

## **Tata Power Southern Odisha Distribution Ltd.** **(A TATA Power and Odisha Government Joint Venture), Odisha**

### **Press Fit Fuse**

In this 21st century electricity makes our lives significantly easier in our day-to-day life. With the daily basic need of electricity, all Discom has safety related challenges while providing uninterrupted and reliable power supply to consumers in such wide geographical area of operation. At Discoms, the new fiscal has dawned rich with promises for providing a safe workplace for employees and safe electricity supply to consumers. Currently every organization is enthusiastically exploring the best innovative techniques through technological interventions for further enhancement of safety at workplace.

Considering the Southern Odisha districts electricity supply TPSODL holds in deep reverence to the values of lives of its employees as well as public at lives. In order to achieve the goal making TPSODL free from accident & injuries and to develop a positive safety culture not only for its employees and employees of Business Associates but also for public at large.

Starting from inception of TPSODL (A Joint Venture ( A TATA Power and Odisha Government Joint Venture in January 2021 ) number of safety innovation & technological intervention had been taken with prime focus to minimize the employee, public and animal incidents by ensuring safe workplace for employees and safe electricity supply to its consumers.

From the list of TPSODL safety innovation "Press Fit Fuse" is a key flagship innovation project in safety & operational excellency with below mentioned benefits:-

HG Fuse is a protection arrangement to any overhead distribution sector line and equipment's. Due to any fault the fuse may blow out and it's required fuse replacement by creating safety zone and climbing up to the HG fuse structure to replace the fuse. But it's found that the maximum incidents are happening during fuse replacement due to no compliance of safety zone creation and work at height safety guidelines violations. To eliminate the risk through engineering and substitution method Team TPSODL developed and innovative project called HG fuse replacement (Press Fit Fuse) tool. In which the HG fuse can be replaced from ground level without any ladder and other tools.

#### **Press Fit Fuse use Benefits:**

1. HG Fuse replacement from ground level by eliminating work at height & direct contact with electrical line.



Patent Application Number : 202331044271

2. Quick Fuse replacement and outage restoration.
3. Safe execution of O&M activity.
4. Cost effective and durable in nature.
5. Made in TPSODL with Make in India, Skilled Odisha Model.



*"Let's Prepare and prevent, don't repair and repent ..."*

**Jai Surakshya**

Thank You.....

# Tata Power Delhi Distribution Limited

## Delhi

### The Evolution of Ladder Design : From Utility to Innovation

– Rohit Sethi\*

#### Abstract:

This technical article focuses on the design improvements in ladders used for electrical utilities in India. With the rapid growth of the electrical industry in the country, there is a pressing need for safe and efficient equipment for professionals working in the field. Ladders play a crucial role in ensuring the safety and accessibility of technicians, and this article explores the various design enhancements that have been made to address the specific challenges faced by electrical utility workers in India. By examining key aspects such as material selection, ergonomic considerations, and enhanced stability features, this article highlights the advancements in ladder design that have significantly improved safety and productivity in the electrical utility sector.

#### Introduction:

Tata Power Delhi Distribution Limited (Tata Power DDL) is a prominent power distribution company that supplies electricity to the northern region of Delhi, India. It is a joint venture between Tata Power Company Limited and the Government of Delhi. Tata Power DDL is committed to providing reliable, efficient, and affordable electricity to its consumers while actively promoting sustainability and environmental stewardship. The 11 / 0.44 KV Power distribution network of Tata Power-DDL is equipped with an installed transformation capacity of app.5992 MVA spread over a vast geographical area of over 510 Sq. Km. This network includes over 11550 Ckt Km of network comprising largely of LT and HT bare conductor, LT and HT AB Cables of different ratings laid over a 3 lakh poles. Under such circumstances, ladders act as indispensable tools that allow technicians to access elevated areas safely, thereby enabling efficient maintenance and installation work on this network. Therefore, the importance of safety and reliability of ladders in this utility business electrical utility industry cannot be overstated. However, traditional ladder designs often fell short in meeting the unique requirements of electrical utility workers. There have been a series of incidents caused by inadequacy in design of ladder due to which working on height while using a ladder became a high potential risk for the organisation. Subsequently, various design enhancements have been made to address the specific challenges faced by electrical utility workers by examining key aspects such as material selection, ergonomic considerations, and enhanced stability features.

