Metal-Asia

I-Beam & H-Beam Manufacturing Technologies — A Technical Guide for Global Procurement

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Overview

Structural I-beams and H-beams are manufactured through several distinct processes, each offering specific advantages in terms of dimensional flexibility, structural performance, and cost structure. For international procurement managers, understanding these manufacturing pathways is critical to supplier qualification, quality assurance planning, and total cost of ownership analysis.

Metal Asia sources both hot-rolled and welded structural beams directly from ISO-certified Chinese steel mills, with full production traceability and third-party NDT verification.

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1. Hot-Rolled Manufacturing

Hot-rolling is the **dominant industrial process** for structural beam production worldwide. A steel billet (bloom) is heated to rolling temperature (~1,200°C) and progressively shaped through a series of rotating mill stands into a monolithic I- or H-profile.

Production Process Flow

```
Steel Bloom (Billet)
        ↓
Reheating Furnace (~1,200°C)
        ↓
Roughing Mill Stands (initial shaping)
        ↓
Intermediate Mill Stands (web forming)
        ↓
Finishing Mill Stands (final H/I profile)
        ↓
Controlled Cooling on Cooling Bed
        ↓
Straightening (roller or press)
        ↓
Quality Control (dimensional + mechanical)
```

```
        ↓
Finished Hot-Rolled Beam
```

Key Production Stages

Stage	Function	Critical Control Points
Reheating	Uniform temperature distribution across billet	±20°C uniformity, scale minimization
Roughing	Initial cross-section reduction	Draft schedule, width spread control
Intermediate	Web formation, initial flange development	Roll gap precision, temperature maintenance
Finishing	Final profile geometry achievement	Roll wear compensation, speed matching
Cooling	Controlled transformation to achieve target mechanical properties	Cooling rate (air/water), uniformity
Straightening	Removal of residual camber and twist	Roller pressure, multiple-pass strategy
QC	Dimensional verification, mechanical testing	Laser profiling, tensile testing, UT scanning

Advantages for Procurement

Advantage	Procurement Impact
Monolithic structure	No weld-related failure modes; predictable fatigue life
High production rate	Short lead times for standard sizes; economies of scale
No residual weld stresses	Uniform stress distribution; simplified structural analysis
Standardized dimensions	Interchangeable across suppliers; simplified inventory management
Mill availability	Continuous production; reliable delivery schedules

Limitations

Limitation	Mitigation Strategy
Restricted to standard sizes	Order welded beams for non-standard requirements
Mill scale on surface	Specify shot blasting + primer coating if required
Maximum practical height ~600 mm	Source welded beams for profiles > 600 mm
Weight of thick-web profiles	Optimize with hybrid welded designs

Technical Constraints

Parameter	Typical Limit
Maximum profile height	~600 mm (60B series)
Standard length	4 – 12 m (up to 24 m by arrangement)
Maximum flange width	~400 mm
Minimum order quantity (mill-direct)	25 – 50 MT depending on profile

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2. Welded (Fabricated) Beam Production

Welded beams are fabricated from three separate steel plates — two flanges and one web — joined by submerged arc welding (SAW). This method is the solution of choice when project requirements fall outside standard hot-rolled dimensional ranges.

Production Process Flow

```
Steel Plate (per GB/T 19903 / ASTM A6 / EN 10025)
        ↓
CNC Plasma/Flame Cutting (flange + web plates)
        ↓
Edge Preparation (beveling for SAW)
        ↓
Assembly on Jig (H-section formation)
        ↓
Submerged Arc Welding (4 longitudinal seams)
        ↓
Ultrasonic Testing of Welds (mandatory)
        ↓
Post-Weld Heat Treatment (if specified)
        ↓
Straightening (thermal or mechanical)
        ↓
Shot Blasting + Surface Treatment
        ↓
Final Dimensional Inspection
        ↓
Finished Welded Beam
```

Detailed Process Stages

Stage 1 — Plate Procurement
Steel plates are sourced per GB/T 19903-2015 (China), ASTM A6 (US), or EN 10025 (Europe). Plate flatness, thickness tolerance, and certification to specified steel grade are verified before cutting.

