

Materials Research

Anusha Mantha

190100118

1. Cold-formed steel

Cold-formed Steel (CFS) is the common term for products made by rolling or pressing steel into semi-finished or finished goods at relatively low temperatures. Cold-formed steel products are created by the working of steel billet, bar or sheet using stamping, rolling (including roll forming), or presses.

Properties:

1. Lightness in weight
2. High strength and stiffness
 - a. Possess one of the highest strength to weight ratio, and this leads to broader design options and span and better material usage.
3. Ease of prefabrication and mass production
4. Fast and easy erection and installation
5. Substantial elimination of delays due to weather
6. More accurate detailing
7. Non-shrinking and non-creeping at ambient temperatures
8. No formwork needed
9. Termite-proof and rot proof
10. The economy in transportation and handling
11. Non-combustibility
12. Recyclable material
13. Panels and decks can provide enclosed cells for conduits.

Market Availability:

- India Government Plans to Use Cold-Formed Steel Framing In 919 Health Centers
 - There are many and upcoming companies growing in the production of cold-formed steel.
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Some of the prominent companies operating in the cold-formed steel market include

- HBIS group
- AK Steel Corporation
- ArcelorMittal
- Nippon Steel and Sumitomo Metal Corporation
- Baosteel
- POSCO
- Nucor Corporation
- Steel Dynamic Inc
- JSW steel

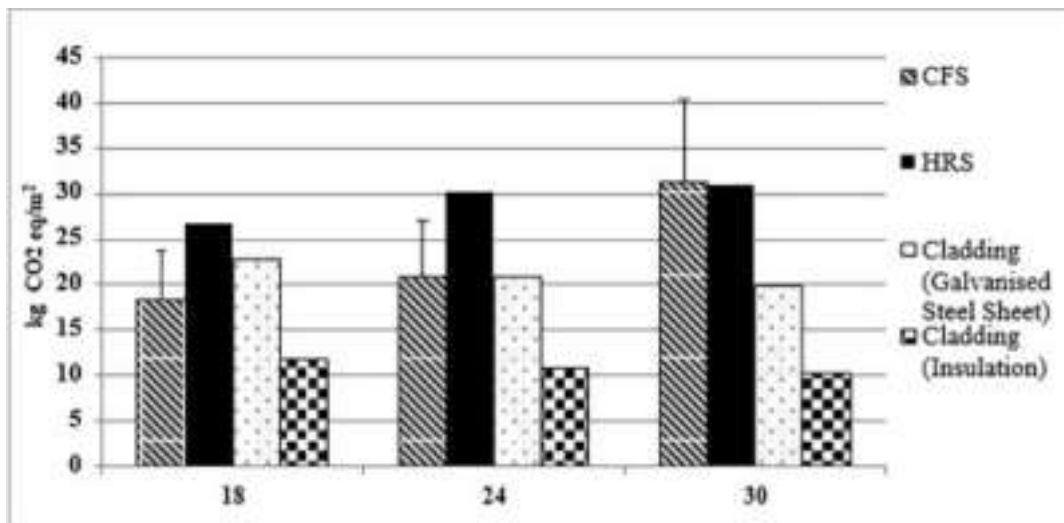
Cost Analysis:

Section	D (mm)	B (mm)	t (mm)	M _c (kNm)	Cost (£/m)
C15014	152	64	1.4	6.49	4.04
C15016	152	64	1.6	7.91	4.23
C15018	152	64	1.8	9.24	4.74
C15020	152	64	2.0	10.48	5.19
C20015	203	76	1.5	10.29	5.02
C20016	203	76	1.6	11.44	5.31
C20018	203	76	1.8	13.74	5.98
C20020	203	76	2.0	15.93	6.56
C20025	203	76	2.5	20.96	8.12
C25018	254	76	1.8	17.36	7.00
C25020	254	76	2.0	20.26	7.95
C25025	254	76	2.5	27.03	9.88
C25030	254	76	3.0	33.35	11.82
C30025	300	95	2.5	36.42	11.18
C30030	300	95	3.0	46.01	13.04

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- Cost of various cold-formed sections by comparing from various online sources are:
 - SRF Cold-formed section - 55Rs/kg
 - Cold-formed section - 57/kg
 - Top hat cold roll form section
 - Builders risk insurance premiums are typically lower for steel than for wood.
 - Builders risk insurance for a four-story, 400-unit hotel built over 24 months in Ohio cost \$360,000 because cold-formed steel framing was used.
 - It would have cost \$1.6 million had it been built with wood - a savings of about \$1.3 million

Carbon Footprint:

- Steel production accounts for about 6.6 % of the world's anthropogenic CO₂ emissions , according to the World Steel Association.
- The greenhouse gas of most relevance to the world **steel industry** is **carbon** dioxide (**CO₂**). On average for 2018, 1.85 tonnes of **CO₂** were emitted for every tonne of **steel** produced. The **steel industry** generates between 7 and 9% of direct **emissions** from the global use of fossil fuel.



Comparison between CFS and other building materials:

- High strength to weight ratio and it's greater than wood and concrete.
 - This reduces the building's total load and saves costs at the foundation.
- Ready-mixed supply of CIP concrete during winter construction can add cost to a project And, concrete requires artificial heat to cure during cold temperatures. Neither of these costs is associated with steel framing.
- Non-combustible nature of CFS doesn't cause fires, unlike wood. So, CFS framing minimises the risk of any fire spreading to adjacent buildings and reduces the possibility for subsequent legal action, putting less burden on building owners and firefighters.
- When compared to concrete
 - **Accelerated schedule**
 - **increased usable floor space**
 - **Future modification and adaptability**
 - **Reduced waste and pollution**
 - **Long-lasting and durable**
 - **Quality, predictability, and value**
- When compared to wood
 - **No height limitation**
 - **Accelerated schedule**
 - **Flexibility in space planning**
 - **Reduced waste and pollution**
 - **Quality, predictability, and value**

References:

- Wikipedia.com
- Buildsteel.com
- Aisc.org

2. RECYCLED PLASTIC

The reason I have chosen Recycled/Waste Plastic is because of its harmful nature towards nature, if the plastic is disposed of unnecessarily there is an abundant waste and can instead be utilised as a construction material since we significantly cannot control the production of plastic.

