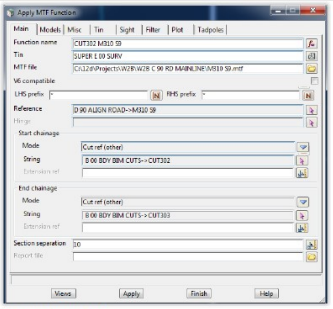
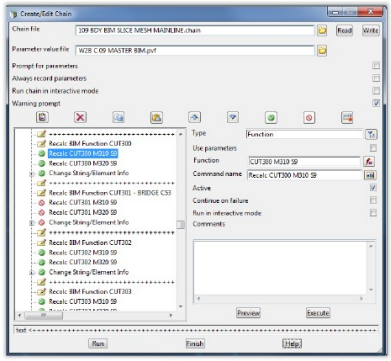


Figure 5 – Example of functions between Cuts



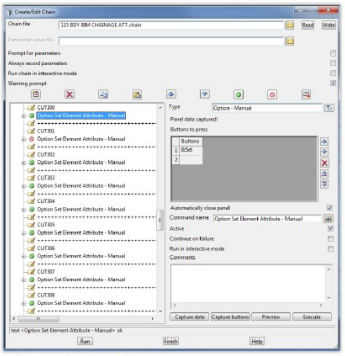
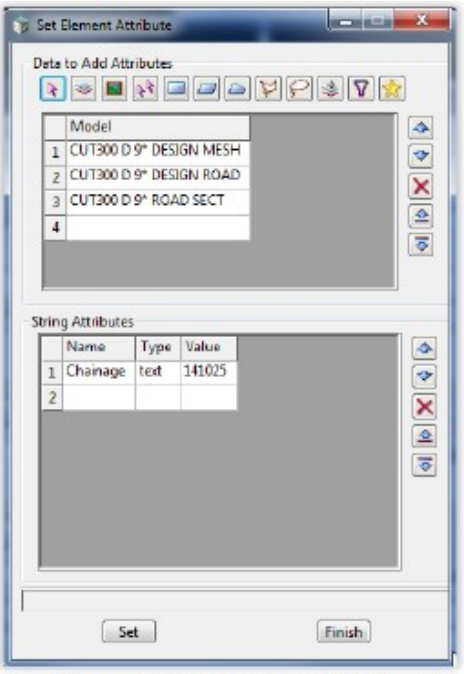


