



# **Australia & New Zealand Shop Detailing Documentation Guide**



# Use of this Guide

Thank you for choosing to design with mass timber. XLam manufacture Cross Laminated Timber (CLT) from one hundred percent natural and renewable radiata pine. Each lamella and panel is unique, even with great care by XLam, slight deviations in grain pattern, knot location and colour will occur. By choosing to design in mass timber you are embracing the natural beauty of a renewable building material, its perfection is in its natural imperfection.

The information in this guide is based on testing methodology and certification owned by XLam. The information is provided for use in the design and specification of XLam manufactured Cross Laminated Timber (CLT) only. The guide is not intended as general information and guidance for all manufactured Cross Laminated Timber (CLT). The guide and information is specific to XLam CLT and no warranty is given to the suitability and application of the information to other manufacturers CLT.

## Design Guide Description

XLam has published this document to inform industry stakeholders such as architects, building designers, structural engineers, builders and other consultants who will be preparing drawings and information that will form the basis of XLam's shop drawings.

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## Context

Our Shop Detailing document is intended to provide a clear understanding of the level of detailed documentation required to ensure a seamless transition from XLam's shop drawing process through to manufacturing. This document is also intended to assist clients in understanding what is required from their consultants to ensure XLam can provide the right product in accordance with the agreed specification. This will ensure customers achieve the maximum benefits available for the project. XLam's intention for this document is to clearly define both our expectation of what incoming information is required, and to inform stakeholder expectations on what XLam will deliver through the shop drafting process.

## Glossary

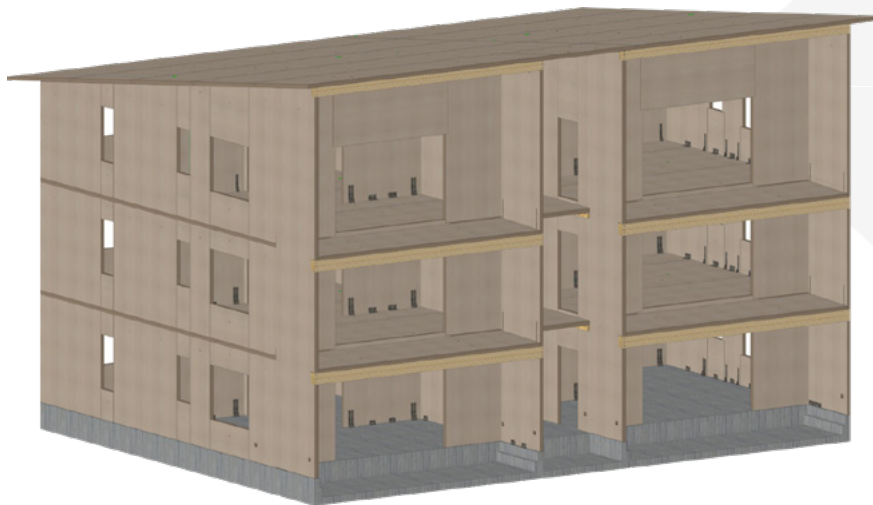
|        |  |
|--------|--|
| CLT    | Cross Laminated Timber                                 |
| BIM    | Building Information Modelling                         |
| CNC    | Computer Numerical Control (automated cutting process) |
| Billet | A large pressed CLT slab, from which panels are cut    |

## Overview of Prefabrication

Cross Laminated Timber (CLT) is produced in a factory environment using highly accurate manufacturing equipment. CLT is part of a family of prefabricated building materials which require a different construction philosophy, which includes enhanced coordination and earlier planning. The early engagement of the design team can identify problems that might occur on-site on computer screens well ahead of construction phase. A large volume of the construction work that was previously being done on-site is being done earlier, in state-of-the-art, factory-controlled conditions.

The level of precision achieved through the prefabrication process requires all stakeholders involved in the project to coordinate and complete drawings earlier in the project lifecycle, compared to a more traditional construction process. If stakeholders work to traditional project process and documentation timeframes, many of the benefits of prefabrication may become redundant.

