**NORTHEAST FRONTIER RAILWAY**


# WORK STUDY REPORT
# ON
# REVIEW OF STAFF STRENGTH OF BLACKSMITH SHOP UNDER CHIEF WORKSHOP MANAGER OF NEW BONGAIGAON WORKSHOP N.F.RAILWAY

**GUIDED BY:**

**SHRI B. LAKRA. SDGM**

**SHRI L.R.WARY. E.O.**

**CO-ORDINATING OFFICERS & PERSONNEL**

**BRANCH OFFICER : SHRI P.P.ROY. CWM/NBQ'S .**

**ASSOCIATED OFFICER: SHRI LALAN RAJAK. APO/NBQ's**

**CONDUCTED BY**

**SHRI B.R.GHOSE DASTIDAR, WSI.**

**SHRI A. BARUAH, WSI.**

**STUDY NO. WSNF/ 09/2020 -21**

**CASE NO. Z/375/10/09/2020 -21.**

**CENTRAL PLANNING ORGANISATION**

**N. F. RAILWAY/MALIGAON**

**GUWAHATI - 781011.**

## EXECUTIVE SUMMARY

**SUBJECT:** Review of Staff Strength of Black-Smith Shop under CWM/NBQ's of N.F. Railway

**STUDY NO** : **WSNF/09/2020 -21**

**CASE NO** : **Z/375/10/09/2020 -21**

**AUTHORITY** : **SDGM/N.F.R.**

**CONCERN DIV.** : **HQ**

**DEPARTMENT** : **MECHANICAL.**

**DATE OF COMMENCEMENT :** **18 /11/2020**

**DATE OF COMPLETION :** **02/12/2020**

**DATE OF SUBMISSION :** **02/12/2020**

**TERMS OF REFERENCE**:

Approved Annual Programme of Work Study.

**NOS. OF RECOMMENDATION**: 1(One)

In this work study 5 nos. of vacant posts of Tech-I has identified as surplus and proposed for surrender.

**PROJECTED MAN POWER:** **5 Posts.**

**PROJECTED FINANCIAL SAVING:** **Rs 23.90 Lakhs per annum**.

**MONTH AND YEAR OF CIRCULATION:** **DEC/2020**

**I N D E X**

## CHAPTER - I

### 1.0 INTRODUCTION:

This is the second Railway Workshop established at New Bongaigaon in Bongaigaon district in 1965 covering an area of about 80 hectares . This project at New Bongaigaon consist of 3 amalgamated factories and was completed at a cost of about Rs. 10.52 crores. It has a periodical overhauling capacity of 1,500 units of passengers coaches and 3,000 units of goods wagons per annum. It also undertakes manufacturing work for various Divisions of North-East Frontier Railways.

NBQ workshop achieved the high scale of skill due to hard work of all staff and officers and adopted high skill to operate modern machineries.

### VITAL STATISTICS

1. Sanctioned Strength 3133
2. On Roll Strength 2717
3. No. of Officers 15
4. No. of Supervisors 282
5. Total Area 846700 sq.m.
6. Covered Area 45858 sq.m.
7. Township Area 16 sq.km.
8. Power Consumption 569504 KWH
9. Water Consumption 13680 KL/month

   47880 KL/month (raw water
10. Annual Budget Rs.85 Cr.

### MAIN ACTIVITIES

S/N. Activities Outturn 09-10 &Target 10-11

1. BG AC Coach POH 85 &84
2. BG NAC Coach POH 482& 432
3. BG Wagon POH 1217& 1200
4. MG Coach POH – 60

**BRIEF HISTORY OF NEW BONGAIGAON WORKSHOP**

The Carriage and Wagon Repair Workshop, New Bongaigaon was conceived in the year 1965, soon after the formation of Northeast Frontier Railway. It is situated in an eco-friendly environment at about 2 km. to the west of New Bongaigaon Railway station. The main civil township of Bongaigaon is about 4km to the East of Workshop.