Properties:

1. Appearance
 - a. transparent, coloured which gives a good appearance
2. Chemical resistance
 - a. It can replace corrosive metals
3. Dimensional stability
4. If thermo-plastics are used, they can be reused and reshaped
5. Ductility - low
6. Durability
 - a. The problem is termites but since there are no nutritional values in it, it doesn't affect them badly.
7. Electric insulation
8. Finishing
9. Fire resistance
10. Fixing - can bolt, drill or glue easily
11. Humidity- Plastics made of PVC gives excellent resistance towards humidity
11. Maintenance
12. Melting point is usually low, but thermosetting plastics can be used
13. Optical property - some are transparent, translucent.
13. Sound absorption
 - a. By the saturation of phenolic resins, we can produce acoustic boards.
 - b. These acoustic boards are sound absorbents and provide sound insulation.
 - c. Generally, for home theatres, seminar halls, this type of acoustic ceilings are used .
14. Strength
15. Thermal property - very low
16. Weather resistance
17. Weight

Market Availability:

There are many plastics producing companies and industries and have a good place in the National and Bombay stocks like

About 60 percent of plastic waste in India is recycled, according to various estimates. Just nine percent of all plastic waste ever produced globally has been recycled, according to the United Nations

NSE	BSE				
Company	CMP	Change	Change(%)	Mkt Cap	PE
Tatawala Chem.	53.65	4.85	9.94	50.17	18.74
Prince Pipes	184.85	12.4	7.19	2,036.58	20.94
Safari Inds.	431.20	27.25	6.75	964.56	375.04
Beardell	8.40	0.4	5	23.68	6.00
Amara Greentech	34.60	2.6	5	75.57	20.06
Tijaria Polypipe	8.75	0.3	4.85	19.07	0.00
SNVD Poly Pack	12.00	0.45	3.9	5.96	8.32
VIP Inds.	300.00	10.7	3.69	4,348.00	448.66
W M Corp & Son	51.95	1.8	3.59	34.75	12.40
Tulga Plast Ind	63.25	1.55	2.51	56.32	72.47
Katag Polymers	24.25	0.5	2.11	21.06	29.11
Sens Industries	12.85	0.25	1.97	73.37	118.18
Sens Plastics	2.70	0.05	1.89	167.22	33.12
Majur Uniquoters	303.55	9.2	1.74	1,382.49	21.08
IPRO India	23.00	0.4	1.73	27.70	0.00
Jai Corp	97.78	1.8	1.86	1,743.45	43.04
Freder Inds.	510.00	7.25	1.44	6,326.62	20.62
Prochem Pipes	81.40	1.15	1.43	145.80	6.70
Satal Poly Tech	1,182.75	14.0	1.39	17,791.29	96.16
Kaigla Science	464.00	5.6	0.71	586.90	43.84
Scemo Pipes	14.90	0.1	0.67	39.95	7.84
Mamooka PVC	140.00	0.05	0.4	461.04	18.52

Table 21 Values of plastics in end-use markets

Material	Material	Value \$/t (2005)	Estimated value \$/t (2007)	Assumptions \$/t
1 PET	non-coloured	500-550	500-700	600
	coloured	350		
	flaked	550-600		
2 HDPE	milk bottles	400-450	1,000	700
	pelletised	600		
	janitorial-grade	250		
3 PVC			300	300
4 LDPE				300
Other				300

Cost Analysis:

Energies and prices of virgin and recycled plastics [8,9]					
Commodity plastics	Embodied energy, virgin (MJ/kg)	Price virgin material (\$/kg)	Embodied energy, recycled (MJ/kg)	Price, recycled material (\$/kg)	
HDPE	77-85	1.9-2.0	35-45	0.84-0.97	
PP	75-83	1.8-1.85	35-45	0.99-1.1	
PET	79-88	2.0-2.1	60-64	1.1-1.2	
PS	96-105	1.5-1.6	40-50	0.75-0.86	
PVC	63-70	1.4-1.5	35-40	0.77-0.99	

Carbon Footprint:

- Recycling all plastic waste would reduce carbon dioxide equivalent emissions to 4.9 gigatons in 2050, or 25 percent from business-as-usual emissions.
- Recycling all waste plastics and using 100 percent renewable would give 77 percent, 84 percent and 86 percent reductions in greenhouse gas emissions from fossil fuels, corn and sugarcane-based plastics, respectively.

Comparison with other construction materials:

	Wood	Composite	Bedford Plastic Products
50 year warranty			✓✓
Insect and borer resistant			✓✓
Rot and decay resistant	*	✓*	✓✓
Load bearing and structural	✓✓		✓**
Compression Loading			✓✓
Non-splintering		✓	✓✓
Low friction			✓✓
Low Maintenance			✓✓
UV Color stability			✓✓
Non-leaching/toxin-free			✓✓
Recycled feedstock			✓✓
Recyclable	✓		✓✓
Long-term aesthetics			✓✓

*with chemical treatment **FIBERFORCE® & BARFORCE® only

References:

- Constructor.org
- Plasticboards.com
- bbc.com/future
- Hindawi.com