Stage 2 — Cutting & Preparation
CNC plasma or oxy-fuel cutting achieves ±1.5 mm dimensional accuracy. Edge beveling (typically 30–45°) prepares joint geometry for full-penetration SAW welds.

Stage 3 — Assembly
Plates are positioned on an assembly jig with hydraulic clamping. Critical checks: web perpendicularity (±1 mm/m), flange-to-web gap (zero tolerance), overall squareness.

Stage 4 — Submerged Arc Welding (SAW)
Four longitudinal fillet welds (both sides, both flanges) are deposited using automatic SAW equipment. Flux coverage prevents oxidation; multi-pass technique ensures full throat dimension. Typical welding parameters: 600–1,200 A current, 28–36 V, travel speed 30–60 cm/min.

Stage 5 — Quality Control

- **100% Ultrasonic Testing (UT)** per GB/T 11345 or ASTM E164
- Visual inspection per AWS D1.1 or EN ISO 5817
- Dimensional verification (web alignment, flange squareness, camber)

Stage 6 — Post-Processing
Thermal straightening corrects weld-induced distortion. Shot blasting (SA 2.5) removes scale and prepares surface for protective coating if specified.

Production Capabilities

Capability	Specification
Maximum height	**1,500 mm** (standard), up to **2,000 mm** (specialized mills)
Maximum length	**15,000 mm** (standard), up to **24,000 mm** on request
Maximum flange width	**8,000 mm** (asymmetric configurations possible)
Web perforation	Available (for MEP routing, weight reduction)
Variable cross-section	Tapered depth along length achievable

Capability	Specification
Hybrid material construction	High-grade flanges + standard-grade web for cost optimization
Stiffener welding	Automated or manual attachment of transverse stiffeners

Advantages

- ✅ **Dimensional freedom** — Any height, width, and length within equipment limits
- ✅ **Weight reduction** — Optimized plate thicknesses; typically 30–50% lighter than hot-rolled equivalents for equivalent performance
- ✅ **Hybrid construction** — Combine Q355B flanges with Q235B web for cost efficiency
- ✅ **Clean surface** — No mill scale; ready for coating or fire protection
- ✅ **Lead time flexibility** — Mill-independent; production at fabrication shops

Limitations

- ❌ **Weld seam stress concentration** — Requires UT verification and fatigue assessment
- ❌ **Weld distortion** — Requires straightening; affects geometric tolerance
- ❌ **Higher unit cost** — Labor-intensive vs. hot-rolling; competitive only at larger sizes
- ❌ **Longer production time** — 2–4 weeks typical vs. mill stock availability

Connection Methods

Connection Type	Application	Standards
Bolted	Demountable structures, temporary works	AISC 360, Eurocode 3
Welded	Permanent structures, moment-resisting frames	AWS D1.1, EN ISO 5817
Bolted + Welded	Critical connections, redundancy requirements	Project-specific WPS

> **Note:** Riveted connections are **not recommended** for modern I-beam structures.

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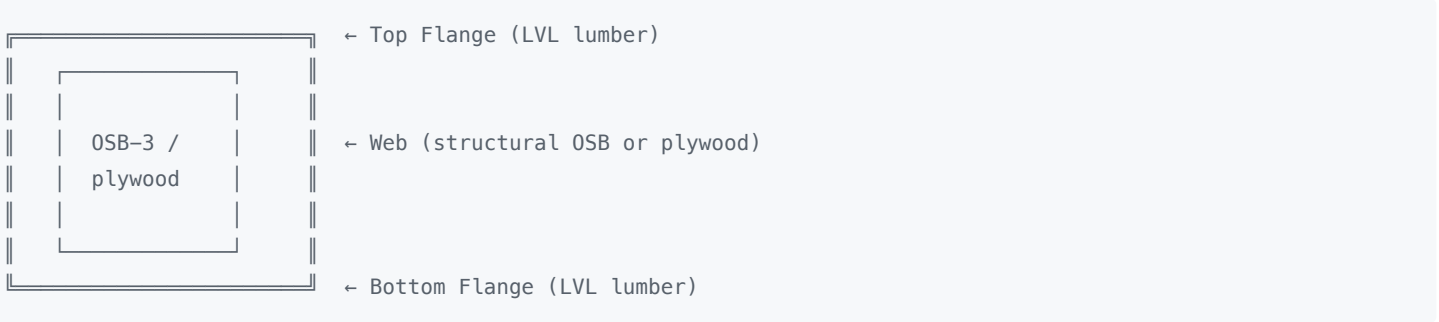
3. Glued Laminated Timber I-Beams

