Arvind
COMPOSITES

Building and Construction Solutions

Agenda

- Introduction to Arvind and Arvind Composites
- FRP and its properties and applications
- Arvind's FRP offerings in Building and Construction

Arvind Composites is a part of Arvind Ltd.

$1.4Bn
Indian conglomerate

Interests in **Textiles, Retail, Advanced materials, Environmental solutions and Real estate**

Founded in 1931
during Swadeshi movement

Among **Global top 5**
organized Denim manufactures and **pioneers of Denim in India**

Our fabric can go around the earth
~6 times

2 pieces every second
an Arvind managed brand apparel is sold in India

Own or manage
15 Global
apparel brands in India

40K hectares
of farmland under organic cultivation

Largest
Fire Protection Fabric Producer in India

22 global patents
for environmental solutions

Brief introduction: Arvind Composites

- Arvind Ltd. started its Composites division in 2014 under the overall umbrella of the Advanced Materials Division
  - We are the first and only listed Indian corporate to enter this segment

- Arvind has initially started with structural profiles and hand-laminated products catering to cooling towers and industrial customers

- In 2 years, Arvind has quickly scaled up its monthly production to 400T+, and has delivered products to 30+ countries around the world

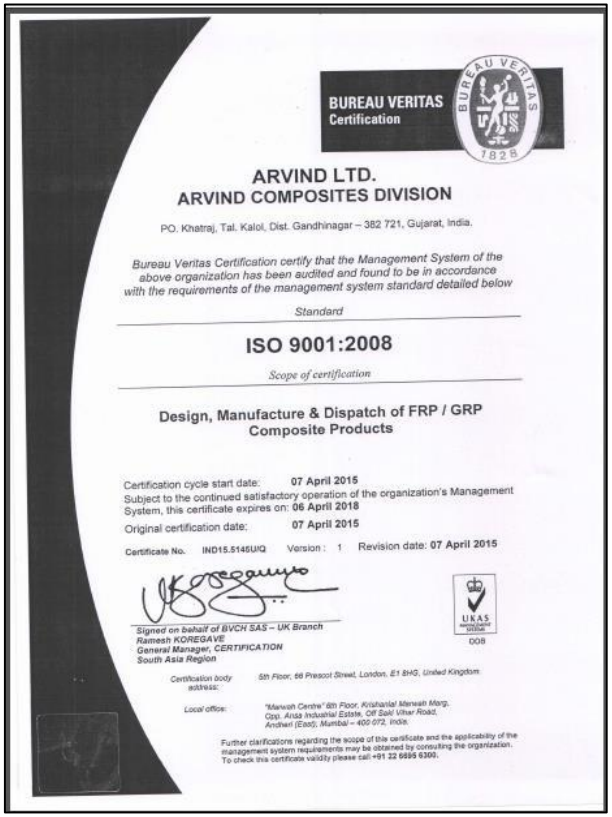
- Our capacity in pultruded structural materials is 500T+/month – highest in India, and we offer a full range of design, fabrication and installation services

Key capabilities

- 22 pultrusion machines with monthly capacity of 500T+
- 100+ skilled manpower for both pultrusion / hand-lamination; access to many more through contracted manpower suppliers
- Fully equipped mechanical and chemical laboratory for all tests
- Glass fabric manufacturing facility (in JV with PD Group) with capacity of 500 tons/month
- Strong design team and own CNC based fabrication facilities

Our customers include major Indian industrial houses and global cos.

Certifications & Accreditations



BUREAU VERITAS Certification

ARVIND LTD.
ARVIND COMPOSITES DIVISION

P.O. Khatraj, Tal. Kalol, Dist. Gandhinagar – 382 721, Gujarat, India.

