

INDIAN METAL BUILDING FORUM

IMBF

Connecting India's Metal Building Ecosystem

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RESOURCE CENTRE

Technical Knowledge Series

FABRICATION GUIDANCE SERIES

Welding Requirements for Steel Building Fabrication

Shop and site welding of PEB and structural steel | Based on AWS D1.1 practice

Qualify the Procedure

Qualify the Welder

Inspect the Weld

DOCUMENT NO:	IMBF-FAB-001
SERIES:	Series C: Fabrication (IMBF-FAB)
APPLIES TO:	PEB built-up members and structural steelwork
REFERENCE CODE:	AWS D1.1 Structural Welding Code: Steel
USE:	Quick reference for fabricators, QA/QC and inspectors

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Rev 00 | 05 October 2026 | Educational / Technical Reference (Draft for technical review)
A quick-reference summary. The contract specification and the applicable code edition always govern.

A DOCUMENT CONTROL AND STATUS

Document No.	IMBF-FAB-001
Revision	Rev 00
Publication date	05 October 2026
Prepared for	Indian Metal Building Forum, Resource Centre, Technical Knowledge Series
Series	Series C: Fabrication (IMBF-FAB)
Status	Educational / Technical Reference
Subject	Welding requirements for shop and site fabrication of steel buildings

Technical review status

- ☒ Draft (compiled from code practice and a manufacturer fabrication plan; not yet reviewed)
- ☐ Technical Review
- ☐ IMBF Approved for Publication

Disclaimer

This document has been prepared by the Indian Metal Building Forum (IMBF) as an educational quick reference. It summarises common welding requirements for statically loaded steel building structures. It is not a code and does not replace AWS D1.1, Indian Standards, the contract specification, the approved WPS or the engineer's instructions. Where this document and any of those differ, they govern. Numerical values are given for carbon and low-alloy structural steels of ordinary strength, welded with low-hydrogen processes. They were written from code practice as commonly applied and must be checked against the code edition named in the contract before use. IMBF does not accept responsibility for fabrication or engineering decisions made solely on the basis of this document.

1 SCOPE AND BASIS

- **Covers:** shop and site welding of built-up PEB members (web to flange, end plates, base plates, stiffeners, clips) and hot-rolled structural steelwork.
- **Basis:** AWS D1.1, Structural Welding Code: Steel, for statically loaded structures. Indian references commonly named with it are IS 800, IS 816 and IS 9595; confirm titles and editions against BIS.
- **Does not cover:** cyclically loaded structures such as crane girders, tubular connections, sheet steel under 3 mm, reinforcing bar, stainless steel or pressure parts.
- **Order of precedence:** contract specification, approved drawings and weld map, approved WPS, code, then this guide.

2 THE THREE DOCUMENTS: WPS, PQR, WPQ

WPS

Welding Procedure Specification. The written instruction to the welder: process, joint, base metal, filler, position, current, voltage, travel speed, gas, preheat. Must be approved and available at the welding station.

PQR

Procedure Qualification Record. The test evidence that a WPS produces sound welds: actual parameters and the results of bend, tensile and other tests. Not needed for a WPS that meets all the code rules for a prequalified procedure.

WPQ

Welder Performance Qualification. The test record showing that a named welder, operator or tack welder can make sound welds with that process, in that position and thickness range.

- A change in an essential variable beyond the code limit, for example process, filler classification, position or a large change in heat input, needs a new or revised WPS and, if not prequalified, a new PQR.
- A welder's qualification stays valid while the welder keeps using the process. If the welder has not used it for more than six months, or there is specific reason to doubt ability, requalify.
- Keep a current welder list with identification stamp numbers, processes and positions. Each weld should be traceable to a welder.

3 MATERIALS AND CONSUMABLES

Item	Requirement
Base metal	Grade as shown on drawings, with mill test certificate and heat number traceability. Typical: ASTM A36, A572 Gr 50, IS 2062 E250 / E350.
Filler metal	Matching strength for the base metal, as stated in the WPS. Typical for these steels: E7018 (SMAW), ER70S-6 (GMAW), E71T-1 (FCAW), F7A2-EM12K (SAW). Batch certificate on file.
Low-hydrogen SMAW electrodes	Buy in sealed containers. After opening, keep in a holding oven at 120 deg C minimum. E70XX electrodes may be out of the oven for 4 hours at most.
Re-drying	Electrodes exposed beyond the limit: re-dry at 260 to 430 deg C for at least 2 hours, once only. Discard wet electrodes.
SAW flux	Dry and free of dirt, mill scale and slag. Flux from damaged bags: dry before use or discard. Do not reuse flux that has been wet.
Wire and shielding gas	Wire clean and rust-free; gas of welding grade with the flow rate in the WPS.