Timber I-beams (TJIs) are used exclusively in low-rise residential and light commercial construction. They consist of LVL (Laminated Veneer Lumber) flanges bonded to an OSB (Oriented Strand Board) web.

Structural Composition



Advantages

- ✅ Lightweight — 60–70% lighter than steel equivalents
- ✅ Dimensionally stable — no shrinkage with proper moisture control
- ✅ Long spans achievable (up to 12 m for residential loads)
- ✅ Easy field cutting and drilling
- ✅ Sustainable — renewable material, low carbon footprint

Limitations

- Residential/light commercial only

- Fire protection requirements per building code
- Moisture protection mandatory during construction
- Cannot support concentrated heavy loads

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4. Extruded Aluminum Profiles

Aluminum H-sections are produced by forcing heated aluminum billet through a hardened steel die. The process yields profiles with excellent dimensional accuracy and surface finish.

Typical Alloy Designations

Alloy	Series	Key Properties
6060-T6	6xxx	Corrosion resistant, excellent anodizing response
6063-T6	6xxx	High formability, architectural finishes
6082-T6	6xxx	Structural grade, higher strength, marine applications

Applications

- Aerospace structural components
- Automotive crash structures
- Architectural glazing support systems
- Exhibition and retail fixtures
- Lightweight access platforms

Procurement Note

Aluminum extrusions are **not structural substitutes for steel beams** in load-bearing applications. Their modulus of elasticity is approximately **one-third** that of steel, resulting in significantly higher deflections under equivalent loads.

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5. Precast Concrete Beams

Precast prestressed concrete I-girders (PCI standards in North America) are used in bridge construction and large-span commercial buildings. They offer excellent fire resistance and durability but require heavy-lift equipment and specialized connection detailing.

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6. Technology Comparison Matrix

Parameter	Hot-Rolled	Welded	Timber	Aluminum
Structure	Monolithic, seamless	4 SAW welds	Glued (PUR adhesive)	Monolithic extrusion
Strength	Maximum	High (verify UT)	Moderate	Low (vs. steel)
Max Height	~600 mm	1,500–2,000 mm	~600 mm	~400 mm
Max Length	12 m (24 m special)	15 m (24 m special)	12 m	6 m
Weight	Heavy	Optimized (lighter)	Very light	Ultra-light
Surface	Mill scale	Clean (shot-blasted)	Smooth	Anodized-ready
Lead Time	2–4 weeks (mill stock)	2–6 weeks	1–2 weeks	3–6 weeks
Economics	Best for standard sizes	Best for large/non-standard	Residential niche	Premium applications
Global Standards	GOST, GB/T, ASTM, EN	GOST R 58966, GB/T 33814	EN 14081	EN 755

