



PRACTICAL GUIDE TO PLANNING THE SAFE ERECTION OF STEEL STRUCTURES

1st Edition
October 2016

Australian Steel Institute
in conjunction with
Multiplex Constructions Pty Limited



AUSTRALIAN STEEL INSTITUTE

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Practical Guide to Planning the Safe Erection of Steel Structures

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1ST EDITION OCTOBER 2016

Australian Steel Institute
Practical Guide to Planning the Safe Erection of Steel Structures

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This document does not replace the need to review and manage obligations under the various state and national regulations applicable to building construction. Rather, this document may be used to establish a framework for process and controls that can help the stakeholder meet obligations to demonstrate duty of care on construction projects utilising structural steel.

This document does not mandate specific approaches to procedures and equipment to be used by the erector. It remains the erector's responsibility to evaluate the total work environment and select an appropriate methodology, provided that at least equal levels of safety inherent in the processes outlined in this Guide are maintained.

PREFACE

This guidance document is one of the required deliverables resulting from an Enforceable Undertaking (EU) actioned by Multiplex Constructions Pty Limited. In order to provide a balanced view on industry good practice, the document was prepared by a working group including representatives from Australian Steel Institute and Multiplex Constructions Pty Limited and various industry representatives including engineers, fabricators and erectors.

It is intended the publication is used as a basis for industry awareness and education and to drive positive change, which forms a component of the Enforceable Undertaking.

The publication was peer reviewed by a range of subject matter experts and industry professionals prior to being published.

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1. Introduction

1.1 Purpose

This Guide sets out practical guidance for planning the safe erection of steel structures. The purpose of the Guide is to define the planning processes and controls necessary to help support best practice outcomes which mitigate health and safety risks for all stakeholders associated with the erection of steel structures. The aim of the guide is to inform stakeholders so that better practices as a whole may be considered and implemented and to increase awareness of the legislative requirements in each state for all parties to understand their obligations. Appendix A contains a number of examples of existing publications, which are relevant reference documents for this Guide.

Within the context of this document, “shall” indicates a statement is mandatory and “should” indicates a recommendation.

1.2 Scope

This Guide is intended for any person involved with the design, coordination, fabrication or erection of steel structures. The Guide is intended to apply to all types of projects and provides a framework for the user to determine what steps are appropriate for their particular scope of work. Stakeholders may need to redefine the processes, roles and responsibilities outlined in this Guide to reflect the contractual arrangement applicable to the specific project and scope of work.

1.3 Terms and Definitions

TERM	DEFINITION
Competent Person:	A person who has acquired through education, training, qualification or experience (or a combination of same) the knowledge and skill that enable that person to perform the required task correctly and safely.
Erection Drawings:	Drawings included in the Erection Sequence Methodology which depict information essential to the safe erection of the steel structure. These may include Erection Sequence Diagrams.
Erection Sequence Diagrams:	Diagram/s which depicts the required sequencing in the erection of members. These should include location of any temporary propping or bracing and the sequence of installation and removal of that propping or bracing.
Erection Sequence Methodology (ESM):	The documented process for the safe erection of the steel structure. The ESM should include a sequence for installation for all steel members and be supported with Erection Drawings.
Permanent Works Engineer (PWE):	The professional structural engineer or engineering organisation, with experience in structural steel, responsible for structural design of the permanent works and for defining the technical requirements for the steel structure.
Principal Contractor:	The person or organisation engaged by the client to execute the contract works and who is authorised to have management or control of the workplace.
Safe Work Method Statement (SWMS):	A document that sets out the high risk construction work activities to be carried out at a workplace, the hazards arising from these activities and the measures to be put in place to control the risks involved.
Structural Steel Subcontractor:	The entity engaged to supply structural steel for a defined scope of work.
Temporary Works Engineer (TWE):	The professional structural engineer or engineering organisation responsible for the temporary condition and stability aspects of a steel structure during erection. This role requires the person to have a sound knowledge of the structure and its capacity in a temporary state. This role may be assumed by the Permanent Works Engineer.

1.4 Standard versus Non-Standard Structures

This guide draws a distinction between ‘standard’ and ‘non-standard’ steel structures. Competencies are a key factor when stakeholders determine whether the scope of work they are considering is standard or non-standard for them. For the purposes of this document, standard steel structures are those for which the steel erector has extensive experience and a high level of competence and which do not require them to consider any special processes or erection methodology.

The distinction between standard and non-standard structures may influence the scope and extent of implementation of requirements outlined in this Guide, including:

- » The range of stakeholders engaged at the various project phases (see Section 1.6)
- » The extent of risk planning workshops (see Section 2.2)
- » The scope and extent of the ESM (see Section 2.3 and Appendix B)

Engagement of a TWE is recommended for all non-standard structure scopes of work with regular consultation with the PWE. Engagement of the TWE may be by the Principal Contractor, the Structural Steel Subcontractor or the Steel Erector.

1.5 Project Phases

This Guide is structured around the **phases** of design, fabrication and erection of structural steel on a typical project as detailed below and set out in the chart under Section 1.7. Phases may occur concurrently particularly during shop drawing and pre-erection as pre-erection planning may provide outcomes that are required to be captured by detailing within the shop drawings.

PHASE	DESCRIPTION
Concept Design	The phase where the overall structural design concept is formulated and buildability aspects are initially considered.
Design Development	The phase where the design is developed to a point where the Principal Contractor is typically engaged and detailed planning for construction of the project can commence.
Detailed Design	The phase during which structural design documentation is completed and construction planning has generally been finalised.
Shop Drawings	The phase where structural steel shop drawings for the project are produced by the Shop Detailer and reviewed by the Permanent Works Engineer, and Temporary Works Engineer where applicable, prior to fabrication.
Pre-Erection	The phase where structural steel erection processes are finalised, are incorporated into the Erection Sequence Methodology and this methodology has been approved.
Fabrication and Transportation	The phase when the designed structural steel is fabricated in accordance with the reviewed shop drawings and the member/assembly identification procedure has been determined. All logistics including transportation to site have been reviewed and agreed.
Daily Erection	The phase where the day to day erection processes are carried out. Where erection processes are split into shifts, and defined processes for beginning of a shift and ending of a shift are determined.
Sign Off and Handover	The phase where project key deliverables are identified documented and managed through a coordinated programme of construction, commissioning and completion activities to achieve Practical Completion and Handover.