The project work for undertaking repairs to carriage & wagon stock of this workshop was sanctioned in 1961-62, at an estimated cost of Rs.6.85 Crores. The work was completed and commissioned in April 1965.The initial capacity of the workshop was for POH of 10 four wheeler unit(FWU) of MG coaches & 50 FWU of MG wagons per month, with a staff strength of about 600. The capacity was subsequently augmented in phases. The workshop was remodeled during 1983-84 for undertaking POH and corrosion repair of BG coaches.

Further, "Modernisation of workshop" was sanctioned by Railway Board in 2004-05 at a cost of Rs.17.87 crores, towards augmentation of capacity and up-gradation of facility. This augmented the capacity for POH of non-AC and AC BG coaches from 31 to 54 VUs and that for BG wagons from nil to 20 VUs per month. In view of traffic requirement on NF Railway, POH of MG wagon was gradually phased out and the released capacity was diverted to POH of BG wagon.

Likewise, POH of MG coach was also phased out and released capacity was 20 diverted to POH of BG coaches. This rationalization has improved the working and productivity of the workshop.

The workshop has been delivering an output/outturn of about 50 BG coaches and 100 BG wagons per month. In addition to that, 33 BG coaches have been taken for IOH per month.

This workshop has the distinction of being one of the Indian Railway workshops which supplies BG, MG and NG wheels of all stock to divisions.

1.1 RATIONALE FOR CONDUCTING THIS STUDY:

- Man power is the most costly and precious resource over Indian Railway and right sizing is the need of the hour.
- Focusing attention on core activities by reducing/elimination of non- core activities.
- Improving the efficiency (output/input) either by improving the output (numerator) or by decreasing the input (denominator).
- Up-gradation/introduction of automation/innovations
- Outsourcing of noncore activity.
- Availability of better process/technology.
- Reducing/removing redundancy in work.

1.2 **AUTHORITY:**

SDGM of N.F.Railway.

1.3 **TERMS OF REFERENCE:**

Approved Annual Work Study Programme

1.4 **METHODOLOGY:**

a) Collection of data relating to workload.

b) Discussion with WM/NBQ's & Subordinates and obtaining their views.

c) Assess the workload for Workshop /field activity.

d) Assess the workload for BSS units.

e) Assess the staff requirements for the above workload.

1.5 **ACKNOWLEDGEMENT:**

Work study team is grateful to Sri P.P.ROY, CWM/NBQ's, for their kind guidance and co-operation for conducting this study. The work study team is thankful to Sri LALAN RAJAK.APO/NBQ's for his assistance rendered to the work study team for conducting the subject study.

**1.6**. CWM/NBQ's has nominated Sri Lalan Rajak APO/NBQ's and G. Narzery Dy CME/ FRT as associated officer for the said study ( placed as Annex-I)

## CHAPTER-II

### 1.0 GENERAL

A **blacksmith** is a metal smith who creates objects from wrought iron or steel by forging the metal, using tools to hammer, bend, and cut (cf. tinsmith). Blacksmiths produce objects such as gates, grilles, railings, light fixtures, furniture, sculpture, tools, agricultural implements, decorative and religious items, cooking utensils and weapons. There was an historical opposition between the heavy work of the blacksmith and the more delicate operation of a whitesmith, who usually worked in gold, silver, pewter, or the finishing steps of fine steel.[1] The place where a blacksmith works is called variously a smithy, a forge or a blacksmith's shop.

While there are many people who work with metal such as farriers, wheelwrights, and armorers, in former times the blacksmith had a general knowledge of how to make and repair many things, from the most complex of weapons and armor to simple things like nails or lengths of chain.

Blacksmiths work by heating pieces of wrought iron or steel until the metal becomes soft enough for shaping with hand tools, such as a hammer, an anvil and a chisel. Heating generally takes place in a forge fueled by propane, natural gas, coal, charcoal, coke, or oil.

Some modern blacksmiths may also employ an oxyacetylene or similar blowtorch for more localized heating. Induction heating methods are gaining popularity among modern blacksmiths.