Bureau Veritas Certification certify that the Management System of the above organization has been audited and found to be in accordance with the requirements of the management system standard detailed below

Standard

ISO 9001:2008

Scope of certification

Design, Manufacture & Dispatch of FRP / GRP Composite Products

Certification cycle start date: **07 April 2015**
Subject to the continued satisfactory operation of the organization's Management System, this certificate expires on: **06 April 2018**
Original certification date: **07 April 2015**

Certificate No. IND15.5145U/Q Version : 1 Revision date: **07 April 2015**

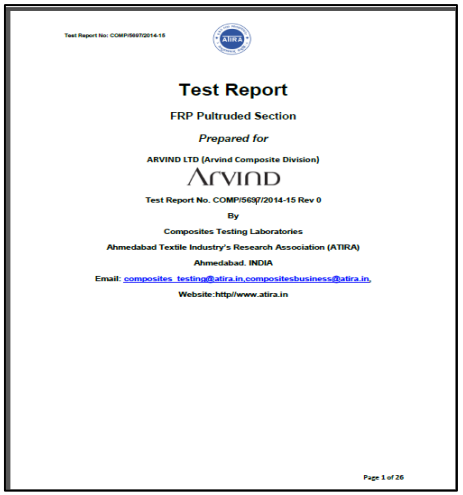
Signed on behalf of BVCH SAS – UK Branch
Ramesh KOREGAVE
General Manager, CERTIFICATION
South Asia Region

UKAS 008

Certification body address: *5th Floor, 66 Prescot Street, London, E1 8HG, United Kingdom*

Local office: *"Marwah Centre" 6th Floor, Krishanlal Marwah Marg, Opp. Ansa Industrial Estate, Off Saki Vihar Road, Andheri (East), Mumbai – 400 072, India.*

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization. To check this certificate validity please call: **+91 22 6695 6300.**



Test Report No: COMP/5697/2014-15

Test Report

FRP Pultruded Section

Prepared for

ARVIND LTD (Arvind Composite Division)

ARVIND

Test Report No. COMP/5697/2014-15 Rev 0

By

Composites Testing Laboratories

Ahmedabad Textile Industry's Research Association (ATIRA)

Ahmedabad. INDIA

Email: composites_testing@atira.in,compositesbusiness@atira.in,

Website:http//www.atira.in

Page 1 of 26

Test Report No: COMP/5697/2014-15

Qualification Testing Plan

Test Report

Prepared for

ARVIND LTD.(Arvind Composite Division)

ARVIND

By

ATIRA Composites Testing Laboratory

Sample Code:	CSR-5697
Test Report No:	COMP/5697/2014-15 Rev. 00
Customer Name and Address:	ARVIND LTD. (Arvind Composite Division) ARVIND International,Khatraj ,Santej, Ahmedabad.
No of Pages:	26
P.O. Number	180/32000004
P.O Date	04/11/2014
Date of testing	21/11/2014 to 29/11/2014
Type of Samples:	18

Name	Reviewed By	Prepared By
	Dr.DipanSotaria	Gokul raj Selvan
Designation	General Manager (Composites)	Technical Officer (Composites)
Date	03/12/2014	01.12.2014

LAPI

LAPI LABORATORIO PREVENZIONE INCENDI S.p.A.

APPROVED FIRE TESTING DIVISION

ATTESTAZIONE / *ASSESSMENT*

METODO DI PROVA: *Test method* — ASTM E 84: 2015

DENOMINAZIONE DELLA PROVA: *Description of the standard* — Caratteristiche di combustione delle superfici di materiali da costruzione / *Surface burning characteristics of building materials*

RICHIEDENTE: *Sponsor* — SPIG S.p.A. Piazza S. Graziano, 2/31 28043 - AROMA (NO)

DENOMINAZIONE DEL MATERIALE: *Denomination of the material* — FRP COOLING TOWER STRUCTURAL ELEMENTS – ARVIND (Nom. Thick. : 4,8 mm)

DESCRIZIONE DEL MATERIALE: *Description of the material* — Pannello corrugato pultruso di colore grigio chiaro. / *Light grey panel made of pultruded corrugated panel.*

Questo documento fa riferimento al Rapporti di Prova no. 908.2ASO840/15 emesso da questo Laboratorio. *This certificate refers to the Test Report no. 908.2ASO840/15 issued by this Laboratory.*

RISULTATI / *RESULTS*

Re. Lab.	Denominazione del materiale / *Denomination of the material*	Rapporto di Prova / *Test Report*	Valori ottenuti / *Values obtained*	CLASSE / CLASS
908/15	FRP COOLING TOWER STRUCTURAL ELEMENTS – ARVIND (Nom. Thick. : 4,8 mm)	908.2ASO840/15	FSI = 20 - SDI = 400	A