1.6 Stakeholders

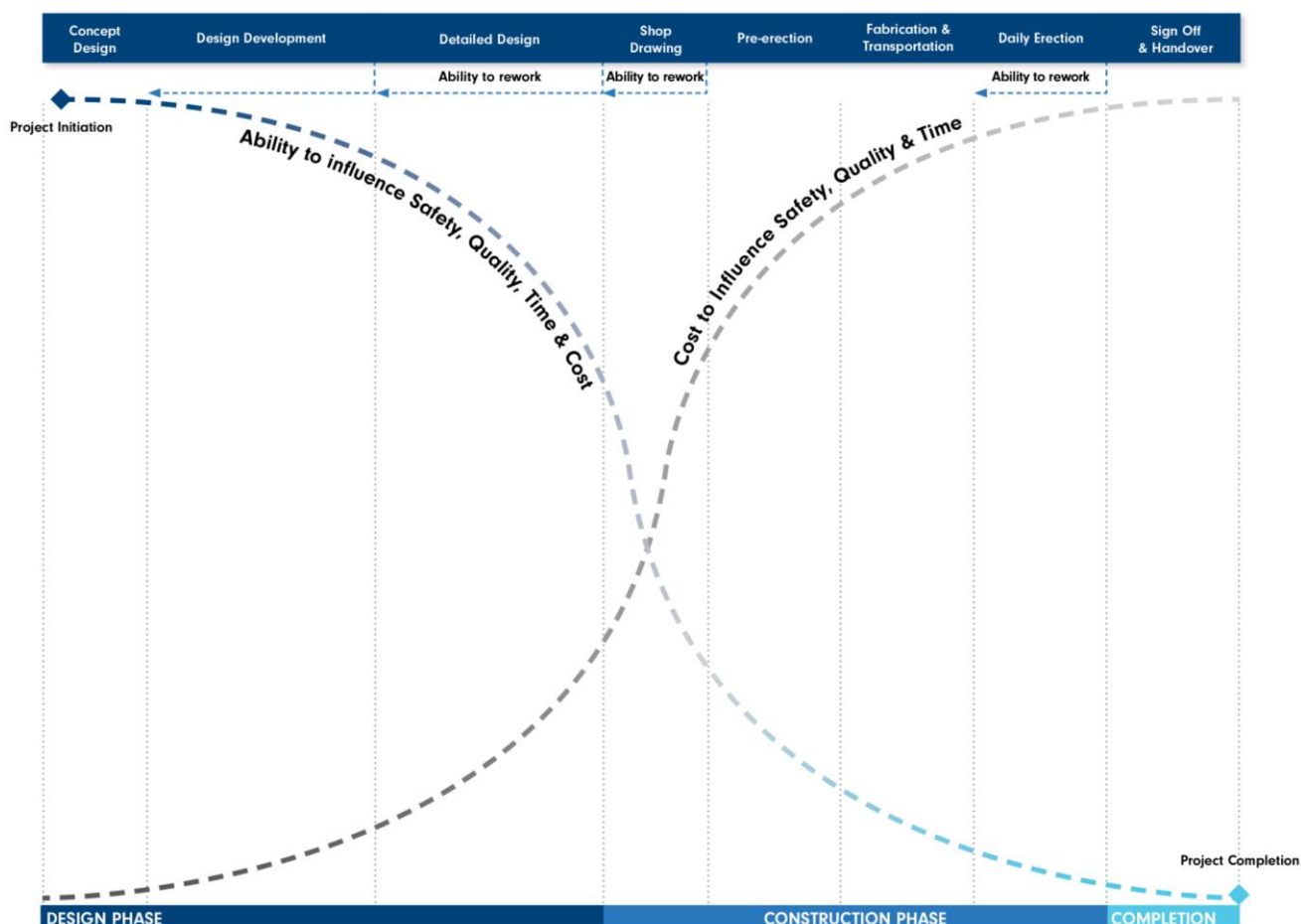
For the purposes of this Guide, the competent persons having roles and responsibilities for planning for the safe erection of steel structures are detailed in the below matrix. Availability of stakeholders and timing of participation will vary for each project and will be determined by contractual arrangements. Assessment of which of the activities is applicable for the specific scope of work is required by the Principal Contractor in consultation with stakeholders as is the allocation of responsibilities.

ROLES AND RESPONSIBILITIES	Permanent Works Engineer	Principal Contractor	Temporary Works Engineer	Structural Steel Subcontractor	Shop Detailer	Fabricator	Steel Erector
Consult and communicate with all stakeholders at all stages of the project lifecycle.	✓	✓	✓	✓	✓	✓	✓
Prepare and contract scopes of work for the PWE, the TWE, the structural steel subcontractor and any other stakeholder that is associated with the works.		✓					
Prepare Safety in Design risk register/report in accordance with legislative requirements in consultation with relevant stakeholders.	✓						
Conduct design review meetings and risk planning workshops at intervals defined in this guide and document the results of the reviews with required actions.		✓					
Attend and participate in design review meetings and risk planning workshops .	✓	✓	✓	✓	✓	✓	✓
Check that the Key Process Activities outlined in this guide are utilised.	✓	✓	✓	✓	✓	✓	✓
Monitor Safety in Design risk register/report to ensure items that remain unresolved following design modifications are addressed and closed out.		✓		✓	✓		✓
Prepare the ESM (party responsibility for preparation determined by contractual arrangement).			✓	✓		✓	✓
Review and approve ESM (approving party determined by contractual arrangement).	✓	✓	✓	✓			
Develop and implement a scope specific SWMS as an outcome of the risk planning workshop/s and in accordance with legislative requirements. The SWMS shall incorporate the approved ESM.				✓			✓
Check shop drawings comply with the structural design before steel members are fabricated.	✓	✓		✓		✓	
Scheduling of steel members to be delivered to site in the required sequence for erection at the times agreed to by the Principal Contractor and the Steel Erector.		✓		✓		✓	✓
Induct all stakeholders into the SWMS incorporating the ESM and maintain a record all attendees with signoff that they have understood the SWMS.		✓		✓		✓	✓
Conduct work shift Pre-Start Meeting to review the ESM.		✓		✓			✓
Erect the steel structure in accordance with the approved drawings, specifications and ESM.		✓		✓			✓
Monitor steel erectors activities and performance against SWMS.		✓		✓			✓
Monitor progress of works and coordinate TWE and PWE hold and witness point inspections when required.		✓		✓			✓
Inspect the steel structure to ensure compliance with approved drawings, specification and ESM.	✓	✓	✓	✓			✓
Have the skill, competence, experience and ability necessary to perform the task.	✓	✓	✓	✓	✓	✓	✓

1.7 Opportunities to Influence Safety, Quality, Time and Cost

The opportunities to influence safety, quality, time and cost are typically greater and are more effective in the early stages of the project lifecycle. Adopting a mindset of 'Things Will Change' will encourage all parties to be open to the opportunity to replan at any phase. Equally the changing nature of construction projects during the progress of works may be such that the plan may require modification.

STRUCTURAL STEEL ERECTION FLOW CHART



2. Key Process Activities

The key process activities used to coordinate the management and control in respect of maximising safe work outcomes of the erection of multi-element steel structures include:

- » Communication and consultation
- » Risk planning workshops
- » Erection sequence methodology
- » Work shift meetings

2.1 Communication and Consultation

Communication, consultation and the sharing of information between all stakeholders at relevant levels and stages of the design and erection of structural steel is vital. Minutes of meetings including records of attendees, actions resulting and parties responsible for closing out actions are recommended at all times.

