USE OF FRP COMPOSITES ON INDIAN RAILWAYS

By

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ABSTRACT

Adoption of FRP on Indian Railways’ Rolling Stock has been a success story. Slowly but surely, Railways have gone in for selective use of FRP for sub-assemblies which used to be erstwhile problem areas. Replacement of Aluminium shutters by FRP shutters was the first major step. It followed with a very cozy looking FRP modular Toilet for coaches, FRP doors for mainline and suburban Coaches, Under-slung FRP high capacity water tanks and Radiator fan blades of Diesel Locos. New projects are Driver’s Cabin of Diesel Loco, which has direct bearing on safety and Interior paneling of Coaches. Each project has been a judicious blend of Railway’s initiative and commitment of FRP Industry.

THE introduction of Fibre Reinforced Plastic (FRP) on Indian Railways (IR) arose out of its own compulsions. The Railway coach window shutters were made of Aluminum and its pilferage was a quite normal happening. FRP shutter, initially as assembled unit and finally as one integrated unit, replaced Aluminum shutter. One coach window has two shutters, and a coach has 22 windows. In all there are over One Million shutters in use on IR on the existing coaches. The use of FRP window shutter was, therefore, a Win-Win situation for IR and FRP industry. So a massive influx of FRP shutters for total replacement of Aluminum shutters was an expected happening.

THERE was a brief lull thereafter. IR, which has sinews of steel, were not sure in what ways FRP can be of help. Not that there were no problems on Rolling stock (a generic term which Railways use for anything that is motorised and moves on wheels). The Passenger was to be always kept satisfied. And so the choice was rightly to be coaches – especially Coach Toilets. Could it be possible for an alternative material like FRP to present an attractive design so as to satisfy the
passenger and maintainer? The initial answers were skeptical. It was not just replacement like window shutter. Something more was needed.

Yet a start was made. Coach toilets are, presently, made of mild steel structure and decorative laminated plastic sheets (an improved version of plywood). A comprehensive view was needed. Perhaps, there could be value additions as added bonanza. There were basic issues needing to be addressed in a coach Toilet design. A “Toilet On Wheels” is much different from a Toilet as made in our houses. There are vibrations, corrosion of supporting members of steel, ballast hits, pilferage of fittings and above all no ownership and a VERY HEAVY USAGE. Compare these figures. A coach with 75 passengers comprises of 4 toilets and has limited supply of water. In our house a family of 4 or 5 uses 2 or 3 Toilets without water restriction. And all this less usage at home is with ownership of Toilets. Any new Toilet design concept could never overlook such demanding realities of a “Toilet On Wheels”. Finally to be an attractive proposition it had to be price competitive. Again the same question – Could FRP do it?

FRP MODULAR COACH TOILET

A FRP Toilet became reality when the first coach with 4 Toilets rolled out of Carriage Workshop, Lower Parel Western Railway, Mumbai in November 2001. Because of the type of toilets in use and associated layout there were three toilet designs. It was an Air Conditioned Rajdhani Express coach, which ran between Mumbai and New Delhi.
Sketches of Modular Toilets

THE design was modular – made up of four pieces. This was needed as the toilet had to be retrofitted i.e. the toilet structure should pass through the coach doors and get assembled inside the coach. This was a challenge, which had wide ramifications. IR has 25,000 coaches and another 2000 coaches are manufactured every year. FRP design had to cater to both yet retrofitment was fundamental.

MAKING a rigid module joint was critical. The joints were rivetted in a recessed groove and masked with a tape. Many years later it would help if removal was required. The panels had pockets, projections, and handles. The pockets were needed to access the leakages of plumbing as the plumbing had now been concealed. The tube lights were flushed with the panels and hence a pocket was needed for it too. The projections provided a place for keeping toiletries. The chromed handles were required as a holding support while the coach was in motion. In order to avoid pilferage, the mirror was glued to the wall with special adhesive.
THE matching of window with the coach steel exterior was a tricky issue. There are large number of coach models in service on IR and the distance of window from the coach ends varied significantly. The flexibility of window fitment was vital for adaptability - an issue so critical to retrofitment. So a provision of special rubber beading was done.

TO give a feeling of spacious interior, the door was made in two halves, the washbasin was pushed inside and made integral with FRP housing. The angles of taps and contour of washbasin was so made so as to avoid water splashes. A piano type flush cock replaced the traditional ugly flushing valve; and a light weight, noiseless, brush lees DC fan replaced the bulky corner fan.

Photo:1 old toilet design

Photo:2 old toilet design

Photo 1, 2, 3:- Observe the changes of piping which are now concealed, a much better window and neater overall look.

Photo 4, 5:- The front bottom corner of the toilet has no visible pipes and a much neater look. The ambience of overall assembly of wash basin/mirror area changes completely with concealed lighting and FRP panels.

Photo:3 FRP modular toilet
The Toilets of Coaches

(Before and After)

ONE of the fundamental requirements of a Toilet design enjoined that water should not accumulate on the floor. This was easy for Indian style toilets. For Western designs the laying of slope was to be carefully done. At the same time the flooring should have anti-skid features without water absorption properties. The use of FRP, therefore, reduced the corrosion of supporting steel members below. The pre-fabrication of FRP toilets made it easier to provide for adequate slope from all sides and an anti-skid property with cement grey colours to the flooring.