Color is important for indicating the temperature and workability of the metal. As iron heats to higher temperatures, it first glows red, then orange, yellow, and finally white. The ideal heat for most forging is the bright yellow-orange color that indicates *forging heat*. Because they must be able to see the glowing color of the metal, some blacksmiths work in dim, low-light conditions, but most work in well-lit conditions. The key is to have consistent lighting, but not too bright. Direct sunlight obscures the colors.

The techniques of smithing can be roughly divided into forging (sometimes called "sculpting"), welding, heat-treating, and finishing.

#### Forging

Forging—the process smiths use to shape metal by hammering—differs from machining in that forging does not remove material. Instead, the smith hammers the iron into shape. Even punching and cutting operations (except when trimming waste) by smiths usually re-arrange metal around the hole, rather than drilling it out as swarf.

Forging uses seven basic operations or techniques:

- Drawing down
- Shrinking (a type of upsetting)
- Bending
- Upsetting
- Swaging
- Punching
- Forge welding

These operations generally require at least a hammer and anvil, but smiths also use other tools and techniques to accommodate odd-sized or repetitive jobs.

#### Drawing

Drawing lengthens the metal by reducing one or both of the other two dimensions. As the depth is reduced, or the width narrowed, the piece is lengthened or "drawn out."

As an example of drawing, a smith making a chisel might flatten a square bar of steel, lengthening the metal, reducing its depth but keeping its width consistent.

Drawing does not have to be uniform. A taper can result as in making a wedge or a woodworking chisel blade. If tapered in two dimensions, a point results.

Drawing can be accomplished with a variety of tools and methods. Two typical methods using only hammer and anvil would be hammering on the anvil horn, and hammering on the anvil face using the cross peen of a hammer.

Another method for drawing is to use a tool called a fuller, or the peen of the hammer, to hasten the drawing out of a thick piece of metal. (The technique is called fullering from the tool.) Fullering consists of hammering a series of indentations with corresponding ridges, perpendicular to the long section of the piece being drawn. The resulting effect looks somewhat like waves along the top of the piece. Then the smith turns the hammer over to use the flat face to hammer the tops of the ridges down level with the bottoms of the indentations. This forces the metal to grow in length (and width if left unchecked) much faster than just hammering with the flat face of the hammer.

**Bending**

Heating iron to a "forging heat" allows bending as if it were a soft, ductile metal, like copper or silver.

Bending can be done with the hammer over the horn or edge of the anvil or by inserting a bending fork into the hardy hole (the square hole in the top of the anvil), placing the work piece between the tines of the fork, and bending the material to the desired angle. Bends can be dressed and tightened, or widened, by hammering them over the appropriately shaped part of the anvil.

Some metals are "hot short", meaning they lose their tensile strength when heated. They become like Plasticine: although they may still be manipulated by squeezing, an attempt to stretch them, even by bending or twisting, is likely to have them crack and break apart. This is a problem for some blade-making steels, which must be worked carefully to avoid developing hidden cracks that would cause failure in the future. Though rarely hand-worked, titanium is notably hot short. Even such common smithing processes as decoratively twisting a bar are impossible with it.

**Upsetting**

Upsetting is the process of making metal thicker in one dimension through shortening in the other. One form is to heat the end of a rod and then hammer on it as one would drive a nail: the rod gets shorter, and the hot part widens. An alternative to hammering on the hot end is to place the hot end on the anvil and hammer on the cold end.

**Punching**

Punching may be done to create a decorative pattern, or to make a hole. For example, in preparation for making a hammerhead, a smith would punch a hole in a heavy bar or rod for the hammer handle. Punching is not limited to depressions and holes. It also includes cutting, slitting, and drifting—all done with a chisel.

**Combining processes**

The five basic forging processes are often combined to produce and refine the shapes necessary for finished products. For example, to fashion a cross-peen hammer head, a smith would start with a bar roughly the diameter of the hammer face: the handle hole would be punched and drifted (widened by inserting or passing a larger tool through it), the head would be cut (punched, but with a wedge), the peen would be drawn to a wedge, and the face would be dressed by upsetting.

As with making a chisel, since it is lengthened by drawing it would also tend to spread in width. A smith would therefore frequently turn the chisel-to-be on its side and hammer it back down—upsetting it—to check the spread and keep the metal at the correct width.