Methods of communication and consultation may include:

PHASES	EVENT	PURPOSE
Design Phase	Principles of Design Meeting	Permanent Works Engineer to present proposed design to all relevant stakeholders which must consider an initial approach to erection including assessment of temporary stability.
	Safety in Design (SiD) Risk Workshop	Permanent Works Engineer and Principal Contractor (if engaged), to take part in SiD Risk Workshop with Design Team to identify the significant construction, maintenance, service, repair, decommissioning and demolition health and safety risks and implement control measures to eliminate or minimise the identified risks so far as is reasonably practicable.
	Risk Planning Workshop	Permanent Works Engineer and Principal Contractor to consider the activities outlined under Section 2.2 Design Phase. Additional stakeholders to be included subject to timing of engagement.
Construction Phase	Logistics Workshops	Review transportation types and routes, delivery scheduling, materials handling and major plant involved with unloading and handling at site.
	Risk Planning Workshop	Principal Contractor, PWE, TWE, Structural Steel Subcontractor and Steel Erector to consider the activities outlined in Section 2.2.2 Construction Phase as a minimum and develop an ESM in accordance with Section 2.3.
	Shop Detailing and Design Review	PWE to review completed shop drawings, produced by the Shop Detailer, against permanent design documentation. TWE to review shop drawings against temporary works design documentation for where temporary works affect the fabricated steel
	Project Induction	Principal Contractor to outline the project specific information and minimum requirements for all personnel working on the project.
	SWMS Induction	Steel erection crew to be inducted into the site specific SWMS incorporating the approved ESM with record of inductees maintained.
	Work Shift Pre-Start Meeting	Steel erection crew to conduct a work shift pre-start meeting and consider the activities outlined in Section 2.4.1 Work Shift Pre-Start Meeting.
Completion	Handover	Principal Contractor, Structural Steel Subcontractor and PWE to transfer key documents to the client including: <ul style="list-style-type: none"> » Safety in Design Risk Register » As-Built drawings and supporting documentation » Operation and Maintenance Manual. Principal Contractor to conduct a collaborative post-completion project review to assess performance and identify and document any lessons learnt.

2.2 Risk Planning Workshops

Risk planning workshops shall include all relevant stakeholders and should consider the following:

2.2.1 Design Phase

- » Design principles as defined by the PWE including an initial erection sequence or methodology and the nature and extent of temporary works including a structural stability assessment during that sequence or methodology
- » Construction program to inform the design program and identify any procurement constraints
- » Project constraints such as limitations on plant and equipment due to ground conditions or existing structures, restrictions associated with logistics to and around the site, or working in or around an operating environment
- » Assessment of adjacent structures when required to connect to, or when required to work around
- » Sizes, lengths and weights of members and assemblies for both transport and erection
- » Connection types, if welded and/or bolted including if Snug (S), Tension Friction (TF) or Tension Bearing (TB) and assessment of connections in both the temporary and permanent condition
- » Steel, fasteners and consumables procurement sources and quality assurance and quality control requirements to ensure compliance to contractual documentation
- » Safety in design risk register/report

2.2.2 Construction Phase

Engineering

- » Site conditions including topography, prevailing weather and boundary conditions
- » Geotechnical assessment to determine if ground conditions are suitable for storage and erection of structural steel including safe operation of associated plant (eg. cranes, elevated work platforms)
- » Structural engineering assessment to determine the capability of existing structures to support temporary loads associated with storage and erection of structural steel including safe operation of associated plant
- » Structural engineering assessment of column base plate and hold down bolt assembly designs for temporary condition
- » Lifting strategy for inclusion of required connection points
- » Assessment of transient and/or locked in stresses, deflections and stability that result from the adopted erection sequence

Pre-Erection

- » Whether the scope of work is deemed standard or non-standard (refer Section 1.4)
- » Construction program to identify any time constraints for key activities
- » Terrain and topography for the correct selection of major plant
- » Identification and locating of existing services including power lines and service pits particularly in the areas where major plant will be operated
- » Sequential erection of steel members indicating nature and extent of temporary works required during the sequence with witness and hold points
- » Critical props and/or bracing and/or connections required for the erection sequence, when they are required to be installed, when they are required to be completed if permanent, or when they can be removed and how they are removed if temporary
- » Development of a scope specific SWMS in consultation with all relevant parties
- » Detailed work instructions to be developed as required with toolbox talks to review by steel erector
- » Survey of all cast-ins including bolts for accuracy and tolerance

Access

- » Access to all work faces including connections (scaffold, plant and sequencing) for installation, inspection, testing and painting
- » Working at heights including edge and/or perimeter protection
- » Assessment of adjacent activities and interaction with other trades
- » Exclusion zones for each stage of erection (lateral and vertical)

Materials Handling

- » Lifting methodology including crane selection, major plant set-up areas, expected loads including size, weight and geometry, lifting point locations with associated certification and any specialised rigging equipment required
- » Erection methodology for large and/or complex lifts and assess if any additional specific lift engineering assessment is required (ie. lift studies)
- » Laydown and storage zones – location, size and load capacity

Deliveries and Transportation

- » Delivery schedule to suit steel erection sequence
- » Method and type of transportation to site including delivery route and traffic management
- » Safety Issues with transportation and unloading of containerised loads

Erection

- » Induction of all relevant parties into scope specific SWMS and record of all inductees
- » Nomination of a key steel erector supervisor required to be in attendance each work shift
- » Expected weather conditions and identification of alternate activities that can be undertaken during inclement weather events
- » Physical marking of critical props and/or bracing including identifying whether temporary or permanent, and physical protection of same if in a location where there is risk of impact/damage
- » Progressive survey of installed members for tolerance and verticality and include what survey is a witness or hold point based on member criticality as determined by the TWE in consultation with the PWE
- » Identification of what connections require completion (full bolting or welding versus partial) and when baseplates require full grouting as erection progresses

2.3 Erection Sequence Methodology

As an outcome of the risk planning workshops an ESM shall be developed, the scope and extent of which will be determined prior to completion of the risk planning workshops and will reflect whether the scope of work is standard or non-standard (refer Section 1.4). There will usually be more than one way to sequence the erection of a steel structure. The ESM must document the sequence and method that is consistent with the specific project and appropriate for the range of stakeholder competencies.

The erection sequence methodology shall be reviewed and approved by the PWE, and the TWE if engaged, and should include:

- » A description detailing the sequential erection of steel members indicating all temporary propping and/or bracing requirements with witness and hold points
- » Erection drawings that illustrate key components of the ESM, which will include erection sequence diagrams and may include information such as foundation plans, loading and storage plans or diagrams
- » Erection sequence diagrams that will illustrate:
 - Sequential erection of steel members and location of all temporary props and/or bracing utilising colour coding if required
 - Any adjacent structures that are connected to and relied upon for temporary or permanent stability

- Critical props and/or bracing and/or connections, as determined by the TWE in consultation with the PWE, required for the erection sequence, when they are required to be installed and completed (if permanent) or when they can be removed and how they are can be removed (if temporary)
- Physical marking of critical props and/or bracing including identifying whether temporary or permanent
- Control measures such as physical protection where there is risk of impact/damage to any critical prop and/or brace
- » Details, planned layout and imposed loads of plant and equipment proposed
- » Plans/diagrams showing the location and extent of exclusion zones required for duration of erection including any staging associated with the erection sequence
- » Erection methodology for large and/or complex lifts including lifting points and any additional specific lift engineering assessment undertaken
- » A process for daily sign off by a competent person that confirms the erected steel is in accordance with the ESM at the completion of each work shift
- » Identification of key supervisor required to be in attendance for each work shift

Examples of some of the key components of an ESM are provided in Appendix B. The examples provided illustrate the differing scope and extent of the ESM when a structure is considered standard or non-standard.