4 JOINT PREPARATION AND FIT-UP

- Surfaces to be welded: smooth, and free of loose scale, rust, grease, paint, moisture and cutting slag. Tight mill scale that survives wire brushing may remain, except where the code or WPS requires removal.
- Fillet joints: bring parts into close contact. A root gap up to 5 mm may be accepted; where the gap is over 1.6 mm, increase the fillet leg by the amount of the gap.
- Groove joints: root opening, root face and bevel angle as in the WPS, within its tolerances.
- Tack welds: made by qualified tack welders to a WPS, to the same quality as the final weld. Remove cracked tacks; do not weld over them.
- Use run-on and run-off tabs for groove welds where the design needs full section at the ends, and remove them as specified.
- Balance the welding sequence and use restraint or presetting to control distortion, especially of end plates and thin webs.

5 PREHEAT, INTERPASS TEMPERATURE AND ENVIRONMENT

Thickest part at the joint	Minimum preheat and interpass temperature
Up to 38 mm	10 deg C
Over 38 mm to 64 mm	65 deg C
Over 64 mm	110 deg C

Values as used in a manufacturer's fabrication plan for A36 and A572 Gr 50 with low-hydrogen processes. Higher-strength steels, non-low-hydrogen electrodes and highly restrained joints need more; follow the WPS. Measure with temperature crayons or a contact thermometer, about 75 mm from the joint.

- If the steel is below 0 deg C, warm it to at least 20 deg C and hold that temperature while welding.
- Do not weld on wet surfaces, in rain, or in high wind without shelter.
- Gas-shielded processes (GMAW, gas-shielded FCAW, GTAW): shield the work when wind speed at the weld exceeds about 8 km/h.
- Do not weld when the ambient temperature is below minus 20 deg C.

6 WELD SIZE AND DETAILING RULES

Thickness of thinner part joined	Minimum fillet weld size (single pass)
Up to 6 mm	3 mm
Over 6 mm to 12 mm	5 mm
Over 12 mm to 20 mm	6 mm
Over 20 mm	8 mm

For low-hydrogen processes. The weld need not be larger than the thinner part. The design size on the drawing governs when it is larger.

- Maximum fillet size along a plate edge: the plate thickness for plates under 6 mm; 2 mm less than the thickness for plates 6 mm and over, unless the drawing calls for build-up to full thickness.
- Minimum effective length of a fillet weld: four times its size.
- Web-to-flange welds of PEB members are often made from one side by automatic SAW. This is acceptable only where the design and the contract allow it; some projects require welding on both sides.
- Weld symbols, sizes and lengths come from the shop drawing and weld map. Do not substitute intermittent for continuous welds or change sizes on the shop floor.

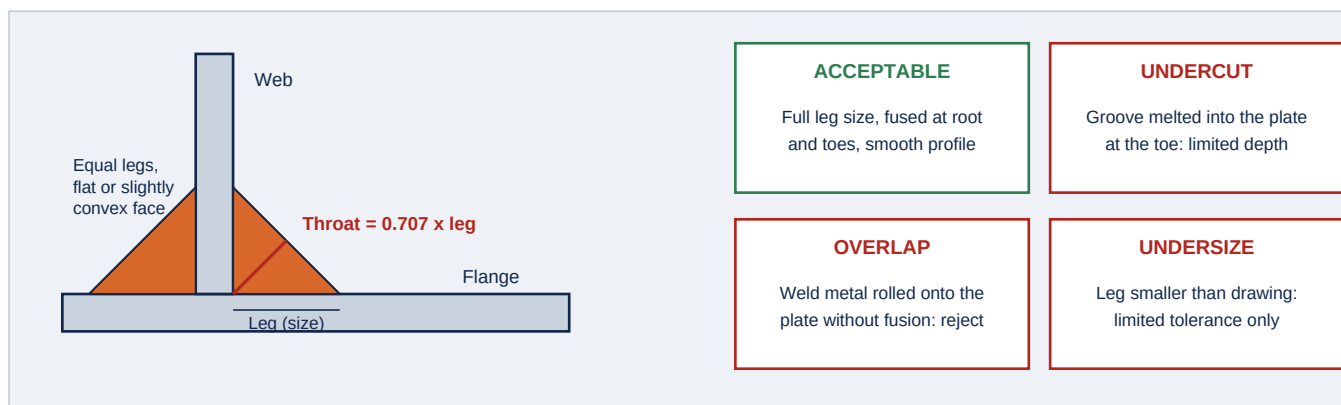


Figure 1. Fillet weld terms and common profile conditions. Original IMBF schematic, not to scale.

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VISUAL ACCEPTANCE CRITERIA (STATICALLY LOADED STRUCTURES)

All welds are visually inspected over their full length, after cooling and cleaning.