Or, if a smith needed to put a 90-degree bend in a bar and wanted a sharp corner on the outside of the bend, they would begin by hammering an unsupported end to make the curved bend. Then, to "fatten up" the outside radius of the bend, one or both arms of the bend would need to be pushed back to fill the outer radius of the curve. So they would hammer the ends of the stock down into the bend, 'upsetting' it at the point of the bend. They would then dress the bend by drawing the sides of the bend to keep the correct thickness. The hammering would continue—upsetting and then drawing—until the curve had been properly shaped. In the primary operation was the bend, but the drawing and upsetting are done to refine the shape.

**Welding**

Welding is the joining of the same or similar kind of metal.

A modern blacksmith has a range of options and tools to accomplish this. The basic types of welding commonly employed in a modern workshop include traditional forge welding as well as modern methods, including oxyacetylene and arc welding.

In forge welding, the pieces to join are heated to what is generally referred to as *welding heat*. For mild steel most smiths judge this temperature by color: the metal glows an intense yellow or white. At this temperature the steel is near molten.

Any foreign material in the weld, such as the oxides or "scale" that typically form in the fire, can weaken it and cause it to fail. Thus the mating surfaces to be joined must be kept clean. To this end a smith makes sure the fire is a reducing fire: a fire where, at the heart, there is a great deal of heat and very little oxygen. The smith also carefully shapes mating faces so that as they come together foreign material squeezes out as the metal is joined. To clean the faces, protect them from oxidation, and provide a medium to carry foreign material out of the weld, the smith sometimes uses flux—typically powdered borax, silica sand, or both.

The smith first cleans parts to be joined with a wire brush, then puts them in the fire to heat. With a mix of drawing and upsetting the smith shapes the faces so that when finally brought together, the center of the weld connects first and the connection spreads outward under the hammer blows, pushing out the flux (if used) and foreign material.

The dressed metal goes back in the fire, is brought near to welding heat, removed from the fire, and brushed. Flux is sometimes applied, which prevents oxygen from reaching and burning the metal during forging, and it is returned to the fire. The smith now watches carefully to avoid overheating the metal. There is some challenge to this because, to see the color of the metal, the smith must remove it from the fire—exposing it to air, which can rapidly oxidize it. So the smith might probe into the fire with a bit of steel wire, prodding lightly at the mating faces. When the end of the wire sticks on to the metal, it is at the right temperature (a small weld forms where the wire touches the mating face, so it sticks). The smith commonly places the metal in the fire so he can see it without letting surrounding air contact the surface. (Note that smiths don't always use flux, especially in the UK.) Now the smith moves with rapid purpose, quickly taking the metal from the fire to the anvil and bringing the mating faces together. A few light hammer taps bring the mating faces into complete contact and squeeze out the flux—and finally, the

smith returns the work to the fire. The weld begins with the taps, but often the joint is weak and incomplete, so the smith reheats the joint to welding temperature and works the weld with light blows to "set" the weld and finally to dress it to the shape.

**Finishing**

A blacksmith at work depending on the intended use of the piece, a blacksmith may finish it in a number of ways:

- A simple jig (a tool) that the smith might only use a few times in the shop may get the minimum of finishing—a rap on the anvil to break off scale and a brushing with a wire brush.
- Files bring a piece to final shape, removing burrs and sharp edges, and smoothing the surface.
- Heat treatment and case-hardening achieve the desired hardness.
- The wire brush—as a hand tool or power tool—can further smooth, brighten, and polish surfaces.
- Grinding stones, abrasive paper, and emery wheels can further shape, smooth, and polish the surface.

A range of treatments and finishes can inhibit oxidation and enhance or change the appearance of the piece. An experienced smith selects the finish based on the metal and on the intended use of the item. Finishes include (among others): paint, varnish, bluing, browning, oil, and wax.