In order for a project to move from design, through shop drawings and into production, XLam needs to model the project, detail the panels, and nest the individual panels into larger billets ready to be pressed and CNC machined. For XLam to begin this modelling and drawing process, we require an accurate and complete set of documentation so that we can fully understand the structural, architectural and services design intent and convert this into fabrication information for our processing plant. The set of drawings provided to XLam to start drawing should ideally be the full, final and frozen engineering and architectural drawings. In other words, the drawings need to be fully detailed and complete, coordinated, and ready for construction.



When a contract is executed with XLam, a production slot is booked within one of our two manufacturing plants. The production slot contains three critical elements; the first is the allocation of resources to undertake shop drawings, the second is the feedstock ordering for the production and pressing of the billets, and the final allocation is the CNC cutting of the panels. It is vitally important to meet the deadlines associated with the allocation of resources for the project. A production slot for panel production and CNC cutting can only be booked once. If this slot needs to be cancelled, it is normally not possible to fill it with an alternative order at relatively short notice given the 12 - 16 week leadtimes. A failure to have sufficient documentation may result in the allocated slot being missed, and the next available slot being provided. In times of high demand, this could be a significant time delay for the project. It should be noted that a one week delay on the project may not transfer into a one week delay in manufacturing. A number of other factors relative to other customers orders need to be considered. Hence, the requirement to meet deadlines to ensure a smooth process.

## Architectural Documentation Requirements:

.PDF (printed from CAD i.e. not hand sketches) copies of CLT plans, sections, elevations and details, clearly indicating:

- CLT outline of floors and roofs, nominating all penetrations, rebates and recesses in the panels  
Note that specialty CNC machining will come at an additional cost and will not have been assessed or allowed for in initial pricing
- All items relevant to XLam panel fabrication appropriately dimensioned
- Set-down areas to be nominated in floor and roof plans
- CLT outline of all walls (in plan) drawn as correct thicknesses as per structural requirements
- Details of wall and floor build-ups
- Door and window schedule clearly nominating the structural opening size with window labels on plans/elevations/sections

## Structural Engineering Documentation Requirements:

.PDF (printed from CAD i.e. not hand sketches) copies of CLT plans, sections, elevations and details, clearly indicating:

- CLT outline, thickness and no. of layers, span directions, penetrations (minor and major)
- Durability treatment of elements
- All CLT and all Glulam (if part of scope) element sizes
- Sizes for any steel framing, and details of any steelwork penetrations or cutouts in CLT
- All supporting elements shown with nominated structural sizes
- Connection details for every unique junction both timber-timber and timber-supporting element nominating:
  - Tolerances where required
  - Screw/bolt/bracket brand, type, size, quantity

It should be noted that installers onsite will need to refer to the structural engineers drawings to understand how to connect panels together. Screws and fixing details are not redrawn on XLam shop drawings.

## BIM and CLT

At XLam, we pride ourselves on our accuracy of detail, which is critical to the prefabrication and production process. The industry has taken great leaps in a short period of time, and XLam is at the forefront of this exciting change. The following section is intended to outline how we currently deal with Building Information Modelling (BIM) when received from consultants.

## Models from Architects and Building Designers

Architects and building designers are the stakeholders responsible for defining the dimensions and levels within any structure. As such, models from architects and building designers are generally accurate, and a great starting point for XLam's drawing process. XLam fabricate panels to millimetre tolerance and it is important that our models are also built to that accuracy. At the current point in time, we treat the models received as a geometric baseline, and develop our own modelling, panelisation and detailing accordingly. It is critical that incoming 3D models are accurate and do not contain errors (overlapping panels, panels not meeting properly at interfaces, etc). In some cases, where the model has not been completed to this standard, XLam needs to develop a 3D model from scratch. If XLam are required to rebuild the model, additional charges may apply. In order to realise the benefits of prefabrication and BIM in the CLT manufacturing and construction process we would recommend that the accuracy of models should be a key consideration early in the process.

### CAD Drawings:

Corresponding CAD files (in the form of a .DWG file) are required for all architectural .PDF plans, sections, elevations and details as per above with the following requirements:

- CAD drawing must be accurate, scaled correctly, clean and free of clutter
- Panels must be drawn accurately, with no elements clashing or overlapping
- CLT extent must be in a layer able to be isolated from the main drawing
- Lines must be drawn accurately with integer dimensions i.e. not decimals
- Gridlines and reference points must be in every drawing plan, elevation and section
- All supporting members (timber, steel, concrete) drawn to exact sizes as per structural drawings

### 3D Models

If a 3D model is available, a copy of this is requested in either RVT, IFC or SAT format. Consultants should carry out a clash detection review prior to issuing documentation. The content of the 3D model should match the .PDF and CAD drawings issued. XLam do not accept hand sketches or computer assisted sketches as final "for construction" drawings. We can review hand sketches during the design development stages however we must commence shop drawings from CAD drawings in .DWG or .DXF.