VALUTAZIONE / *JUDGEMENT*

Sulla base dei risultati di prova sopra riportati al materiale in oggetto
È ATTRIBUIBILE
in accordo alla ASTM E 84: 2015 la CLASSE A
On the basis of the above results to the material in object
IS ATTRIBUTABLE
according to ASTM E 84: 2015 the CLASS A

Note e limitazioni al presente documento / *Notes and limitations to this document*

1) Si riporta lo schema di classificazione descritto in National Fire Protection Association NFPA 101 *Life Safety Code*. Si richiama l'attenzione sul fatto che possono essere richiesti o specificati schemi di classificazione diversi da quello riportato. *The classification scheme described in National Fire Protection Association publication NFPA 101 Life Safety Code is reported. The attention is drawn on the fact that schemes of classification different from the one reported could be requested.*

Classe / Class A: 0 – 25 FSI; 0 – 450 SDI	Classe / Class B: 26 – 75 FSI; 0 – 450 SDI	Classe / Class C: 76– 200 FSI; 0 – 450 SDI

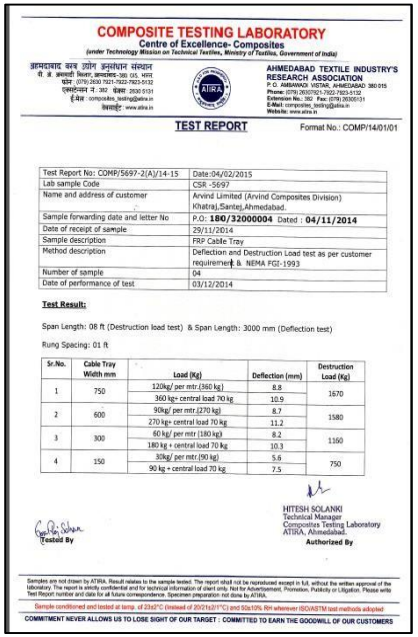
2) I suddetti risultati e per conseguenza la suddetta classificazione sono validi solo per il prodotto sottoposto a prova e per l'applicazione come descritta nel Rapporto di Prova no. 908.2ASO840/15. *The above results and by consequence the above classification are valid only for the product tested and for the application as described in the Test Report no. 908.2ASO840/15.*

Prato, 24/06/2015 — Il Responsabile Certificazione / *The Certification Manager* — Il Direttore del Laboratorio / *The Director of the Laboratory*

Valid until: 23/06/2018

Questo documento deve essere letto congiuntamente al Rapporto di Prova per la descrizione del prodotto e per ogni altro extra di dettaglio. Questo documento non costituisce approvazione di tipo né certificazione di prodotto né rappresenta dichiarazione di conformità, che spetta esclusivamente a Produttore / Sponsor. *This document has to be read in conjunction with the Test Reports, for the description of the product and for every other detail. This document does not represent type approval or certification of the product neither declaration of conformance, that is exclusively under the responsibility of the Manufacturer or Sponsor.*

Il presente Rapporto di Prova non può essere riprodotto in forma parziale senza l'autorizzazione scritta di questo Laboratorio



COMPOSITE TESTING LABORATORY
Centre of Excellence- Composites
(under Technology Mission on Technical Textiles, Ministry of Textiles, Government of India)

अहमदाबाद वस्त्र उद्योग अनुसंधान संगठन
P.O. AMBAWADI VISTAR, AHMEDABAD 380 015
फोन/Phone : (079) 2630 7321-7922-7923-5132
एक्सटेंशन नं./Extension No.: 382 फैक्स/Fax: (079) 2630 0131
ई-मेल/E-Mail: composites_testing@atira.in
वेबसाईट/Website: www.atira.in

AHMEDABAD TEXTILE INDUSTRY'S RESEARCH ASSOCIATION

TEST REPORT Format No.: COMP/14/01/01

Test Report No: COMP/5697-2(A)/14-15	Date:04/02/2015
Lab sample Code	CSR -5697
Name and address of customer	Arvind Limited (Arvind Composites Division) Khatraj,Santej,Ahmedabad.
Sample forwarding date and letter No	P.O: **180/32000004** Dated : **04/11/2014**
Date of receipt of sample	29/11/2014
Sample description	FRP Cable Tray
Method description	Deflection and Destruction Load test as per customer requirement & NEMA FG1-1993
Number of sample	04
Date of performance of test	03/12/2014