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7. Procurement Decision Framework

```
REQUIREMENT ANALYSIS
    │
    ├── Standard sizes needed? (≤ 600 mm height)
    │       ├── YES → HOT-ROLLED (cost-optimized, shortest lead time)
    │       └── NO  → Continue...
    │
    ├── Non-standard dimensions required?
    │       ├── YES → WELDED (custom height, width, length)
    │       └── NO  → Continue...
    │
    ├── Weight-critical application?
    │       ├── YES → WELDED (thin-web optimization) or ALUMINUM (non-structural)
    │       └── NO  → Continue...
    │
    ├── Residential/light commercial?
    │       ├── YES → TIMBER (cost + speed)
    │       └── NO  → HOT-ROLLED or WELDED
    │
    └── Fire rating > 2 hours required?
            ├── YES → Evaluate concrete or intumescent-coated steel
            └── NO  → Standard steel solution
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8. Installation & Connection Standards

Column Base Installation

- Vertical alignment checked with optical plummet or total station
- Anchor bolt templates verified before concrete pour
- Grout thickness: 20–50 mm under base plate (non-shrink grout)
- Leveling shim packs with tack welding for stability during grouting

Connection Quality Requirements

Parameter	Tolerance
Web plumbness	≤ H/500
Flange levelness	≤ L/1,000
Bolt hole alignment	≤ 2 mm
Weld profile	Per WPS (minimum throat dimension)
Post-weld inspection	100% VT + specified % UT/RT

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9. Chinese Manufacturing Standards (GB/T)

China is the world's largest producer of structural steel, and Chinese mills manufacture to GB/T standards that are technically equivalent to GOST, ASTM, and EN norms. Understanding these standards is essential for responsible global procurement.

GB/T Standards for Beam Manufacturing

International Standard	Chinese GB/T Equivalent	Application
Hot-rolled parallel flange (GOST 26020 / EN 10365)	**GB/T 11263-2017** Hot-rolled H and I sections	Primary structural beams

International Standard	Chinese GB/T Equivalent	Application
Hot-rolled tapered flange (GOST 8239)	**GB/T 706-2016** Hot-rolled section steel	General construction, retrofits
Special beams (GOST 19425)	**YB/T 5055 / GB/T 706**	Monorails, mining applications
Welded beams (GOST R 58966)	**GB/T 33814-2017** Welded H-section steel	Custom fabricated profiles
Plate for welded beams (ASTM A36 / EN S235)	**GB/T 700-2006 + GB/T 709-2019**	Carbon steel plate
High-strength plate (ASTM A572 / EN S355)	**GB/T 1591-2018**	Low-alloy high-strength plate

Chinese vs. International Manufacturing Capability

Parameter	GOST (Former USSR)	GB/T (China)	Notes
Max hot-rolled height	~600 mm	~700 mm	Chinese mills offer wider size range
Max welded height	1,500 mm	2,000 mm	Leading Chinese fabricators exceed global norms
Standard length	12 m	12 m (up to 24 m)	Equal capability
Dimensional tolerance	±2–4 mm	±1.5–3 mm	Chinese mills often achieve tighter tolerances
Annual production capacity	—	>100 million MT	Unmatched global scale

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10. Metal Asia Mill-Sourcing Services

Metal Asia (www.metal-asia.pw) operates as your **on-the-ground procurement office in China**. We bridge the gap between international buyers and Chinese steel mills, providing the transparency, quality assurance, and logistics management that direct mill relationships require.

Our Manufacturing Audit Services

Service	Deliverable
Mill Pre-Qualification	ISO 9001, ISO 14001, API certification verification
Production Monitoring	Real-time status updates from mill floor
In-Process Inspection	Dimensional checks during rolling/fabrication
Pre-Shipment NDT	Ultrasonic testing of 100% of welds (welded beams)
Documentation Package	MTC, mill certificates, third-party inspection reports

Value-Added Procurement Support

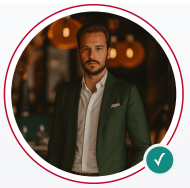
- **Mill-direct pricing** — Eliminate trading company margins (typically 5–15%)
- **Consolidated shipping** — Combine multiple steel products in single containers/breakbulk
- **Customs brokerage** — Full export/import documentation, HS code classification
- **Cargo insurance** — All-risks coverage from mill gate to destination port
- **Payment security** — Letter of Credit arrangements, escrow options

Request a logistics quotation or review our payment terms for your next structural steel project.

Maxim Vedunkov

LEAD STRUCTURAL STEEL ENGINEER & INTERNATIONAL PROCUREMENT ADVISOR AT METAL-ASIA.PW

Specializes in mill audits across China's steel-producing provinces, cross-standard steel grade matching (GOST/ASTM/EN/GB), and oversized cargo logistics. **Core principle:** «The manufacturing process determines the destiny of the entire structure. Hot-rolled for standard projects, welded for bespoke requirements. We know which Chinese mills produce each type at the highest international standard — and we verify every weld seam before it leaves the factory.»



REQUEST A MILL AUDIT

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