2.4 Work Shift Meetings

2.4.1 Pre-Start Meeting

A work shift pre-start meeting should be conducted by the Steel Erector to:

- » Confirm that the nominated steel erector key supervisor is in attendance
- » Review the ESM and status from previous work shift
- » Confirm approval has been obtained from the PWE, and TWE if required, for any amendments to the ESM resulting from previous work shifts
- » Assess weather conditions for the duration of the work shift
- » Identify if any critical props and/or bracing are available for removal
- » Ensure all required exclusion zones are established
- » Consider the end of shift position and plan for the eventuality that the target completion point has not been reached

2.4.2 End of Shift Review

Additional considerations may need to be made at completion of a work shift. These may include:

- » If there are any modifications required to the ESM as a result of site conditions changing or a preferred erection sequence or methodology determined, these should be made prior to commencement of the next work shift. For non-standard structures these may require input from the PWE and/or TWE
- » If there is to be a significant time lag prior to commencement of the next work shift such as when a construction site is closed for a period of time, an assessment of forecast weather conditions to determine the likelihood of a severe inclement weather event occurring must be carried out as additional measures may need to be taken to ensure temporary stability of the steel structure is maintained. The PWE and TWE may need to be consulted to determine if additional measures are required and what they are.

APPENDIX A

Reference Material

Appendix A: Reference Material

A.1 General References

1. Australian Steel Institute, 'Structural steelwork fabrication and erection code of practice', 2014.
2. Standards Australia/Standards New Zealand, AS 4100:1998 (R2016) Steel Structures
3. Standards Australia/Standards New Zealand, DR AS/NZS 5131:2016 Structural steelwork – Fabrication and erection.

A.2 Workplace Health and Safety

1. Safe Work Australia, 'Construction work. Code of practice', 2013.
2. Safe Work Australia, 'Construction work – roof work. Information sheet', 2016.
3. Safe Work Australia, 'Construction work – steel erection. Information sheet', 2016.
4. Safe Work Australia, 'Hazardous manual tasks. Code of practice', 2011.
5. Safe Work Australia, 'How to manage work health and safety risks. Code of practice', 2011.
6. Safe Work Australia, 'Managing the risk of falls at workplaces. Code of practice', 2015.
7. Safe Work Australia, 'Safe design of structures. Code of practice', 2012.
8. Safe Work Australia, 'Managing the risk of falls at workplaces code of practice', 2015.
9. Safe Work Australia, 'Safe Work Method Statement for High Risk Construction. Information Sheet', 2014.
10. Safe Work SA, 'Fact sheet. Working at heights in construction', n.d.
11. Western Australia Commission for Occupational Safety and Health, 'Code of practice. Safe design of buildings and structures', 2009.
12. WorkCover New South Wales, 'Safe design of structures code of practice', 2014.
13. WorkCover New South Wales, 'Dogging', 2013
14. Workplace Health and Safety Queensland, 'A guide for doggers', 2010.
15. Workplace Health and Safety Queensland, 'Steel construction code of practice', 2004 rev. 2011.
16. WorkSafe Victoria, 'Designing safer buildings and structures', 2005.
17. WorkSafe Victoria, 'Safety erection of structural steel for buildings. Industry standard', edition no. 1, 2009.

APPENDIX B

Examples of Erection Sequence Methodologies

Appendix B: Examples of Erection Sequence Methodologies

It remains the responsibility of the Steel Erector, understanding their own experience and competence in erecting the type and complexity of structure being assessed, to determine what level of detail is required in the ESM. Contractual arrangements with the Structural Steel Subcontractor and/or the Principal Contractor may require an ESM with a greater level of detail than the Steel Erector may otherwise provide.

There a number of minimum characteristics an ESM should contain which include:

1. A clearly written set of steps describing the sequential erection procedure, with any witness of hold points nominated by the PWE.
2. Preferably, a pictorial representation of the erection sequence, and could range from a simple hand mark-up of existing engineering drawings through to a CAD or digital mark-up of workshop drawings (as illustrated in the examples).

The following examples are provided to depict the erection sequence adopted for both a standard structure and a non-standard structure (refer Section 1.4). The examples are not comprehensive ESM's as detailed in Section 2.3 but include key elements of an ESM for the purpose of providing guidance.

The same structural steel portal frame has been used for ease of comparison between the two ESM extents.

Standard Structure Erection Sequence Methodology

- 1.1 - Erect Columns x 10 (members shown in **red**) on grids 1, 4, 1N and 1P including temporary props **P1** and **P4** inc.
- 1.2 - Erect 'WB' members on grid 1 and grid 4, pre-assemble grid 1N and 1P rafters on ground and erect (members in **blue**)
- 1.3 - Erect 'T' roof members x 3 and all 'RB' cross-bracing (members in **green**)
- 1.4 - Snug tighten all bolts and tension bracing

Removal of props P3 and P4 following release of Hold Point #1 inspection by PWE. Props P1 and P2 to remain.



- Plant utilised - EWP + Crane X
- Stage 1 sequence to be completed in single work shift
- Unless noted otherwise, columns can be released from the crane once leveling nuts are plumbed and snug tightened
- Purlins and any other secondary members can be installed at any time to suit the construction sequence

STRUCAD

REVISION X

ISS

DESCRIPTION

BY

DATE

IMPORTANT NOTES

1. ALL CHANNELS/ANGLES TO BE ERECTED WITH DIRECTION OF FLANGES/LEGS AS INDICATED ON PLANS/ELEVATIONS.

2. ALL MEMBERS TO HAVE MARK END AS PER MARK BUBBLE ON PLANS/ELEVATIONS, i.e. MARK END AS SHOWN ON FABRICATION DRAWING IS REPRESENTED BY LOCATION OF MARK BUBBLE. SEE DIAGRAM -

011

MARK END

Inspection and Approval prior to progressing to Stage 2 of 3.

Supervisor: _____

TWE: _____

Date: _____

STANDARD STRUCTURE
ERECTION SEQUENCE
BUILDING 1 - STAGE 1 of 3

PROJECT _____

AREA BUILDING 1

TITLE 3-D VIEW

NOT TO SCALE DRG # _____

REVISION X

ISS.

- 2.1 - Erect Columns x 9 (members shown in red) on grids 1, 4 and 1R including temporary props P5 to P6
- 2.2 - Erect 'WB' members on grid 1 and grid 4, pre-assemble grid 1R rafter A1006+A1007 on ground and erect (members in blue)
- 2.3 - Erect R1004 and R1005, then R1006 and R1007, then 'T' x 2 and 'B' x 2 roof members (members in brown)
- 2.4 - Snug tighten all bolts

Removal of props P1 to P2 following release of Hold Point #2 inspection by PWE.