SO there were value additions as compared to the earlier design. The ergonomics for the user had been adequately studied for standing and squatting positions. The overall ambience was, therefore, appealing.
THE passenger reaction to the new toilet was taken. It covered the parameters of *Aesthetics, lighting, convenience for use, foul smell and cleanability*. As many as 1104 passenger gave their opinion which is summarized below:

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Excellent</td>
<td>39.8%</td>
</tr>
<tr>
<td>(b)</td>
<td>Comfortable</td>
<td>52.1%</td>
</tr>
<tr>
<td>(c)</td>
<td>Needing improvement</td>
<td>8.1%</td>
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**MOST** of the suggestions in category (c) above talked of increasing Toilet space. This needed a complete change of Coach Design and was beyond the purview of toilet design by itself.

**AND** finally the FRP design was price competitive - it almost equalled in cost to the earlier design. It had a better finish with extra features. All such additions did not escalate the final price. The acceptance was therefore, a more formality on IR. Today such toilets are a basic requirement of AC Janshatabdi coaches.

**FRP DOORS OF MAINLINE COACHES AND SUBURBAN COACHES**

**HAVING** witnessed a *Toilet Revolution on IR* through FRP, IR inched forward to other areas. The next was the **Door of mainline coaches and suburban coaches**. The conventional steel door was heavy, its panels were prone to corrosion and the door pivots often gave way. This provided an ideal environment for replacement with FRP. Though the outward looks remained the same

**FRP** doors used stainless steel inserts for pivots and FRP panels made corrosion a non issue. And finally the door was 25% lighter and at the same price. Over a period of time the financial returns of reduced repairs would make the FRP alternate, even more attractive.
UNDERSLUNG FRP WATER TANKS OF AIR CONDITIONED COACHES

THE next project was replacement of Under-slung steel water tanks of Air Conditioned Coaches. It is a twin module unit in which water is stored, each of 410-litre capacity. Water is pumped on the overhead tank by air pressure. The envelope available for design is restricted by permissible moving dimensions of a coach, which directs that certain prescribed clearances shall be maintained. It called for providing semi ellipsoid dished ends; outside diameter of 686 mm, length of 1496 mm and a height of 745 mm. The tank was an LDPE liner with filament wound FRP of 10 mm thickness capable to work with an operating pressure of 2k g/cm2. The vessel was sheathed with ultra high molecular weight high-density polyethylene (UHMHDPE) for prevention against ballast hits. The tanks were to be retrofitted and hence the mounting location was fixed. To accommodate in the space available, the mounting brackets were slightly skewed. This required a careful welding of brackets before assembly. Food grade liner was provided on the inside for safe storing water.

Such modules are on trial on one coach on Western Railway. Once again these blue coloured tanks were cost competitive and hence could be easily adopted for usage.

FRP RADIATOR FAN OF DIESEL LOCOMOTIVES

FRP found its acceptability in Diesel locomotive as well. On IR, Diesel locomotive is a moving Power House of 2600 hp and above. The Radiator Fan, which cools the engine water, consumes 100 hp at a speed of 1200 rpm. Its 6 blades, 64 cms long, 15 cms wide are made of Aluminum. The blades, over a period of time, age and break. If an obstruction comes in between, the breakage is instantaneous with consequential damage to radiators. The blades have a special aerodynamic profile as well. This construction was ideally oriented to replacement with FRP. The FRP blades were light, equally strong and cost competitive. There was no issue of retrofitment, as the FRP blades were easily interchangeable as the changeover happened in Repair Sections and not on Diesel Loco. Diesel Loco Works, Varanasi, therefore, cleared its usage in view of past failures of Aluminum blade design.

NEW PROJECTS OF FRP ON IR

EMBOLDENED by past successes over a period of four years, IR developed sufficient confidence to proceed further in tackling the problem areas by using
FRP. IR accords a very high priority to safety of its passengers. So the next area where the work was begun was in the **Driver's Cabin** design of Diesel Loco. The existing designs are 40 years old; appear drab by today's standards. At the same time the driver needs comfort to remain constantly vigilant. The cabin instrumentation has also undergone a technological change but the mountings have been add-ons. A comprehensive, integrated design, approach was long overdue. The new design shall not only address these issues but shall be better in aesthetics with less maintenance. The instrumentation design is also quite crucial. IR expects to meet all these challenges when a new Drivers' Cabin shall roll out from one of the premier Diesel Loco Sheds of Western Railway before the end of 2004.

**FRP WASTE DISPOSAL**

**A WORD** of caution needs to be sounded. The issue of disposal of FRP waste is looming large. As Railway units progressively go over to ISO 14000, the FRP waste disposal becomes even more prominent. A suitable answer from FRP industry shall be of great help.

The above are indigenous developments with Indian brains. FRP industry is India has been quite responsive and so the march of experiments has been sustained. It is likely to bloom further into new areas like End Cab Nose design, bridge sleepers for rail tracks, Interior panelling of coaches. For IR, the journey of fancy with FRP has just begun.

![Arunendra Kumar](image)

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