## Models from Structural Engineers

XLam requires LOD 350 as a minimum. Structural models are often not completed to the same level of accuracy XLam requires for shop drawings. Models usually do not locate all structural elements in their true location to the nearest millimetre. I.e. a steel beam is often not drawn at the correct height and plan location, as the structural engineer is not responsible for defining the setout dimensions in a building. We often use a structural engineer's model for general understanding of the design intent, however we seldom use it to develop our models and drawings from.

## What XLam will Commit to Deliver

The following table outlines documentation that XLam will issue through the course of a typical project. This schedule may vary depending on project size and complexity.

|  | Purpose  | To whom  | Format   |
|--|--|--|--|
| <b>Issue 1 – For Consultant Comment</b>            | Consultant review of model for dimensional correctness and interpretation of structural intent | Customer, Architect & Structural Engineer            | .PDF of drawings and IFC, SAT or WEBGL file of model |
| <b>Issue 2 – For Consultant Approval</b>           | For Approval Issue of shop drawings & model  | As above   | As above   |
| <b>Issue 3 – For Construction (Internal Issue)</b> | For Construction Issue of shop drawings & model  | As above, XLam factory and third party manufacturers | As above, BVX model and .PDF drawings                |

These documentation issues will include the following information:

### Issue 1 – For Consultant Comment:

- 3D model
- Model panelised and properly interfaced with other structural components
- Items not included: fixings schedule (if relevant), construction sequence, truck sequence, treatment, visual specification and lap joints

### Issue 2 – For Consultant Approval:

- As above, plus;
- Fixing schedule, construction sequence
- Site solutions (if relevant)

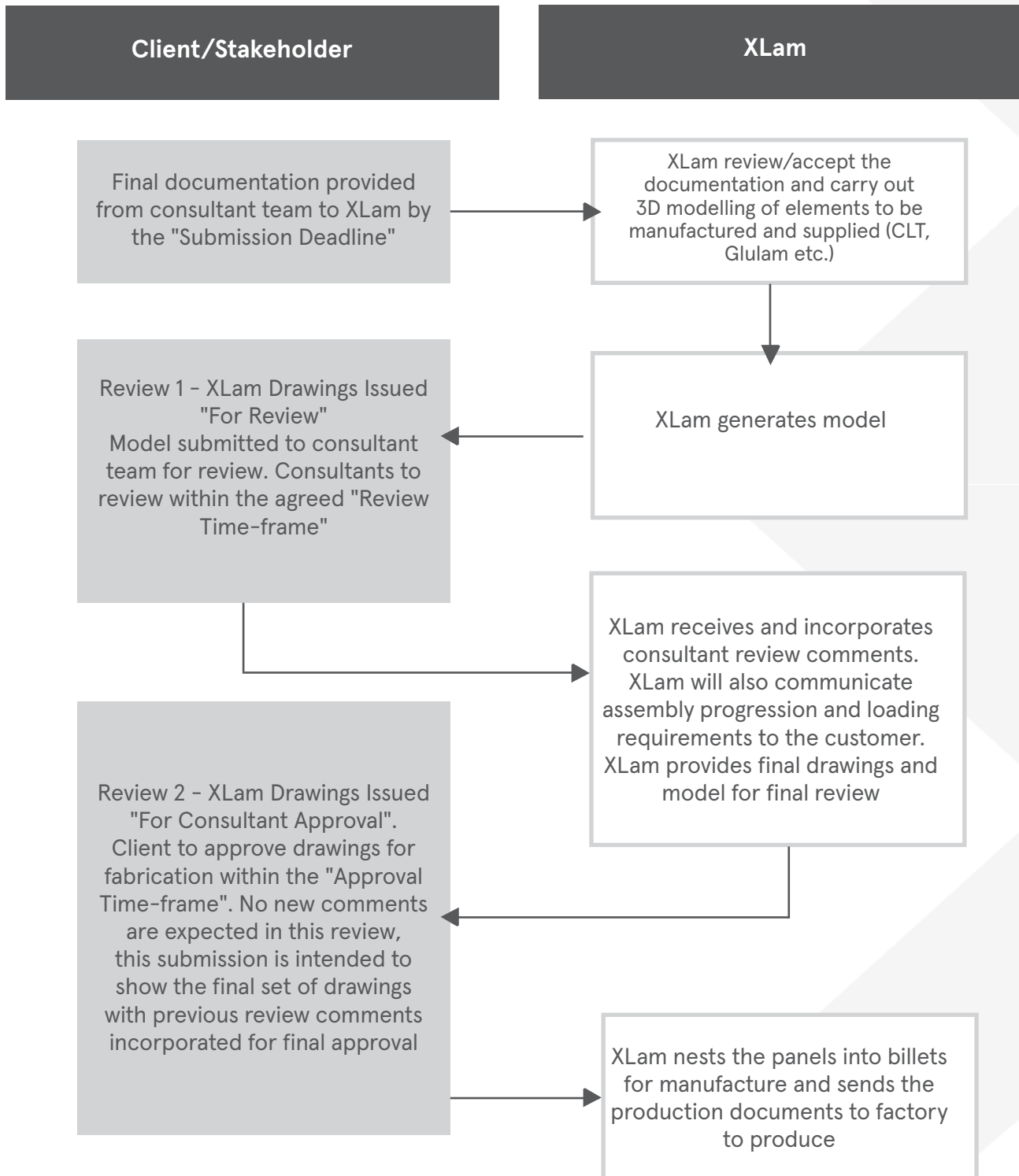
### Issue 3 – For Construction:

- Individual panel QA Drawings in .PDF format (internal use only but can be requested by customer for more information)
- Model file in .BVX format (internal use only)
- Loading drawings
- Production documentation
- Full .PDF drawing file which is essentially an As Built set of drawings

It should be noted that XLam shop drawings will need to be read in conjunction with other drawings onsite, refer to the later section on Site Installation.

## The XLam Drawing Process

The flow chart below outlines the shop drawing process undertaken by XLam prior to the manufacture of cross laminated timber elements. Appendix 4 provides an indicative delivery time-frame flow chart for this process, however this time-scale will vary depending on project volume and complexity.



## The XLam Submission Deadline

The “Submission Deadline” is that date by which the consultant team needs to submit full and final documentation to XLam in order to achieve manufacturing timeframes. The Submission Deadline varies between projects but is 16 weeks or less prior to the production slot. Prior to the Submission Deadline, changes to documentation can be made with no impact on the XLam delivery timeframe.

Once the documentation is submitted to XLam at the Submission Deadline, the design needs to be final and frozen, well detailed, dimensionally accurate and the architect and structural engineer need to have fully coordinated and documented all elements relating to the CLT and the supporting structure. It is at this point that the structure should be considered virtually “built”.

As with any prefabricated building system, the level of involvement from the consultants needs to be of a higher level than that of traditional construction techniques in order to realise the full potential of an offsite solution. A broad outline of this coordination process that should occur prior to the Submission Deadline is as follows:

1. Initial architectural drawings/schemes are developed
2. Initial structural and building services design is developed
3. Architectural drawings are progressed, aligning with the structural and services requirements
4. Final structural and building services design is completed and fully documented
5. Comprehensive architectural package is completed, fully aligning with the engineering documentation

Note: Stages 2-5 often run in conjunction and therefore require continuous collaboration between the consultants to ensure the design documentation aligns.

XLam can assist consultants in reviewing documentation prior to the Submission Deadline and providing feedback. We prefer to work collaboratively to achieve the level of documentation required than to realise at the Drawing Submission that there is insufficient information.

If the documentation is not complete at the Submission Deadline, XLam can assist with developing documentation however there may be time or cost implications. If it is anticipated that this service may be required, it would be beneficial to the project that XLam are made aware of it well in advance of the Submission Deadline. Depending on the scale and complexity of the project, and consultant experience with offsite building solutions, it may also be beneficial to note that XLam can be engaged under an ECI (Early Contractor Involvement) to consult to the project team to assist the team in delivering the required level of documentation and to help expedite the design and documentation process.