3-D VIEW

- Plant utilised - EWP + Crane X
- Stage 2 sequence to be completed in single work shift
- Unless noted otherwise, columns can be released from the crane once leveling nuts are plumbed and snug tightened
- Purlins and any other secondary members can be installed at any time to suit the construction sequence

TRUCAD

ISS	DESCRIPTION	BY	DATE	IMPORTANT NOTES
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011

MARK END

STANDARD STRUCTURE ERECTION SEQUENCE BUILDING 1 - STAGE 2 of 3

NOT TO SCALE	DRG #	ISS.
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- 3.1 - Erect all columns x 22 (members shown in red) including temporary props P7 to P10 inc
- 3.2 - Erect 'WB' members x 4 on grid 1 plus adjacent and grid 4 plus adjacent , pre-assemble grid 1M and 1L rafters on ground and erect (all members in blue)
- 3.3 - Erect all 'B', 'R' and 'T' roof members (in brown)
- 3.4 - Install cross bracing then all purlins between grids 1L and 1N
- 3.5 - Snug tighten all bolts and tension bracing

Removal of props P5 to P10 inc. following release of Hold Point #3 inspection by PWE.



STAGE 1 COMPLETE

3-D VIEW

- Plant utilised - EWP + Crane X + Maeda
- Stage 3 sequence to be completed in single work shift
- Unless noted otherwise, columns can be released from the crane once leveling nuts are plumbed and snug tightened
- Any other secondary members can be installed at any time to suit the construction sequence

TRUCAD

ISS	DESCRIPTION	BY	DATE	IMPORTANT NOTES
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Diagram of a double-stranded DNA molecule. A box labeled "011" is positioned above the top strand. An arrow labeled "MARK END" points to the right end of the DNA molecule.

Date: _____

PROJECT	
AREA	BUILDING 1
TITLE	3-D VIEW
NOT TO SCALE	DRG #
ISS.	
REVISION X	

REVISION X

Non-Standard Structure Erection Sequence Methodology

NON-STANDARD STRUCTURE - ERECTION SEQUENCE METHODOLOGY

Contract: Example
Site: Building 1
Stage: 1 to 3

Date: XX/XX/XXXX
Revision: XX
Originator: X

Stage	Member Erection Sequence	Member Mark	Member Size	Length (mm)	Mass (t)	Comment	TWE Witness / Hold Point	TWE Sign Off
1	1	C1003	200UC60	5966	0.256	Snug tighten all base plate anchor bolts.		
1	2	C1014	89X6 SHS	6325	0.146	Snug tighten all base plate anchor bolts. Install temporary prop P1, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
1	3	C1027	89X6 SHS	6325	0.073	Snug tighten all base plate anchor bolts. Install temporary prop P2, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
1	4	C1003	200UC60	5966	0.256	Snug tighten all base plate anchor bolts.		
1	5	C1007	150x100x5RHS	5598	0.076	Snug tighten all base plate anchor bolts.		
1	6	C1002	200UC60	5966	0.256	Snug tighten all base plate anchor bolts.		
1	7	C1029	89X6 SHS	6270	0.072	Snug tighten all base plate anchor bolts. Install temporary prop P3, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
1	8	C1028	89X6 SHS	6270	0.072	Snug tighten all base plate anchor bolts. Install temporary prop P4, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
1	9	C1002	200UC60	5966	0.256	Snug tighten all base plate anchor bolts.		
1	10	C1007	150x100x5RHS	5598	0.076	Snug tighten all base plate anchor bolts.		
1	11	WB1002	250X90PFC	7741	0.27			
1	12	WB1002	250X90PFC	7741	0.27			
1	13	R1010 + A1004 + R1016	310UB40	23100	1.56T	Rafter preassembled, includes member 2 x 50x50EA at end columns		
1	14	R1011 + A1005 + R1017	360UB57	23100	1.56T	Rafter preassembled, includes member 2 x 50x50EA at end columns		
1	15, 16, 17	T1005, T1005, T1006	100X4SHS	7758	0.096	Any order		
1	18 to 25 inclusive	RB1001, RB1002, RB1003	20DIA	11059, 8119, 11084	0.029, 0.022, 0.0.29	Any order, tension once all installed		
1	N/A	Purlins	Z200	various	various	Any order	HOLD POINT #1	
1						Temporary props P3 and P4 able to be removed ONCE HOLD POINT #1 released by TWE	PROP REMOVAL ACCEPTANCE	

NON-STANDARD STRUCTURE - ERECTION SEQUENCE METHODOLOGY

Contract: Example
Site: Building 1
Stage: 1 to 3

Date: XX/XX/XXXX
Revision: XX
Originator: X

Stage	Member Erection Sequence	Member Mark	Member Size	Length (mm)	Mass (t)	Comment	TWE Witness / Hold Point	TWE Sign Off
2	26	C1001	200UC60	5699	0.259	Snug tighten all base plate anchor bolts.		
2	27	C1007	150x100x5RHS	5598	0.076	Snug tighten all base plate anchor bolts.		
2	28	WB1003	250X90PFC	7790	0.272			
2	29	C1030	150x100x5RHS	5484	0.075	Snug tighten all base plate anchor bolts.		
2	30	C1025	150x100x5RHS	5484	0.078	Snug tighten all base plate anchor bolts. Install temporary prop P5, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
2	31	C1024	150x100x5RHS	5484	0.078	Snug tighten all base plate anchor bolts. Install temporary prop P6, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
2	32	C1030	150x100x5RHS	5484	0.078	Snug tighten all base plate anchor bolts.		
2	33	C1030	150x100x5RHS	5484	0.078	Snug tighten all base plate anchor bolts.		
2	34	C1013	150x100x5RHS	5484	0.078	Snug tighten all base plate anchor bolts.		
2	35	C1007	150x100x5RHS	5598	0.076	Snug tighten all base plate anchor bolts.		
2	36	WB1005	250X90PFC	7790	0.232			
2	37	WB1008	250X90PFC	6547	0.272			
2	38	A1006 + A1007	310UB40	23562	1.08	Rafter preassembled, includes member 2 x 50x50EA at end columns		
2	39	R1005	410UB60	15927	1.07			
2	40	R1004	410UB60	15926	1.07			
2	41	R1006	310UB40	10105	0.325			
2	42	R1007	310UB40	10100	0.325			
2	43	B1004	250UB34	2491	0.075			
2	44	T1007	100X4SHS	2829	0.037			
2	45	T1008	100X4SHS	2811	0.037			
2	46	B1005	250UB31	2486	0.075			
2	47	HG1001 x 4	20DIA	1255	0.008	Hanger connections WB1008 to A1006/1007	HOLD POINT #2	
2						Temporary props P1 and P2 able to be removed ONCE HOLD POINT #2 released by TWE	PROP REMOVAL ACCEPTANCE	