Test Result:

Span Length: 08 ft (Destruction load test) & Span Length: 3000 mm (Deflection test)

Rung Spacing: 01 ft

Sr.No.	Cable Tray Width mm	Load (Kg)	Deflection (mm)	Destruction Load (Kg)
1	750	120kg/ per mtr.(360 kg)	8.8	1670
		360 kg+ central load 70 kg	10.6	
2	600	90kg/ per mtr.(270 kg)	8.7	1580
		270 kg+ central load 70 kg	11.2	
3	300	60 kg/ per mtr (180 kg)	8.2	1160
		180 kg + central load 70 kg	10.3	
4	150	30kg/ per mtr.(90 kg)	5.6	750
		90 kg + central load 70 kg	7.5	

Tested By

HITESH SOLANKI
Technical Manager
Composites Testing Laboratory
ATIRA, Ahmedabad.
Authorized By

Samples are not drawn by ATIRA. Result relates to the sample tested. The report shall not be reproduced except in full, without the written approval of the laboratory. The report is strictly confidential and for technical information of client only. Not for Advertisement, Promotion, Publicity or Litigation. Please write Test Report number and date for all future correspondence. Specimen preparation not done by ATIRA.

Sample conditioned and tested at temp. of 23±2°C (instead of 20/21±2°C) and 50±10% RH wherever ISO/ASTM test methods adopted

COMMITMENT NEVER ALLOWS US TO LOSE SIGHT OF OUR TARGET : COMMITTED TO EARN THE GOODWILL OF OUR CUSTOMERS

IRIS Certification

CERTIFICATE

awarded to

Arvind Limited PO. Khatraj, Tal. Kalol
Arvind Composites Division
382721, Dist. Gandhinagar. Gujarat
India

TÜV Rheinland Italia S.r.l.

confirms, as an IRIS approved certification body, that the Management System of the above organization has been assessed and found to be in accordance with the

International Railway Industry Standard (IRIS)
Revision 02, June 2009

for the activities of Design and Development and Manufacturing
for the scopes of certification: 2 (Carbody fittings), 8 (Interiors)
Design , Manufacture and Dispatch of interior and exterior FRP/GRP composite Products for railways applications.

Certificate valid from: 13/08/2015 Certificate valid until: 12/08/2018*

Current date: 18/08/2015
Certificate-Register-No: 39 10 001 1505

* Providing that the subsequent surveillance audits are successful before the validity date of the previous audit.
Certification body address: Via Mattei, 3 - 20010 Pogliano Milanese - Italy

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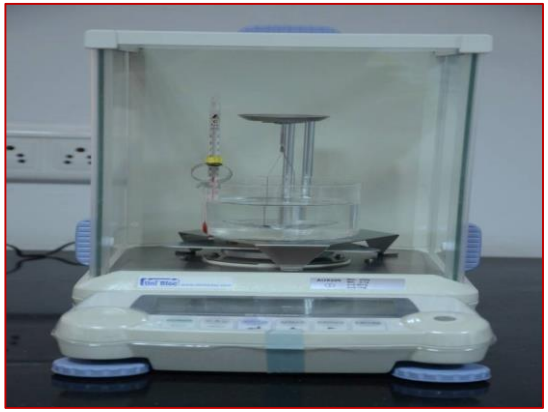
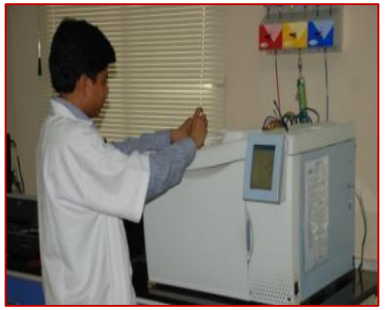
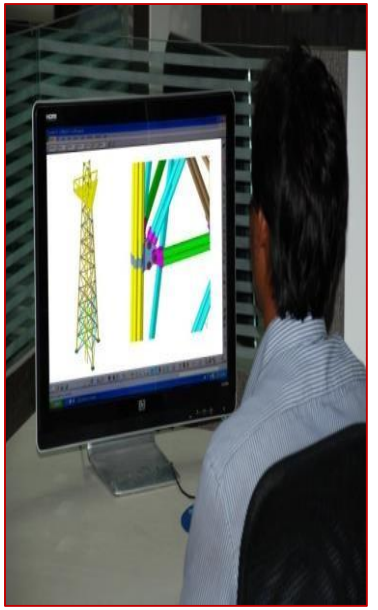
In-house Testing & Research Laboratory