XLam are more often being engaged to produce shop drawings earlier in the design process, working alongside the design team and taking ownership of the CLT portion of the 3D model. This avoids double-handling of modelling, improves fabrication and buildability as we can leverage our understanding of efficient detailing earlier in the process and can shorten the overall leadtimes for the project. Further information can be obtained through discussions with the XLam sales team.



## What Happens if Something Changes After the Submission Deadline

Generally, it is required that all relevant information to XLam's shop drawing work is provided at the Submission Deadline. It is at this point that the project should be considered "built", and therefore XLam do not anticipate, or allow for, any changes to the models or drawings following the Submission Deadline. A change is considered to be any information provided to XLam after this date, that does not match with the documentation submitted at the Submission Deadline. Shop drawing review comments that contradict information provided at the Submission Deadline are also considered to be a change. As mentioned previously, a one week delay on the project may not transfer into a one week delay in manufacturing. A number of other factors relative to other customers orders are required to be considered. Hence, the requirement to meet deadlines to ensure a smooth process.

In some cases, XLam may be able to incorporate changes with no repercussions depending on what level of drawing has been completed. However, if changes received after the Submission Deadline cause XLam to have to carry out additional work, XLam may need to charge a variation for this additional work.

Booking a slot in XLam's production can be thought of like buying an airline ticket. We can only sell the production slot once, and if things change prior to fabrication, it is unlikely we will be able to fill that slot with another job at relatively short notice.

With an airline, if you need to fly on a different day, your options are normally:

1. Lose your seat and buy a new one
2. Seat moved to another date, with additional cost
3. Seat refunded under certain circumstances

Similar to the airline analogy, if the production slot needs to be moved due to design changes or documentation delays, it is possible the production slot would need to be cancelled and rescheduled in the next available slot. We try to avoid this wherever possible, however this reaffirms the importance of receiving complete and coordinated documentation at the Submission Deadline.

Depending on timing, costs resulting from changes may include redrafting of shop drawings, re-nesting of panels for CNC cutting, alterations to orders for timber feedstock, alternative delivery charges if staging changes, storage costs for panels if delivery is delayed and administration charges.

## **Appendix**

**Appendix 1: Working with Other Materials**

**Appendix 2: Site Installation**

**Appendix 3: Quality Assurance of XLam Documentation**

**Appendix 4: Typical Project Timeframes**

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## Appendix 1: Working with Other Materials

### Steel

Steel is a material that also needs to be shop drawn, and hence coordination with XLam's process is critical. XLam often need to detail panels around steel penetrations and cut-outs. Where steel is used, the steel framing is usually the primary support structure, with the XLam components fixed to this primary steelwork.

#### The Process is as Follows:

- Steel detailer produces a 3D steelwork model of just the "shafts", meaning that the connections are not detailed, but all of the lengths of steelwork are modelled. This 3D model will be required by XLam prior to the Submission Deadline in either .SAT or .IFC format.
- XLam will detail the panels around the steelwork. The steel fabricator shop detailer needs to provide a model with all connections in place for our consideration.

It should be noted that advanced engagement with your steelwork detailer will be required when co-ordinating CLT and steel in a project. The steel detailer generally does not have to complete any additional work to achieve the process above, however they may need to carry out this first phase of modelling a little earlier than normal.

The structural engineer needs to ensure that connections are detailed with appropriate tolerance where steel and CLT elements intersect or connect. If the steel fabricator finds that connection plates and details clash with XLam panels once modelled, XLam may need to modify their modelling.

### Precast and Insitu Concrete

Generally speaking, interfaces between concrete elements and XLam components are usually relatively simple connections with appropriate inbuilt tolerance. It is expected that precast panels and insitu elements are fabricated/constructed in accordance with the dimensions outlined in the structural and architectural drawings. XLam generally does not need to coordinate our shop drawing process with the precast manufacturers shop drawing process. Importantly, the structural engineer needs to detail connections between CLT and concrete elements to provide an appropriate level of tolerance between these materials.