Condition	Acceptance
Cracks	None permitted, whatever the size or location.
Fusion	Complete fusion between weld passes and between weld and base metal.
Craters	Filled to the full cross-section of the weld, except at the ends of intermittent fillets outside their effective length.
Profile	Fillet faces flat or slightly convex; no overlap; reinforcement of groove welds within limits and blended smoothly.
Undercut	Material under 25 mm thick: 1 mm maximum, except that 2 mm is allowed for a total of 50 mm in any 300 mm. Material 25 mm and over: 2 mm maximum.
Undersize fillet	May underrun the specified size, for not more than 10 % of the weld length, by up to: 2 mm for fillets of 5 mm or less; 2.5 mm for 6 mm; 3 mm for 8 mm and larger.
Porosity	Fillet welds: sum of visible piping porosity of 1 mm and larger not over 10 mm in any 25 mm of weld, nor 20 mm in any 300 mm. Groove welds in tension: none visible.
Arc strikes	Avoid outside the weld area. Grind smooth and check for soundness.
Slag and spatter	Slag removed from every pass and from the finished weld; tightly adhering spatter may remain unless it affects painting or NDT.

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NON-DESTRUCTIVE TESTING

Method	Typical use in steel buildings	Key controls
Visual (VT)	All welds, 100 %.	Trained inspector; gauges; adequate light.
Ultrasonic (UT)	Full-penetration groove welds: flange and web splices, end-plate butt welds, thickness 8 mm and over.	Calibrated set; scan overlap 10 % minimum; acceptance by indication rating and length.
Magnetic particle (MT)	Fillet and partial-penetration welds; surface cracks at end plates and base plates.	Yoke with verified field; test in two directions at right angles; 1000 lux at the surface.
Dye penetrant (PT)	Surface defects where MT is not practical.	Clean surface; correct dwell and developing time; one product family.
Radiography (RT)	Butt welds where specified.	Radiation safety; film or digital quality indicators.

- The extent of NDT for each joint type is set by the contract and the approved Quality Assurance Plan, not by the fabricator alone.
- NDT personnel: certified to SNT-TC-1A or equivalent; interpretation by Level II or III.
- Mark rejectable indications on the weld, repair, and retest by the same method.

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REPAIR OF WELDS

- Repair to an approved procedure and WPS, by a qualified welder.
- Overlap or excess convexity: remove the excess metal. Undersize welds, undercut and unfilled craters: prepare and add weld metal.
- Porosity, slag and lack of fusion: remove the defective part and re-weld.
- Cracks: find the extent by MT or PT, remove the crack and 50 mm of sound metal beyond each end, and re-weld.
- Removal by grinding, chipping or air-carbon-arc gouging, without nicking the base metal. Clean gouged surfaces to bright metal.

- Heat straightening: steel temperature not over 650 deg C for ordinary structural steels, checked with temperature crayons.
- Re-inspect every repair by the method that found the defect. Do not paint a repaired joint until it is accepted.

10 WELDING CONTROL CHECKLIST

Stage	Check	Status	Remarks
Before welding	Approved WPS at the station; PQR on file where needed	☐	
Before welding	Welder qualified for process, position and thickness; continuity current	☐	
Before welding	Base metal and consumables match WPS; certificates on file	☐	
Before welding	Electrodes and flux stored and issued correctly	☐	
Before welding	Joint preparation, fit-up, cleanliness and tack welds accepted	☐	
Before welding	Preheat applied and measured; weather protection in place	☐	
During welding	Current, voltage, travel speed and gas flow within WPS; logged daily	☐	
During welding	Interpass temperature and cleaning between passes	☐	
During welding	Sequence followed; distortion controlled	☐	
After welding	100 % visual inspection to acceptance criteria	☐	
After welding	Weld size and length to drawing and weld map	☐	
After welding	NDT to the extent in the QAP; reports filed	☐	
After welding	Repairs approved, made and re-inspected	☐	
After welding	Welder identification and inspection records traceable to each member	☐	

11 RECORDS TO KEEP

- WPS, PQR and welder qualification records, with the current welder list.
- Material and consumable certificates.
- Fit-up and welding inspection reports; daily welding parameter log.
- NDT reports and NDT personnel certificates.
- Repair records and non-conformance reports.
- Calibration records for welding machines, ovens, gauges and NDT equipment.

12 BASIS OF THIS GUIDE

Ref	Source	Used for
R1	AWS D1.1, Structural Welding Code: Steel (American Welding Society). Values written from code practice as commonly applied to statically loaded structures; not checked line by line against a specific edition.	Qualification rules, consumable storage, fit-up, minimum fillet sizes, visual acceptance, repair
R2	Fabrication plan of a PEB manufacturer, working to AWS D1.1:2006 (supplied to IMBF).	Preheat table, undercut and porosity limits, NDT controls, repair practice
R3	IS 800, IS 816, IS 9595 and IS 2062 (Bureau of Indian Standards).	Named as related Indian references only; no values taken

Limits of this draft: table and clause numbers are not cited because AWS D1.1 was renumbered in its 2020 edition. Every value should be verified against the edition named in the contract by an IMBF welding reviewer before publication.

Final disclaimer. This IMBF publication is an educational quick reference. It is not a substitute for the applicable welding code, the contract specification, an approved WPS, qualified inspection or professional advice.