**HAMMERS**

For everyday work most blacksmiths use a ball-peen hand hammer weighing about 750 to 1 250 g. A hand hammer should be of a weight that suits the smith. It should have a longer shaft than is usual for other work and be well-balanced. Often special hammers are used for particular jobs. These the smith usually makes as the need arises. Old car-axle shafts are suitable material for hammers.

Sledgehammers may be double-faced, straight- or cross-peen, and usually weigh from 3 to 5 kg. They have long shafts for use with two hands.

All hammer heads must be firmly fastened to their shafts. Both wooden and metal wedges are used. The centre lines of the hammer head and its shaft must be at right angles to each other. Hammer faces should be polished and kept free of marks.

**CHISELS**

The blacksmith needs chisels for cutting both cold and hot metal. For cutting cold metal chisels are comparatively short and thick, while for hot metal they are thinner and longer. Chisels can be of many shapes and sizes, special ones often being made to facilitate the work in hand. They are best made from steel containing about 0.8 percent of carbon. Motor-vehicle coil and leaf springs are a fair substitute if nothing else is available.Smiths are often called upon to make chisels for other tradesmen. These have to be hardened and tempered to suit particular purposes.

**SETS**

Like chisels, sets are used for cutting hot and cold metal. Basically, they are chisels with handles or shafts. Wooden shafts are easiest to handle but many smiths use metal-rod handles. These are cheap and easy to make and fit. As with chisels, sets for cold work are short and thick whereas for hot metal they are longer and thinner. Again, these can be made in a wide range of shapes for various purposes.

**HARDY**

The hardy is a chisel designed to fit the tool hole in the anvil. It is used with a hand hammer for cutting both hot and cold metal.

**TONGS**

The blacksmith uses many different types and styles of tongs. Tongs must hold the workpiece firmly without slipping. They are often made for one specific job or adapted for a particular workpiece and will vary in length, size and weight, as metal sizes also vary. Although smiths make their own tongs, generally from mild steel, it is a good idea to start with at least a few pairs already made.

**PUNCHES FOR HOT WORK**

These can be round, square or almost any other shape to suit the job. Punches should be long enough to keep hands away from reflected heat and large ones can be fitted with handles. They are usually designed to remove the minimum amount of metal from the job and to swell the hole to size and shape.

**DRIFTS**

Drifts are rather like short punches. Made of carbon-tool steel, they are of exact size and shape and may be round, hexagonal, octagonal or almost any other shape. They are usually hammered through the work to finish a hole to size and shape while the metal is only at a dull red heat. A little grease can be applied to make the work easier and to give a better finish.

**FULLERS**

These, like chisels or sets, are made in various sizes and have rounded edges. Small ones may be hand-held while larger sizes require shafts or handles and are struck with a sledgehammer. Fullers are usually made in pairs. The bottom fuller fits into the tool hole of the anvil. They are used for setting down shoulders in preparation for forging tenons and for drawing or moving metal in one direction.

**SWAGES**

These are top and bottom tools between which metal is worked. The most common are semicircular and are used for forming round sections to size after previous forging. The bottom tool fits into the tool hole of the anvil. In some cases top and bottom tools are hinged or fastened together by a spring strap or rod. These can be useful when a smith is working alone. They are also common in power-hammer work.

**FLATTERS AND SET HAMMERS**

These have flat faces with sharp or rounded edges according to requirements and are placed on the work and struck with the sledgehammer. The set hammer is most often used for setting in shoulders, while the flatter is a good finishing tool and should be used only to impart a good finish to flat surfaces.

**HAND MANDREL**

This tool is cone-shaped and fitted with a handle. It is used for rounding up small rings or for stretching them to size. It is hand-held either on the face or over the edge of the anvil.

**BOLSTER PLATES**

These are steel plates with various holes drilled or punched into them. They are used for forming neat shoulders at change of section in the workpiece. Some types have round and square countersunk holes in them and enable countersunk-headed bolts to be made as for ploughshares.