Why FRP?: FRP has both an excellent strength-to-weight ratio and resistance of corrosion (I)

Mechanical Properties	Pultruded FRP		Rigid PVC	Mild Steel	Stainless steel	Wood
	Polyester	Phenolic				
Tensile Strength (N/mm^2)	382	401	44	340	340	80
Flexural Strength (N/mm^2)	468	508	70	380	380	12
Flexural Modulus (N/mm^2)	22,489	48,260	2,400	1,96,000	1,96,000	700
Izod Impact (Kg-m/cm)	1.36	1.63	0.09	1.5	0.53	-
Specific Gravity	1.80	1.80	1.38	7.8	7.92	0.52
Safe Working Temp. (°C)	120	500	55	600	600	160
Fire retardant	ASTM E 84 (<25)	ASTM E 84 (<25)	Not meet fire retardant	NA	NA	Immediate

Why FRP: FRP has both an excellent strength-to-weight ratio and resistance of corrosion (II)

- Fiberglass is highly resistant to environmental extremes. Fiberglass Reinforced Polymer (FRP) products do not rust and can be manufactured to be resistant to corrosion and abrasion

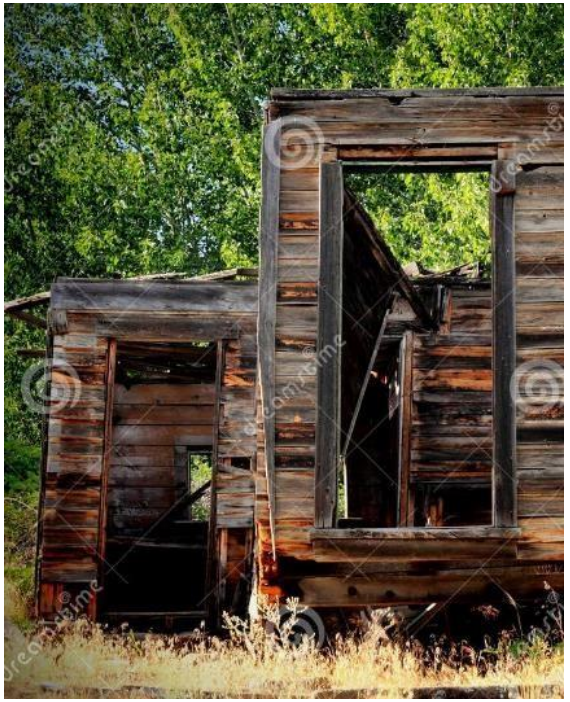
- When FRP corrosion and abrasion resistant products are equally compared with more conventional products such as metal, wood, and non-reinforced plastics, FRP products have a much longer life

- When exposed to extreme temperatures, salty or humid air, sun (ultraviolet light), or acidic chemicals, FRP products will last longer and perform better than most available alternatives. FRP products can be customized to meet your industry specifications and environmental surface concerns