### Timber, LVL's and Glulam Supplied by Others

XLam frequently supplies other mass timber elements like LVL and Glulam to a project and can shop draw these elements if required. It is often preferable to have a single model for all these elements where possible to improve coordination, and XLam can collaborate to provide shop drawings or model files if required. Where XLam is not responsible for shop detailing of LVL or Glulam elements being produced by others, we will model these elements only for spacial consideration to model our XLam elements. Generally XLam does not require any shop detailing model from the LVL or Glulam supplier. If the LVL or Glulam supplier needs to coordinate with XLam's detailing, they can be provided with our 3D model and .PDF shop drawings at the consultant's review stage.

## Appendix 2: Site Installation

### Drawings Used for Site Installation

XLam will produce sufficient drawings to manufacture and set panels out onsite. Installers onsite will need to refer to the structural engineer's drawings to understand how to connect the panels together. XLam will ensure panels are manufactured to suit these onsite connections. For example, XLam will detail panels for manufacturing with a half lap to connect panels together, all connections for CLT with reference back to the structural drawings.

It should be noted that all connections and fixings are modeled in the XLam shop drawings as we need to fully understand each fixing and bracket correctly within the model and so we can determine an accurate bill of quantities for these items.

### Temporary Works

It is a requirement of the project that a suitably qualified and registered temporary works engineer be engaged for the project. Temporary works will be detailed by this engineer and are hence not shown on XLam shop drawings. The contractor will use XLam shop drawings onsite to understand the panel set out, the temporary works engineer's drawings to understand propping, and the structural engineer's drawings to understand the permanent connection between panels.



## Appendix 3: Quality Assurance of XLam Documentation

The XLam QA process is multi-faceted, however can be broken down into two main categories; design QA and factory QA. The following sections detail the quality assurance program for each facet outlining the roles and responsibilities of each party in the process.

### Design QA

During the XLam shop drawing process and subsequent stakeholder reviews there is much scrutiny put onto the model and 2D drawings, in particular with the tolerances in joints, clash detections, grain directions, panels sizes, general geometry, openings, etc. In all of XLam's outputs the project draftsman reviews a checklist of quality assurance items. Once they have completed their review of the drawings and model, a second draftsman from XLam will do the same review. Prior to issuing the drawing set to the customer for review and approval, the Contracts Manager will also do a high-level review of the drawings and model. This process is repeated for each subsequent drawing issue from XLam.

Following the review process with external consultants and manufacturing signoff by the customer, the model is digitally converted into an alternative format for production and machining and is issued to the factory with individual drawings of each panel. The panels shown in our model will reflect the panels delivered to site, within machining tolerances.

### Factory QA

XLam implement a formal manufacturing handover procedure for all projects. This consists of a prefilled handover sheet with project information along with the digital files necessary for the factory to produce the panels. This includes 2D shop drawings, 3D models, BVX file(s) and internal QA panel drawings.

There is a four stage QA check that is performed by the factory staff during fabrication of the CLT; Feedstock, Laboratory Delamination Testing, CNC QA check and Dispatch QA check. The relevant QA checks to the panel geometry are the CNC and Dispatch QA checks.

The CNC check occurs immediately following the completion of the CNC program that is performed on the panel. As the finished panel rolls out of the CNC, an operator will use the internal QA panel drawing to check all major panel dimensions and perform a visual check of every panel. There is a formal handover sheet for each panel that is filled in by the CNC operator which nominates any further work required to the panel. The marked QA sheet, handover sheet and physical panel is then handed over to finishing and dispatch.