During the initial years of its inception, the work on height was performed using manual climbing on poles. However, for safety considerations, it was decided to perform all tasks on poles while using ladders. Subsequently, bamboo ladders were provided to all zonal teams. On the other hand, the highly mobile meter management teams would carry foldable aluminium ladders on top of their vans. The journey of ladder development at Tata Power DDL started in June 2018 w’ q , both bamboo and aluminium ladders were evaluated for their durability and ease of doing work.

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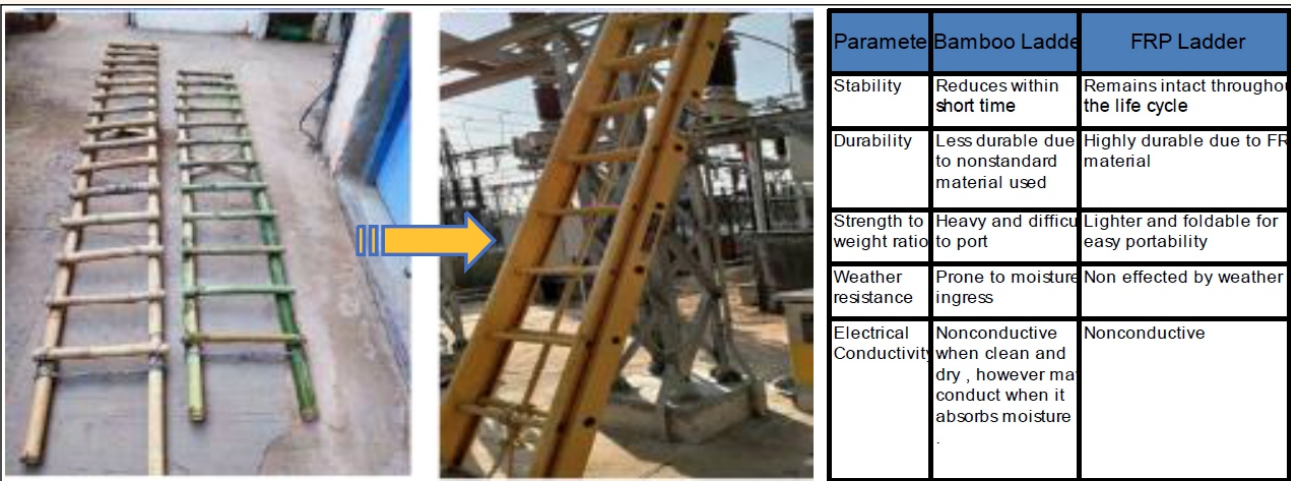
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On the positive side, bamboo is a lightweight material, making the ladder easy to carry and manoeuvre. It is also strong and durable, capable of supporting significant weight. Bamboo ladders are eco-friendly and sustainable since bamboo is a fast-growing and renewable resource. Additionally, bamboo has natural anti-slip properties, providing enhanced safety during climbing tasks. However, bamboo ladders have a few drawbacks. They may not be suitable for heavy-duty tasks or industrial settings that require higher load capacities. Bamboo is also susceptible to weathering and decay if not properly maintained, limiting its longevity.

Aluminium ladders have several advantages over bamboo ladders. Firstly, aluminium is an incredibly lightweight material, making the ladder easy to transport and manoeuvre. It also offers exceptional strength and durability, allowing it to support heavier loads and withstand rigorous use. Aluminium ladders are highly resistant to rust, corrosion, and weathering, ensuring their longevity even in outdoor environments. They require minimal maintenance and can be easily cleaned. Furthermore, aluminium ladders provide better stability and safety due to their sturdy construction and anti-slip features. Lastly, aluminium ladders are often more affordable and widely available compared to bamboo ladders, making them a popular choice.

Aluminium ladders can fail in electrical utility settings due to their conductive nature. When working near or with live electrical equipment, the ladder can become energized if it encounters an energized conductor. This poses a significant risk of electric shock to the user. Therefore, alternatives like FRP (Fiber Reinforced Plastic) ladders are preferred in such settings, as they offer non-conductive properties while maintaining strength and durability. FRP (Fiber Reinforced Plastic) ladders offer several advantages over both aluminium and bamboo ladders. Firstly, FRP ladders are non-conductive, making them exceptionally safe for working near electrical equipment or in environments with electrical hazards. This feature significantly reduces the risk of electric shocks or accidents. Secondly, FRP ladders are lightweight, like aluminium and bamboo ladders, but they are also extremely strong and durable. They can withstand heavy loads and rigorous use without compromising their structural integrity. FRP ladders are non-corrosive and resistant to rust, making them suitable for outdoor use and ensuring their longevity. Moreover, FRP ladders require minimal