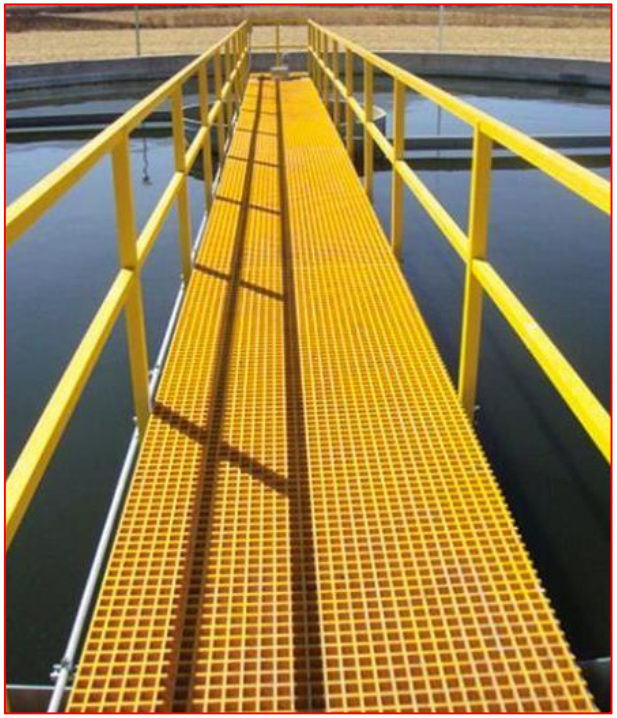
In summary…

Steel rusts…

Wood rots…



FRP lasts

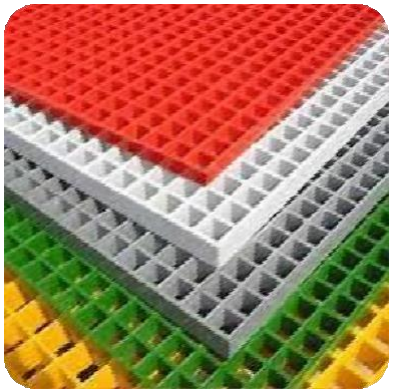


Full range of FRP industrial products at Arvind

Cable trays

Ladders

Gratings



Poles

Custom solutions

Modular infrastructure

FRP is an innovative material for construction / restoration of industrial warehouses and sheds

Reduced civil cost	FRP weighs almost 40% lower than the equivalent steel structure. This leads to lower supporting weight for the civil construction required reducing the overall cost as well as construction time.
No corrosion, long life	FRP material are designed to be immune to weathering and chemical corrosion. Thus, structures can last successfully for decades even in extreme conditions. Therefore, the structures are virtually maintenance-free
Easy to install, fast construction and low labour costs	FRP is light-weight so it can be carried around easily. Furthermore, FRP profiles can be joined using simple fabricating and joining tools, and complex processes requiring skilled workers such as welding etc can be avoided.
Natural insulation, savings on energy costs	FRP is 60% glass, and has very low thermal conductvitiy. Thus, any structure made from FRP provides natural insulation of a temperature difference of 2-4 degrees between inside and outside of the structure.
Natural colour, no painting required	FRP profiles have colour inherently embedded in them and don't require any painting. One can choose colour across all RAL shades

FRP construction follows ASTM Codes

- Components of FRP assembly adhere to ASTM standards

- Examples (Annexure A) –
  - Compressive strength (ASTM D695)
  - Tensile Strength (ASTM D638)
  - Flexural Strength (ASTM D790)
  - Bearing Strength (ASTM D953)

At Arvind, we offer a end-to-end solution for FRP construction

Products

- Full FRP warehouse
- Hybrid (MS + FRP) warehouse
- Refurbishment of metal structures

Full range of services

- Project Design
- Project execution (Civil, fabrication and erection)
- Project co-ordination
- Project schedule monitoring and adherence
- Project Handover
- Annual Maintenance Contract (AMC - As per need)

Full FRP Warehouse

Stage wise Progress (I)

1. Material storage & Segregation

2. Pillar Fabrication

Stage wise Progress (II)

3.Pillar Erection

4.Truss Assembly

Stage wise Progress (III)

5.Truss installation

6.Purlin Assembly

Stage wise Progress (IV)

7.Side Wall Frame

8. Roof sheet Installation

Stage wise Progress (V)