**FUEL AND TOOLS**

Coal, coke or charcoal may be used as fuel. Charcoal is very clean and there is little to contaminate the metal. It is of low density, however, and greater amounts must be burnt to provide enough heat for bigger jobs. Little air blast is required, but it is still a very expensive form of fuel for the smith's work. Good coking coal is usually much cheaper than charcoal. Coal must be in the form of small grains, kept wet on the hearth and gradually drawn toward the fire as work proceeds. During this time the coal changes to coke and may then be fed on to the fire.

Uncoked coal should never be fed to the fire. If this is done, vast volumes of smoke and flame are produced, making working conditions uncomfortable. In addition, there is the danger that the metal will be contaminated with impurities such as sulphur from the coal. Sulphur causes a condition known as hotshort in irons and steels. This is a tendency to fracture at high temperatures. Clean coke is probably the easiest to use as it requires less management than the other fuels. Grains of coke should be small, about 12 to 16 mm.

Tools for managing the fire are a poker, a rake and a small shovel which are usually made by the smith.

The forge fire is always changing and must be looked after constantly. It gradually builds up to its best, maintains this level for a while and then deteriorates. Unburnable materials such as earthy impurities melt and sink to the bottom of the fire to form what is called clinker. This must be removed periodically, the length of time depending on the work and quality of the fuel.

When clinker is to be removed, it is best to let the fire cool down for a few minutes, giving the clinker time to solidify so that it can be removed in one piece Clinker must always be removed before welding or at any time when it hampers work. Particles of clinker can be forced up through the fire to impinge on the metal. Fire management is probably the most difficult part of the smith's craft to master. Fire tools should be constantly in use.

**Forging Machines and Power Hammers**

Blacksmiths have been using machines to ease their workloads since ancient times. It’s easy to imagine the motivation for machining: smiths get old, they run short on help, they find themselves working with very large stock…these problems are as old as time.

**Forging Presses: Hydraulic, Mechanical, Screw**

While powered presses were not used in historical blacksmithing, they are used heavily in modern manufacturing processes, so I thought it would be worthwhile to briefly go over some of the more common ones.

**Blowers and Bellows**

Put simply, fire is the heat byproduct of a chemical reaction between oxygen and a fuel source. Hotter fires will require more oxygen. Efficient blacksmithing requires a fire that is hotter than the typical campfire. Therefore, all forges require some mechanism for shuttling more oxygen into the forge fire.

**Bellows And Air Valves**

Natural wind is too unreliable for industry, and having someone stand by the forge and fan it all day is very inefficient. Simply put, the primitive bellows mentioned earlier were clunky at best. Luckily, bellow technology advanced rapidly with the development of a humble piece of equipment known as an air valve.

The air valve allowed the invention of the bellow as we know it today. With an air valve, air flow could be controlled and contained at the smiths leisure. While this improved the forging experience greatly, bellow technology didn't stop there. Several improved designs for the bellow emerged over time. These designs in turn improve the forging experience even more.

All in all, the bellow was used for almost sixteen-hundred years before the invention of the electric blower. It is a classic blacksmithing tool.

**The Screw Tap**

The tap performs the inverse function of the Die. Taps thread the holes that screws will be placed into. They are used in a very similar fashion to drills.

When using either a tap or a die, it's important to remember to do one half backwards turn for every full forwards turn. This allows debris to fall through as you are cutting your material.

**Drills**

I discussed punches earlier, another option for creating holes in a piece of stock are drills. In the sections below, I will go over both historical and modern drills.

**Cold Saw**

Blacksmithing purists may not like this one, but cold saws are a modern piece of technology that can very efficiently cut stock. If you are working with metal for a living, it's worth having one of these bad boys.

**Historical Blacksmithing Drills**

Metal workers have been drilling holes into metal for a long time. In situations where a hole punch is too crude, a smith will often turn to his drills. Before the invention of electricity, these usually came in a number of flavours:

- Bow Drill
- Pump Drill
- Beam Drill
- Hand Cranked Post Drill
- Mechanical Hand Drill
- Mechanical Breast Drill

Nowadays we have many electric options for drills that make life significantly easier.
Still, I think it's fun looking back and seeing how things used to be done.

**Safety Equipment**

The safety dangers of blacksmithing are pretty straightforward and obvious. You are working with very hot materials, so there is a risk of burns.