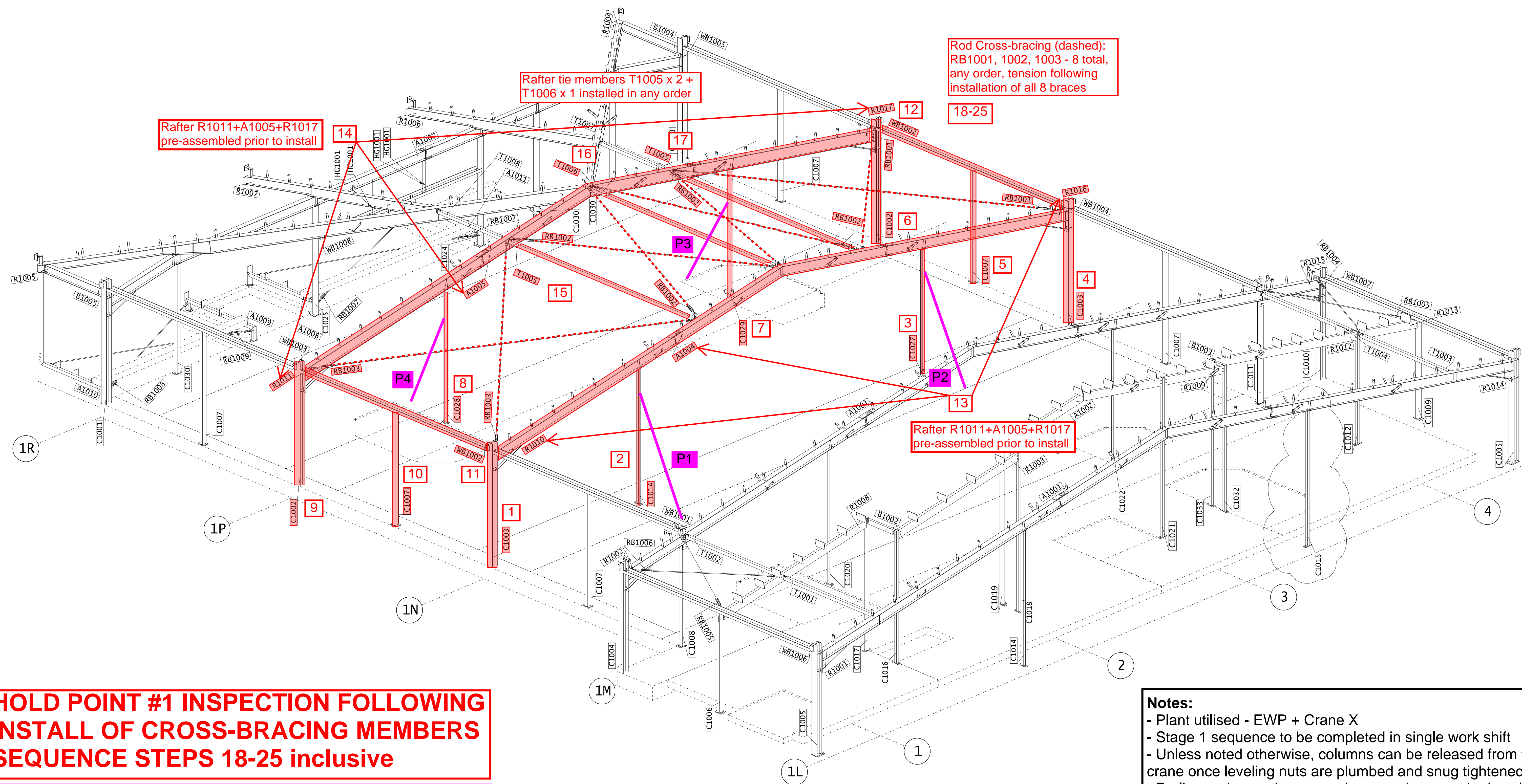
NON-STANDARD STRUCTURE - ERECTION SEQUENCE METHODOLOGY

Contract: Example
Site: Building 1
Stage: 1 to 3

Date: XX/XX/XXXX
Revision: XX
Originator: X

Stage	Member Erection Sequence	Member Mark	Member Size	Length (mm)	Mass (t)	Comment	TWE Witness / Hold Point	TWE Sign Off
3	48	C1008	150x100x5RHS	5225	0.066	Snug tighten all base plate anchor bolts.		
3	49	C1004	200UC60	5534	0.229	Snug tighten all base plate anchor bolts.		
3	50	C1020	89X6 SHS	6327	0.073	Snug tighten all base plate anchor bolts. Install temporary prop P7, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
3	51	C1022	89X6 SHS	6327	0.073	Snug tighten all base plate anchor bolts. Install temporary prop P8, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
3	52	C1011	150x100x5RHS	5225	0.066	Snug tighten all base plate anchor bolts.		
3	53	C1010	200UC60	5534	0.229	Snug tighten all base plate anchor bolts.		
3	54	R1002 + A1001 + R1015	310UB40	29158	1.78T	Rafter preassembled, includes member 2 x 50x50EA at end columns		
3	55	C1007	150x100x5RHS	5598	0.076	Snug tighten all base plate anchor bolts.		
3	56	WB1001	250X90PFC	7714	0.277			
3	57	C1007	150x100x5RHS	7714	0.076	Snug tighten all base plate anchor bolts.		
3	58	WB1004	250X90PFC	7714	0.277			
3	59	C1009	150x100x5RHS	5170	0.071	Snug tighten all base plate anchor bolts.		
3	60	C1005	200UC60	3534	0.229	Snug tighten all base plate anchor bolts.		
3	61	WB1007	250X90PFC	7791	0.272			
3	62	C1012	89X6 SHS	3577	0.065	Snug tighten all base plate anchor bolts.		
3	63	R1013	250X90PFC	1926	0.089			
3	64	T1004	100X4SHS	3862	0.049			
3	65	RB1004	20DIA	4307	0.013			
3	66	RB1005	20DIA	4292	0.012			
3	67	C1033	89X6 SHS	4623	0.079	Snug tighten all base plate anchor bolts.		
3	68	C1032	89X6 SHS	4623	0.079	Snug tighten all base plate anchor bolts.		
3	69	R1012	250X90PFC	3926	0.249			
3	70	B1003	250X90PFC	537	0.031			
3	71	C1021	89X6 SHS	5066	0.089	Snug tighten all base plate anchor bolts.		
3	72	R1009	250X90PFC	1946	0.94			
3	73	C1019	89X6 SHS	5066	0.089	Snug tighten all base plate anchor bolts.		
3	74	C1018	89X6 SHS	5066	0.089	Snug tighten all base plate anchor bolts.		
3	75	A1002	250X90PFC	6833	0.271			
3	76	B1001	150X75PFC	544	0.01			
3	77	C1016	89X6 SHS	4193	0.073	Snug tighten all base plate anchor bolts.		
3	78	C1017	89X6 SHS	4193	0.073	Snug tighten all base plate anchor bolts.		
3	79	R1003	310UB40	10188	0.498			
3	80	B1002	150X75PFC	1071	0.019			
3	81	C1006	150x100x5RHS	5170	0.071	Snug tighten all base plate anchor bolts.		
3	82	C1005	200UC60	5534	0.23	Snug tighten all base plate anchor bolts.		
3	83	WB1006	250X90PFC	7791	0.272			
3	84	R1008	250X90PFC	5928	0.262			
3	85	T1002	100X4SHS	3944	0.05			
3	86	RB1005	20DIA	4307	0.013			
3	87	RB1006	20DIA	4296	0.012			
3	88	C1014	89X6 SHS	6325	0.073	Snug tighten all base plate anchor bolts. Install temporary prop P9, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
3	89	C1015	89X6 SHS	6325	0.073	Snug tighten all base plate anchor bolts. Install temporary prop P10, connect to column. Prop type and column temporary connection as per TWE Detail XX.		
3	90	R1001 + A1001 + R1014	310UB40	29158	1.74T	Rafter preassembled, includes member 2 x 50x50EA at end columns		
3	91	T1003	100X4SHS	3812	0.049			
	92	T1001	100X4SHS	3812	0.049			
3	93	Purlins	Z25024	various	various		HOLD POINT #3	
3						Temporary props P5 to P10 inclusive able to be removed ONCE HOLD POINT #3 released by TWE	PROP REMOVAL ACCEPTANCE	