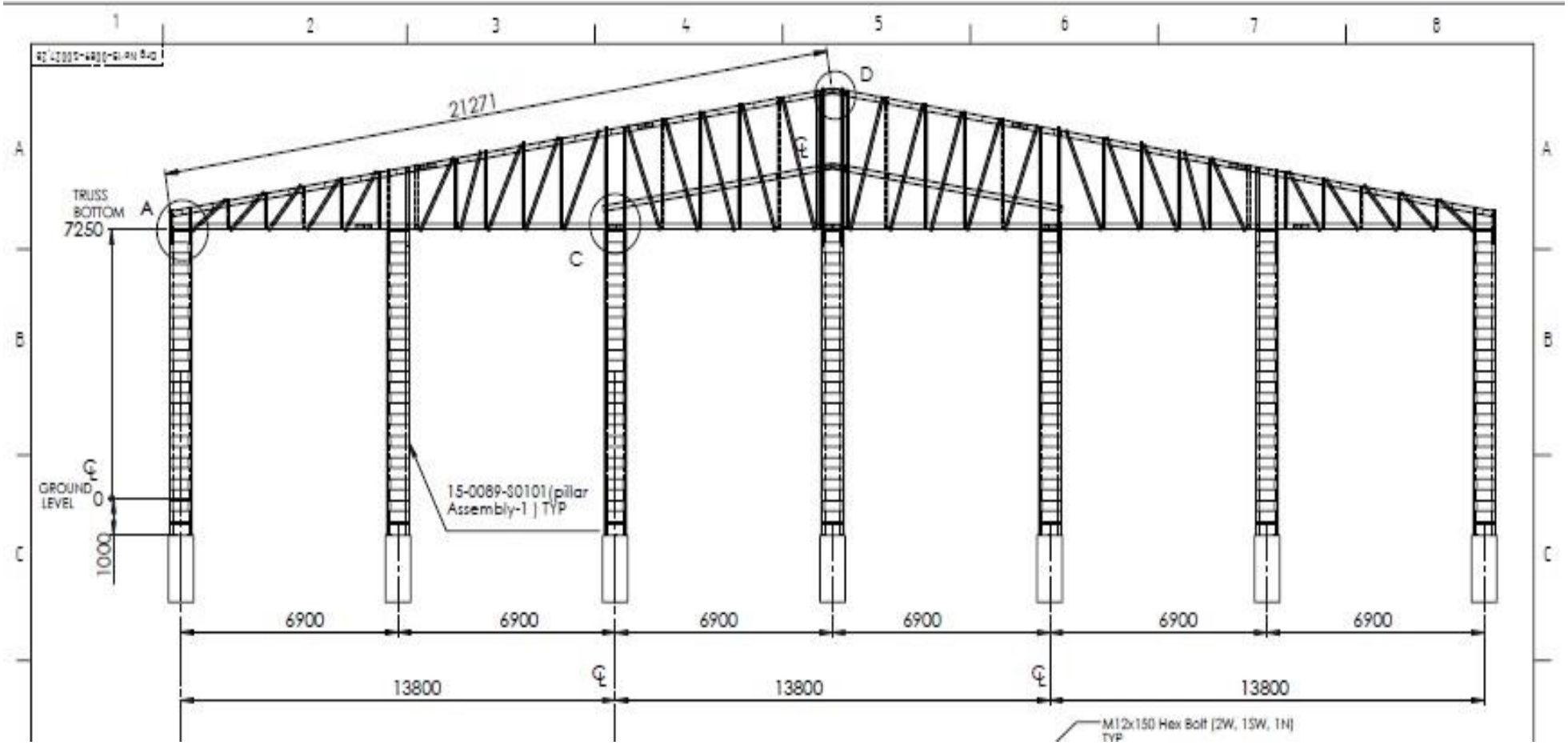
9. Side wall cladding

10. Front & Back cladding

Highlights of the Finish good warehouse

- Area : 7,266 M^2
- No. of Pillars : 140
- No. of Trusses : 30
- Total Weight : 187 MT
- Weight of Structural Members : 129 MT
- Weight of Roof & Cladding Sheet : 58 MT
- **Weight /M^2 : 25.73 Kg**