**Safety Glasses**

This one is non negotiable, if you do nothing else, please wear safety glasses. Your eyes are fragile and worth taking care of.

**Hearing protection**

This one is easy to forget, but take it from a guy who comes from a family of shotgun shooting men who ignored hearing protection…you must take care of your ears if you want a high quality of life in your later years. No, I don't think smithing is as loud as shooting guns, but it's loud enough.

**Pants**

Pants are a good idea, you have less exposed skin this way. Avoid synthetic fibers that will burn quickly or melt onto your skin.

**Shoes**

Flip flops are a bad idea, use closed toe shoes. Don't tuck your pants into your boots/shoes. Coal and bits of debris do have a tendency to fall, so take your footwear seriously.

**Gloves**

Gloves are used to protect your hands, but they can be a bit misleading so be careful. As you work, moisture can accumulate inside the glove; this moisture can conduct heat fairly well so you must be aware of this phenomenon.

Gloves can give a false sense of security when working with hot stock, avoid grabbing stock that is too hot for your gloves to insulate against.

If a hot piece of coal or slag gets onto your glove, it can be surprisingly hard to get them off quickly.

**Respirators For Grinding**

Always grab a respirator when you are grinding steel. Steel dust is bad for you. A dust mask is not usually sufficient, pay up for your health…it's worth it.

**Apron**

A blacksmithing apron is a classic piece of attire. At first glance it might seem superfluous, but it's actually very useful for saving your body and your shirts. If you are doing any sort of grinding or belt work it becomes a must. A welding apron will of course work as well.

All in all it's a handy extra layer of protection. Trusty tools break, things shatter, and sometimes you are just tired and careless. Aprons are a worthwhile investment that will protect your body and your clothes.

**M&P UNDER BLACK SMITH SHOP**

| SL NO | NAME OF M/C | QTY | YEAR OF COMMISSION. |
|---|---|---|---|
| 1 | Pneumatic Power Hammer 250 KG | 1 | 1965 |
| 2 | Star Band 75 T gear type Power Press M/C | 1 | 1975 |
| 3 | GECO high Speed Double Ended Floor Grinding M/C | 1 | 1964 |
| 4 | Combined Shearing Punching &Nibbing M/C | 1 | 1984 |
| 5 | Pecco Brand Spring Scregging& Load deflection Testing M/C | 1 | 1986 |
| 6 | Arc Welding Set | 1 | 2004 |
| 7 | Electro Magnetic Crack Detector for coil spring Test | 1 | 2011 |
| 8 | CNC Hydraulic prssBrack 200T | 1 | 2012 |
| 8 | Airless Centrifugal Shot Blasting Plant for Coil Spring | 1 | 2012 |
| 9 | Magnetic Crack Detector for Bogie Components | 1 | 2013 |
| 10 | Hot Phosphating plant with ETP | 1 | 2010 |
| 11 | Radial Drill M/C | 1 | 2008 |
| 12 | Double Column Hydraulic Guillotine Shearing M/C | 1 | 2006 |
| 13 | Coil Spring Scragging and Load deflection Testing 25 T | 1 | 2015 |
| 14 | Hearth Black Smith ( Middle) Size | 2 | 1971 |
| 15 | Battery Operated Platform Truck 200 KG | 1 | 2008 |
| 16 | Double Door Hanger Type Shot Blasting M/C | 1 | 2019 |
| 17 | Single Door Swing Table Type Shot Blasting M/C | 1 | 2019 |