Figure 6 – Chains for Recalculating Functions and Applying Attributes



- Apply chainage using the Set Elements Attributes macro

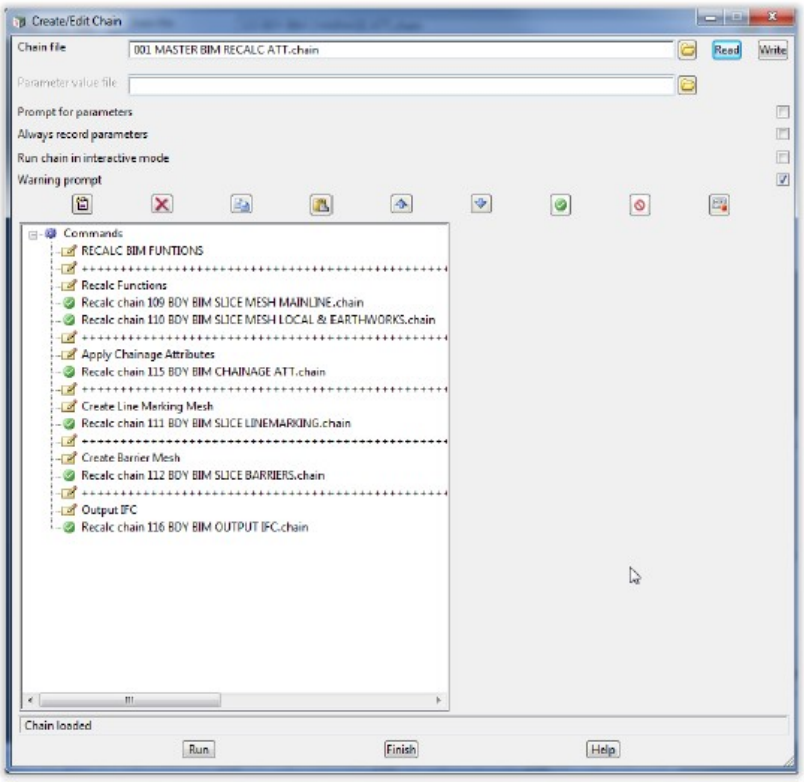


Figure 8 – Master chain for exporting IFC files

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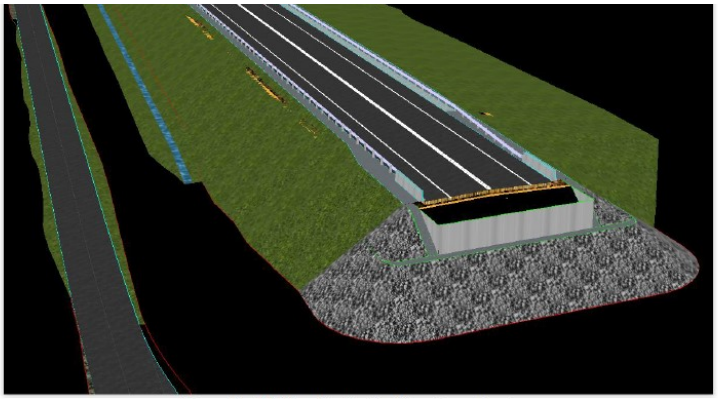

Figure 9 – 3d Visualisation in 12d using extrusions

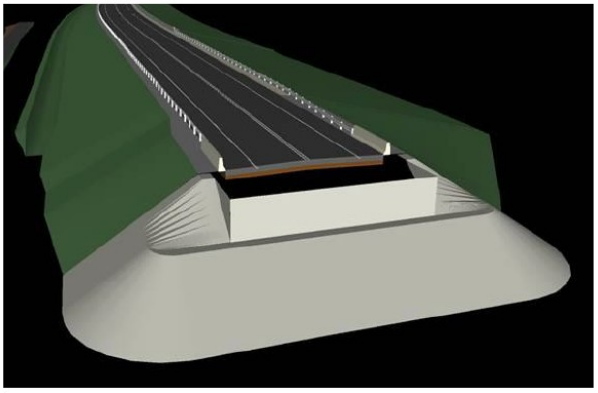

Figure 10 – 3d Visualisation in Navisworks

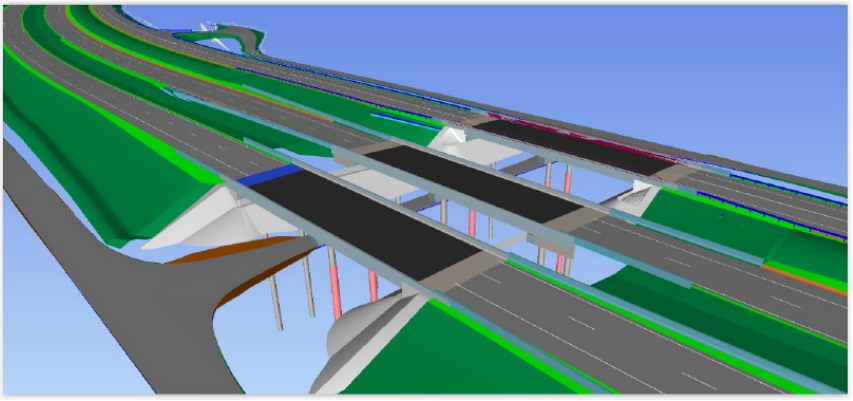

Figure 11 – 3d Visualisation in Navisworks with Bridge Model

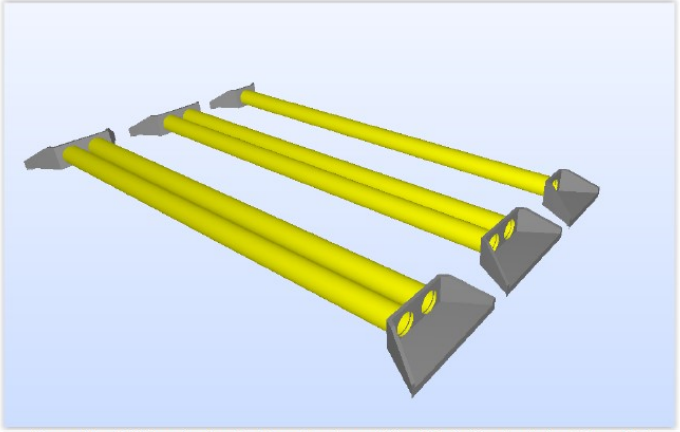

Figure 12 – 3d Visualisation for Cross Drainage Using Mesh Headwall direct from 12d