Current Design With Truss

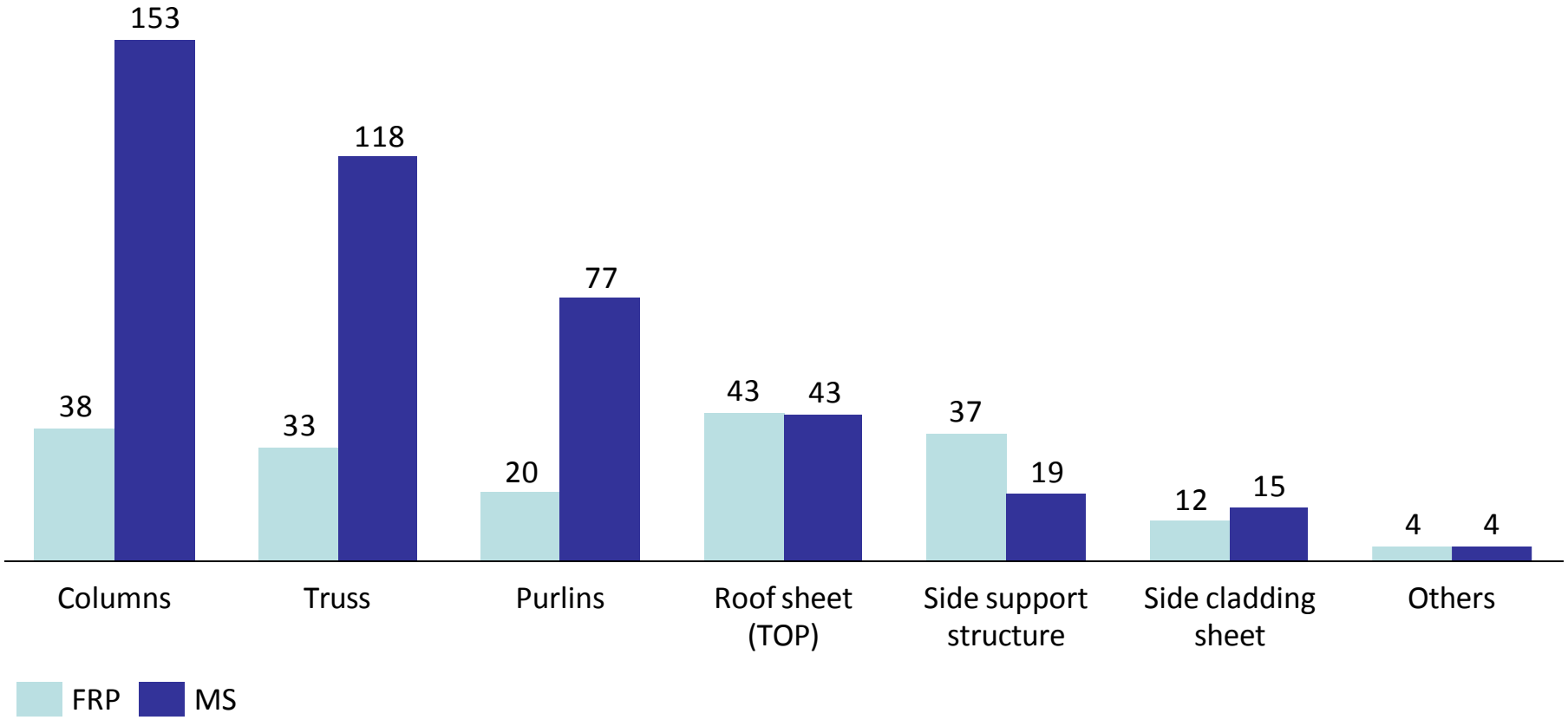


Weight distribution in FRP warehouse across various structural elements

Member	Weight	Percentage
Truss	52,816	28.21%
Roof Sheet	43,111	23.02%
Pillars	38,404	20.51%
Side wall	36,947	19.73%
Cladding	11,907	6.36%
Bend sheet	2,430	1.30%
Others	1,623	0.87%
Total	**187,238**	**100.00%**

Full FRP warehouse is ideal for corrosive environments

Significant weight reduction observed in trusses, columns and purlins compared to MS equivalent structure…



Due to difficulty in making thinner sections, weight advantage not seen in sheeting members

Hybrid structures with FRP structural elements & MS sheets can save upto ~10-15% over conventional pre-fab structures

Actual savings based on design

Several benefits to using FRP structures for refurbishment

- Prefabricated parts eliminates onsite fabrication which requires less complexity and space onsite
- Speedy execution
- Self painted and hence painting activity gets eliminated.
- Joinery with FRP and MS is simple and less hazardous.
- Light-weight so lower load on existing sections
- Easy maneuverability

Restoration and refurbishments using FRP can increase the life of the structure (I)

Illustration: Site refurbishment at Viramgam

Removal of asbestos sheets	Removal of corroded purlins

Restoration and refurbishments using FRP can increase the life of the structure (II)

Illustration: Site refurbishment at Viramgam

Installation of purlins	Installation of roofing sheets
	

FRP is the ideal material of choice if…

✓ *…you are looking from a lifetime cost perspective…*

✓ *…your environment is corrosive or prone to weathering…*

✓ *…you are looking for a light-weight solution…*

✓ *…you are looking for a maintenance free solution*

Thank You!