### Stage I



Parameter	Bamboo Ladder	FRP Ladder
Stability	Reduces within short time	Remains intact throughout the life cycle
Durability	Less durable due to nonstandard material used	Highly durable due to FRP material
Strength to weight ratio	Heavy and difficult to port	Lighter and foldable for easy portability
Weather resistance	Prone to moisture ingress	Non affected by weather
Electrical Conductivity	Nonconductive when clean and dry, however may conduct when it absorbs moisture	Nonconductive

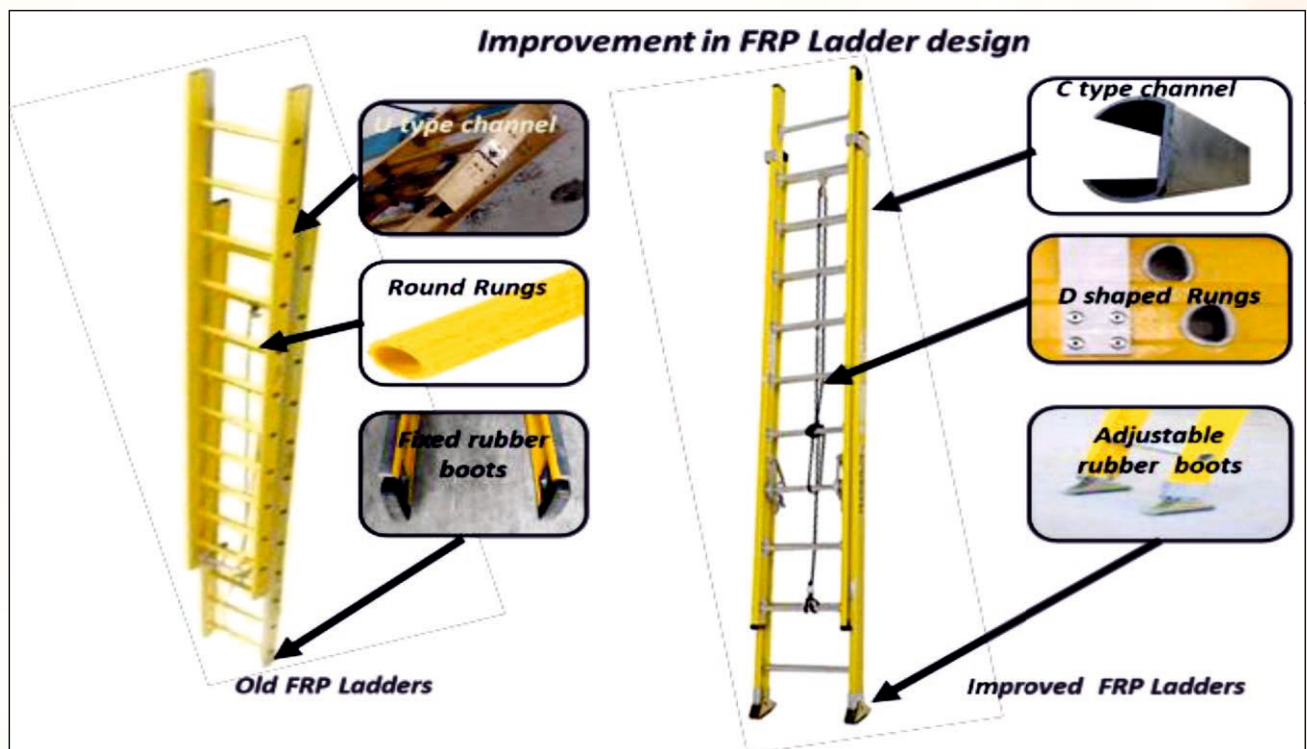
**Replacement of fixed length Bamboo ladder With Extendable FRP Ladder**

maintenance and are resistant to chemical exposure, making them suitable for various industries. They also have excellent anti-slip properties, providing enhanced safety during climbing tasks. Overall, FRP ladders combine the best features of both aluminium and bamboo ladders while offering superior safety, durability, and versatility.

In view of the above advantages of FRP ladder, a mass drive for replacement of all Bamboo and aluminium ladders with FRP ladders was initiated in later half of FY 2018-19 wherein over 500 new FRP ladders were procured. During this mass drive, the best ladder design available in the market was adopted. Though these ladders were better than their previous counterparts, the ground teams started facing certain issues while using these ladders in the field. Firstly, these w w ' work for long duration while standing on these rungs. Secondly, these ladders tend to get pliant and unstable towards the middle while the lineman climbed on them. In an incident, the U-shaped side rails of the twofold ladder got excessively twisted at the middle.