To be read in conjunction with the
Member Erection Sequence Schedule

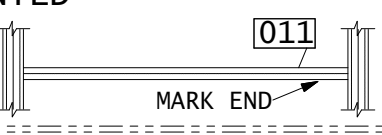


**HOLD POINT #1 INSPECTION FOLLOWING
INSTALL OF CROSS-BRACING MEMBERS
SEQUENCE STEPS 18-25 inclusive**

**REMOVAL OF PROPS P1 to P4 inc. CAN
PROCEED FOLLOWING RELEASE OF
HOLD POINT #1 BY TWE**

Notes:
- Plant utilised - EWP + Crane X
- Stage 1 sequence to be completed in single work shift
- Unless noted otherwise, columns can be released from the crane once leveling nuts are plumbed and snug tightened
- Purlins and any other secondary members can be installed at any time to suit the construction sequence

NOTE:
THIS DRAWING IS ISSUED
FOR CONSTRUCTION.

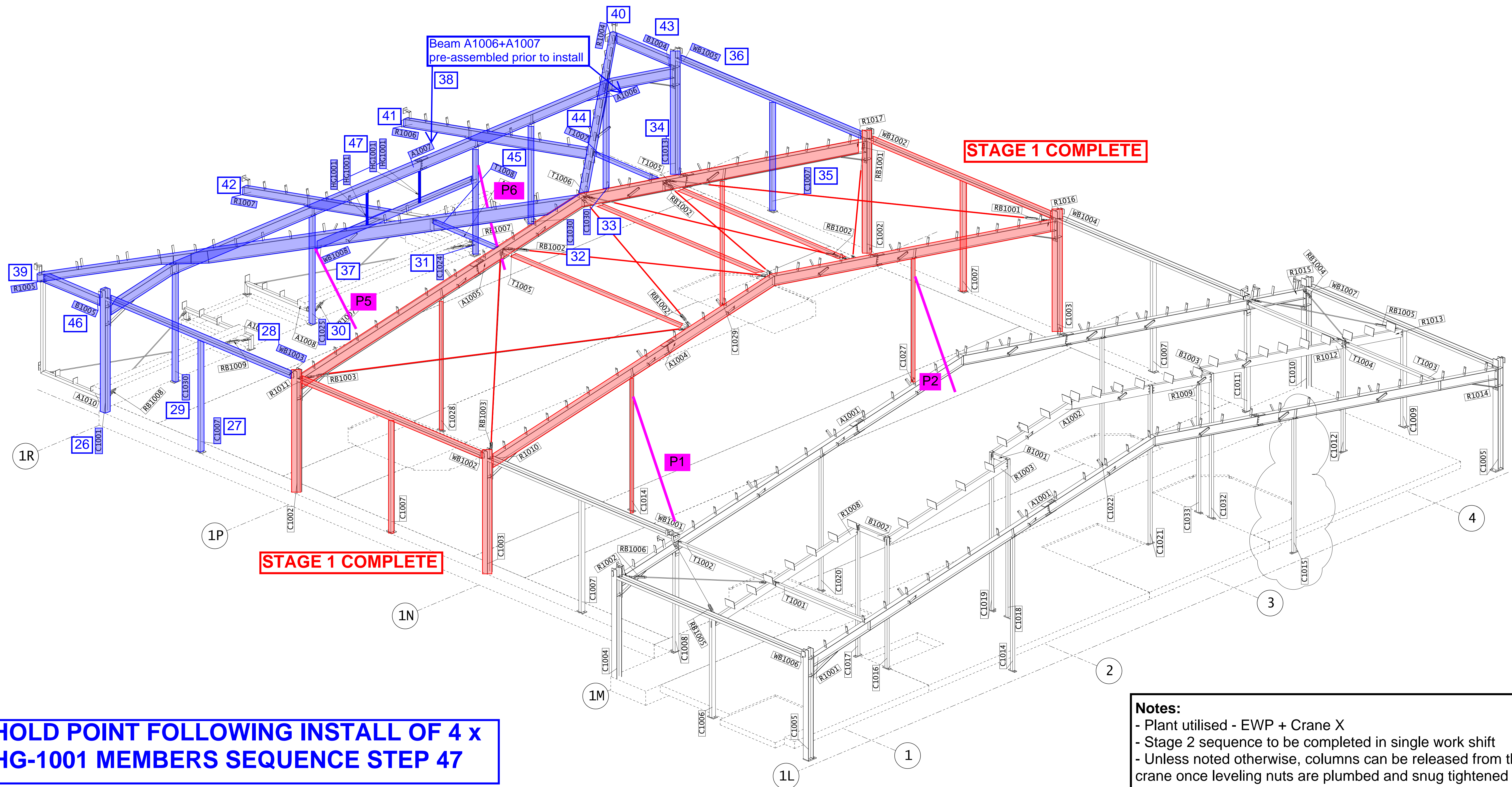
REVISION X				IMPORTANT NOTES	
ISS	DESCRIPTION	BY	DATE		
				1. ALL CHANNELS/ANGLES TO BE ERECTED WITH DIRECTION OF FLANGES/LEGS AS INDICATED ON PLANS/ELEVATIONS.	
				2. ALL MEMBERS TO HAVE MARK END AS PER MARK BUBBLE ON PLANS/ELEVATIONS. i.e. MARK END AS SHOWN ON FABRICATION DRAWING IS REPRESENTED BY LOCATION OF MARK BUBBLE. SEE DIAGRAM -	
					

**NON-STANDARD STRUCTURE
ERECTION SEQUENCE
BUILDING 1 - STAGE 1 OF 3**

PROJECT				STRUCAD	
AREA				BUILDING 1	
TITLE				3-D VIEW	
NOT TO SCALE				DRG #	
				ISS.	

