

Body-in-White (BIW) Explained

BIW nomenclature, architectures, stiffness vs strength, sections and platform sharing

Key Terms

Body-in-white	Welded, bonded or riveted structural shell before paint, trim, glass, doors, powertrain and interior. Named for the old white-primer dip.
Upper structure	Greenhouse: roof panel, headers, roof bows, A/B/C/D pillars, body sides, rear end.
Lower structure	Underbody / platform: motor compartment, floor pan, rockers, rear compartment.
Closures	Hood, doors, liftgate. Door skins are hemmed, not spot welded.
BSO / BSI	Body side outer (Class A, one big die, bake-hardening steel) / body side inner (load-bearing).
Section	2D cut through the vehicle used early to protect packaging space and member size.
Platform sharing	Same underbody, different "top hat" (Ford C2: Escape and Bronco Sport; GM T1: Silverado, Sierra, Tahoe, Yukon, Escalade).

Three Functional Groups

Group	Design driver	Examples
Load-bearing	Stiffness, minimal deformation	Rails, pillars, rockers, cross members
Energy-absorbing	Controlled crash deformation	Front rails, crush zones
Close-out / aesthetic	Formability, styling, aero	Thin Class A outer panels

Stiffness vs Strength (standard relations)

Bending stiffness	$k \propto E \cdot I$	E is about the same for all steels, so geometry (I) is the main lever.
Section property	I grows with section size	Bigger cross-sections carry more load; features cut into a section cost gauge or reinforcement.
Strength	σ_y raises load capacity	AHSS adds strength (not stiffness) and enables thinner gauges and complex shapes.

Architectures

Type	How it works	Best for
Body-on-frame	Ladder frame (two rails + cross members) with body on top	Pickups, full-size SUVs, towing
Unibody	Body and frame integrated; box sections and bulkheads carry load	Most cars and crossovers
Space frame	Cast and extruded Al members, sheet infill; >40% lighter	Low-volume, high-performance
Monocoque	Outer skin itself carries the load	Opposite of a space frame

Quick Facts

- Mostly resistance spot welded (RSW): cheap and repeatable; not used on exterior Class A panels.
- Spot welds are discrete; adhesive bonding or laser welding recovers lost stiffness.
- Rocker extrusions use internal webs ("the snowman").
- Raw materials $\approx$ 47% of vehicle cost.
- Unibodies are harder and costlier to repair after a severe crash.
- Some automakers now cast large floor and rear-compartment sections as one piece.