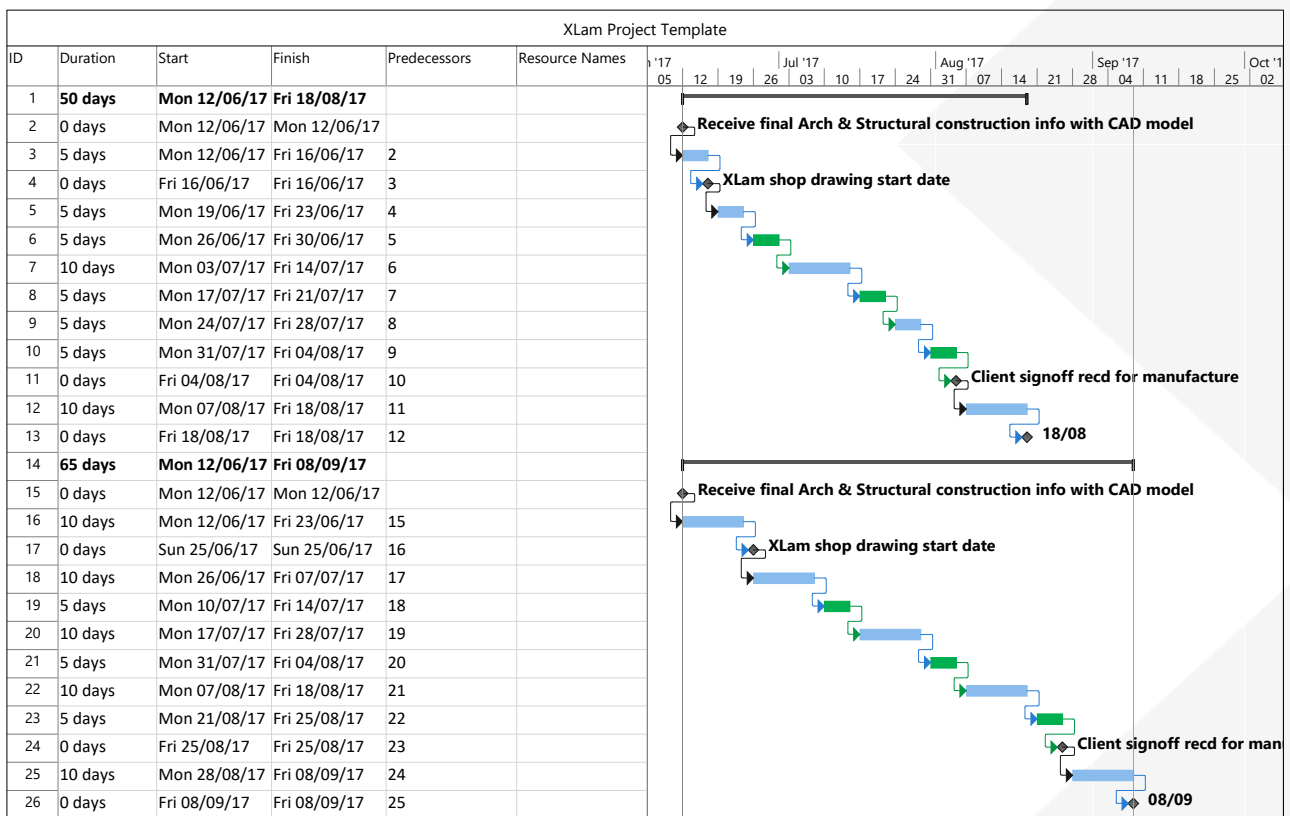
The finishing and dispatch team will review the handover sheet and undertake any finishing required to the panels (pre-fitted wraps, steel plates, drillings, routings, patching etc.). Following the completion of the panels, a dispatch team member will undertake a final, complete QA of all panels dimensions including all ancillary items, drillings, rebates etc. The QA sheet is then signed off for dispatch and the panels are packaged in their corresponding pack. QA sheets are then filed on XLam servers for reference. These QA sheets are not issued out to customers and are for internal use only.

## Appendix 4: Typical Project Timeframes

The XLam Contracts Manager is the main point of contact throughout the project from the time the contract is signed until the product is delivered on-site. The Contracts Manager will submit a design and manufacturing program following the signing of the contract and this will outline the key deliverable deadlines of all parties, including XLam, in order to achieve the manufacturing slot. A sample program is included in Appendix 4. Any delays in the required submission deadlines will have direct delays to the manufacturing slot.

The Contracts Manager will undertake the initial consultant drawing reviews prior to accepting the drawings into the drawing office for shop drawings. The Contracts Manager will also issue out all XLam shop drawings and correspond with the consultant team on the drawing reviews and signoffs. Any changes to the XLam scope following the contract execution will be resolved through variations (both positive and negative sums) and will be issued by the Contracts Manager. The only other staff member the customer will correspond with is the Commercial Manager who will issue the contract claims on a monthly basis throughout the project.

The final contracts claim will be issued by the Commercial Manager to the customer prior to the dispatch of the product from the factory and must be paid for prior to dispatch as per XLam’s Terms and Conditions. XLam can work with drawings via email, or via Aconex or similar platforms should the project require.







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