**Generation 2 FRP Ladders:** The above shortcomings in the generic design caused the teams to think for innovative solutions for making these ladders safer. Hence, a thorough analysis of ladder design was performed and a new generation FRP ladder was developed in coordination with one of the manufacturers. The new design ladder had D shaped rungs for comfort of the linemen. The side rails of these ladders were twisted to C shaped for preventing unlocking and increasing stability as one climbed up the ladder. Further, these ladders were provided with flexible shoes at both top and bottom ends for enhanced grip. The above design was implemented in the field and a few trial runs were made. The same proved to be successful and safer than the generic ladders.

### Stage II



**Generation 3 FRP Ladders:** In the Indivior for achieving further improvement and making safer and easy to use, further design changes were made in these ladders. The new design was fitted with a ball bearing based pulley in place of the generic friction pulley. This improvement reduced the force required for unfolding of ladder by 30 %.



The development of ladder design has also led to the creation of ladder balancers and self-support ladders. Ladder balancers are mechanisms attached to ladders to counterbalance the weight on the opposite side, reducing the strain on the user and enhancing stability. This innovation has made working at heights more comfortable and safer, particularly in situations where the ladder needs to be extended significantly.

Self-support ladders are a recent breakthrough that allows ladders to stand independently without the need for leaning against a structure or wall. This feature is achieved through a combination of innovative materials and design elements that provide stability and support. Self-support ladders are especially useful in situations where there is limited or no access to walls or structures, providing greater flexibility and accessibility.

**Benefits realised so far:**

*Safety Features:*

Safety is paramount in ladder design, and advancements in safety features have greatly contributed to improved worker protection. Innovations such as locking mechanisms, safety gates, and integrated fall arrest systems have been incorporated into modern ladder designs to minimize the risk of accidents and injuries. These features ensure that workers can perform their tasks with confidence, knowing that they are protected by reliable safety measures.

*Ergonomic Considerations:*

Efficient ladder designs consider the ergonomics of workers. Traditional ladder designs often lacked comfort features, leading to fatigue and increased risk of accidents. Modern ladder designs incorporate features such as anti-slip rungs, comfortable handholds, and adjustable heights to minimize strain on workers' bodies. These ergonomic considerations significantly improve the overall user experience and reduce the likelihood of injuries.



Self Supporting Ladder

### ***Stability Enhancements:***

Ladder stability is a critical factor in ensuring worker safety. In India, where the electrical utility industry faces diverse terrain and challenging working conditions, ladder stability is of utmost importance. Modern ladder designs incorporate features such as wider bases, anti-slip feet, and stabilizer bars to enhance stability on uneven surfaces. These enhancements reduce the risk of ladder tipping or slipping, enabling workers to carry out their tasks confidently.

### ***Height Adjustability and Versatility:***

Electrical utility work often requires technicians to access different heights and areas. Design improvements in ladders include height adjustability mechanisms that allow workers to adapt the ladder's height to specific requirements. Additionally, ladder designs now include features such as extendable sections, platform attachments, and multi-position capabilities, providing increased versatility for a wide range of electrical utility applications.

### ***Compliance with Standards and Regulations:***

Ladders used in electrical utilities must adhere to stringent safety standards and regulations. Design improvements in recent years have focused on ensuring compliance with these standards, including factors such as load capacity, stability requirements, and electrical insulation properties. By meeting or exceeding the established safety standards, modern ladder designs offer peace of mind to both workers and regulatory bodies.

### **Conclusion:**

The design improvements in ladders for electrical utilities in India have significantly enhanced safety, productivity, and efficiency for workers in the field. Through advancements in material selection, ergonomic considerations, stability enhancements, height adjustability, safety features, and compliance with standards and regulations, modern ladder designs provide a robust solution for the unique challenges faced in the electrical utility sector. These design improvements underscore the commitment to worker safety and the continuous efforts to improve the tools and equipment used in the industry.

### **Way forward:**

The development of ladder design has come a long way since its early beginnings. From the simplicity of ancient wooden structures to the advanced fiberglass ladders of today, innovation has driven the evolution of ladders to meet the needs of a changing world. With a focus on safety, durability, and user convenience, ladder design continues to evolve, bringing new features and materials to the market. As technology advances, we can expect even more ground-breaking developments such as a telescopic ladder that will further enhance the functionality and safety of ladders, allowing us to reach new heights with confidence.