REVISION X

**To be read in conjunction with the
Member Election Sequence Schedule**



HOLD POINT FOLLOWING INSTALL OF 4 x HG-1001 MEMBERS SEQUENCE STEP 47

**REMOVAL OF PROPS P5 & P6 CAN
PROCEED FOLLOWING RELEASE OF
HOLD POINT #2 BY ERECTION ENGINEER**


Notes:

- Plant utilised - EWP + Crane X
- Stage 2 sequence to be completed in single work shift
- Unless noted otherwise, columns can be released from the crane once leveling nuts are plumbed and snug tightened
- Purlins and any other secondary members can be installed at any time to suit the construction sequence

NOTE:
THIS DRAWING IS ISSUED
FOR CONSTRUCTION.

TRUCAD

REVISION X

			<div>1. ALL CHANNELS/ANGLES TO BE ERECTED WITH DIRECTION OF FLANGES/LEGS AS INDICATED ON PLANS/ELEVATIONS.</div> <div>2. ALL MEMBERS TO HAVE MARK END AS PER MARK BUBBLE ON PLANS/ELEVATIONS. i.e. MARK END AS SHOWN ON FABRICATION DRAWING IS REPRESENTED BY LOCATION OF MARK BUBBLE. SEE DIAGRAM -</div> <div></div>	
ISS	DESCRIPTION	BY	DATE	IMPORTANT NOTES

3-D VIEW

NON-STANDARD STRUCTURE ERECTION SEQUENCE BUILDING 1 - STAGE 2 OF 3

PROJECT

AREA BUILDING

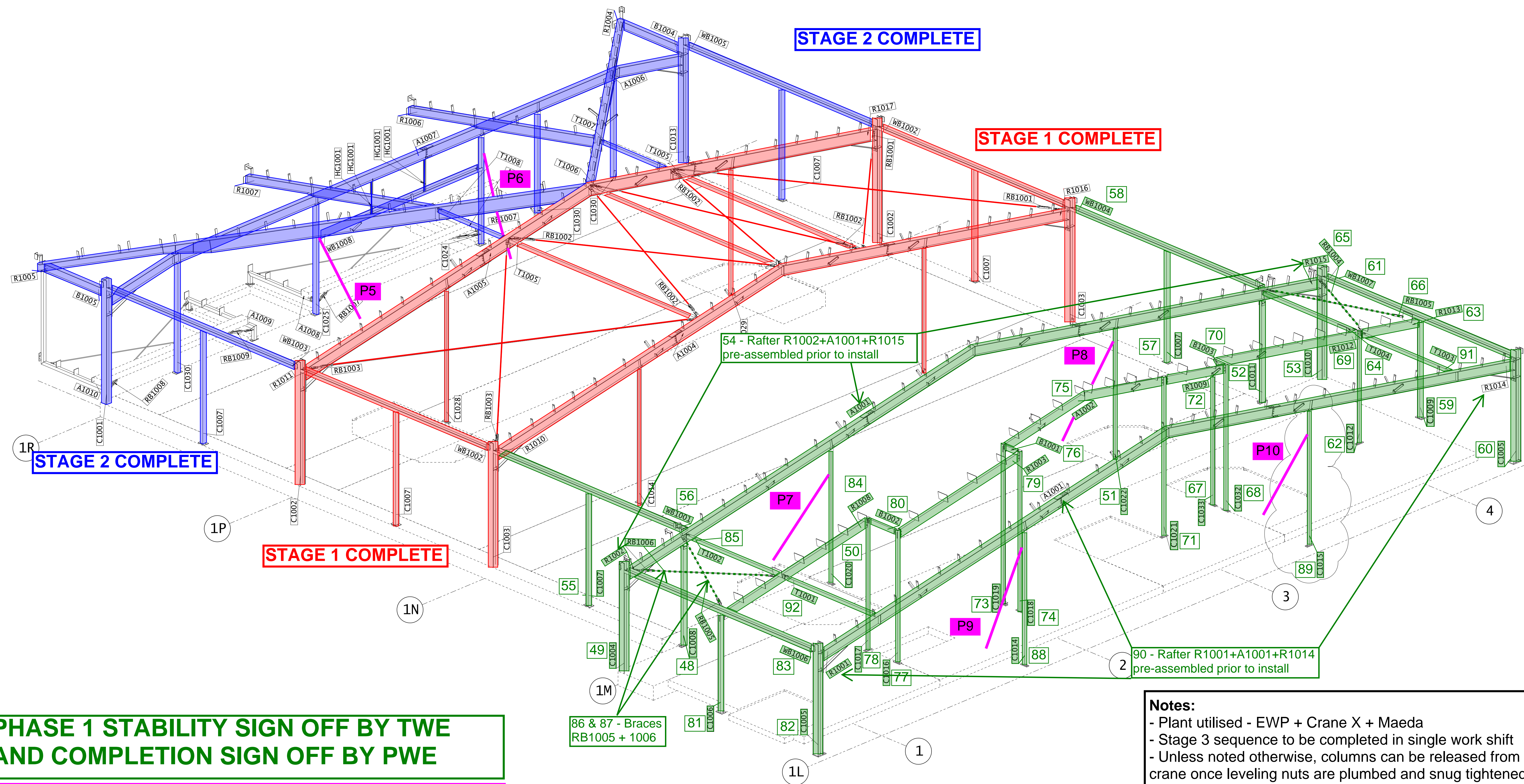
TITLE 3-D VIEW

REVISION X

NOT TO SCALE | DRG #

SS.

To be read in conjunction with the
Member Erection Sequence Schedule



PHASE 1 STABILITY SIGN OFF BY TWE
AND COMPLETION SIGN OFF BY PWE

REMOVAL OF PROPS P5 to P10 inc. CAN
PROCEED FOLLOWING RELEASE OF
HOLD POINT #3 BY TWE

Notes:

- Plant utilised - EWP + Crane X + Maeda
- Stage 3 sequence to be completed in single work shift
- Unless noted otherwise, columns can be released from the crane once leveling nuts are plumbed and snug tightened
- Any other secondary members can be installed at any time to suit the construction sequence

NOTE:
THIS DRAWING IS ISSUED
FOR CONSTRUCTION.

REVISION X				IMPORTANT NOTES
ISS	DESCRIPTION	BY	DATE	
				1. ALL CHANNELS/ANGLES TO BE ERECTED WITH DIRECTION OF FLANGES/LEGS AS INDICATED ON PLANS/ELEVATIONS. 2. ALL MEMBERS TO HAVE MARK END AS PER MARK BUBBLE ON PLANS/ELEVATIONS. i.e. MARK END AS SHOWN ON FABRICATION DRAWING IS REPRESENTED BY LOCATION OF MARK BUBBLE. SEE DIAGRAM -



NON-STANDARD STRUCTURE
ERECTION SEQUENCE
BUILDING 1 - STAGE 3 OF 3

PROJECT				REVISION X
AREA	BUILDING 1			
TITLE	3-D VIEW			
NOT TO SCALE	DRG #			ISS.