## SUMMARY OF WORK LOAD (LAST 3 YEARS) OF BLACK SMITH SHOP

| SN | NAME OF WORK | April/17 –March/18 | | April/18 –March/19 | | April/19 –March/20 | |
|---|---|---|---|---|---|---|---|
| 1 | BG POH PCV NAC- 07106231 | 47208 | Man.hours | 41596 | Man.hours | 28266 | Man.hours |
| 2 | BG POH PCV AC - 07106233 | 6105 | Man.hours | 6815 | Man.hours | 9731 | Man.hours |
| 3 | BG POH OCV NAC- 07106235 | 0 | Man.hours | 853 | Man.hours | 202 | Man.hours |
| 4 | BG IOH PCV NAC- 07106261 | 692 | Man.hours | 20868 | Man.hours | 11352 | Man.hours |
| 5 | BG IOH PCVAC- 07106262 | 1236 | Man.hours | 2631 | Man.hours | 4051 | Man.hours |
| 6 | DEMU POH TC-07106730 | 0 | Man.hours | 2483 | Man.hours | 3984 | Man.hours |
| 7 | DEMU POH DPC-07106732 | 4574 | Man.hours | 2561 | Man.hours | 935 | Man.hours |
| 8 | DEMU IOH TC-07106740 | 0 | Man.hours | 948 | Man.hours | 0 | Man.hours |
| 9 | DEMU IOH DPC-07106741 | 0 | Man.hours | 215 | Man.hours | 0 | Man.hours |
| 10 | BG Wagon POH-07506331 | 68686 | Man.hours | 54094 | Man.hours | 44066 | Man.hours |
| 11 | Store | 1414 | Man.hours | 0 | Man.hours | 0 | Man.hours |
| 12 | Division | 0 | Man.hours | 0 | Man.hours | 12 | Man.hours |
| 13 | Shop on Shop | 0 | Man.hours | 979 | Man.hours | 6015 | Man.hours |
| 14 | Corr Repair PCV NAC-07106232 | 0 | Man.hours | 0 | Man.hours | 0 | Man.hours |

## STAFF POSITION AT BLACK SMITH SHOP UNDER CWM/NBQ'S

| SN | Category | Pay Band | G/Pay | Sanctioned strength | On Roll | Vacancies |
|---|---|---|---|---|---|---|
| 1 | Sr Tech. | 5200-20200/- | 2800/- | 17 | 16 | 1 |
| 2 | Tech -1 | 5200-20200/- | 2400/- | 18 | 10 | 8 |
| 3 | Tech -II | 5200-20200/- | 1900/- | 5 | 6 | -1 |
| 4 | Tech -III | 5200-20200/- | 8800/- | 0 | 0 | 0 |
| | | | | 40 | 32 | 8 |

## CHAPTER-III

### 3.0 CRITICAL ANALYSIS OF EXISTING WORKLOAD AND STAFF REQUIREMENTS:

The activities of the Staff under C&W BlackSmith Shop /NBQ already discussed in CH-II. In reference of above, the requirement/ non-requirement of following category of staff is justified as below-

The present sanctioned strength of staff was calculated on the basis of out-turn of materials manually –

**M&P UNDER BLACK SMITH SHOP**

| Sl NO | NAME OF M/C | QTY | YEAR OF COMMISSION. |
|---|---|---|---|
| 1 | Pneumatic Power Hammer 250 KG | 1 | 1965 |
| 2 | Star Band 75 T gear type Power Press M/C | 1 | 1975 |
| 3 | GECO high Speed Double Ended Floor Grinding M/C | 1 | 1964 |
| 4 | Combined Shearing Punching &Nibbing M/C | 1 | 1984 |
| 5 | Pecco Brand Spring Scregging& Load deflection Testing M/C | 1 | 1986 |
| 6 | Arc Welding Set | 1 | 2004 |
| 7 | Electro Magnetic Crack Detector for coil spring Test | 1 | 2011 |
| 8 | CNC Hydraulic press Brack 200T | 1 | 2012 |
| 8 | Airless Centrifugal Shot Blasting Plant for Coil Spring | 1 | 2012 |
| 9 | Magnetic Crack Detector for Bogie Components | 1 | 2013 |
| 10 | Hot Phosphating plant with ETP | 1 | 2010 |
| 11 | Radial Drill M/C | 1 | 2008 |
| 12 | Double Column Hydraulic Guillotine Shearing M/C | 1 | 2006 |
| 13 | Coil Spring Scragging and Load deflection Testing 25 T | 1 | 2015 |
| 14 | Hearth Black Smith ( Middle) Size | 2 | 1971 |
| 15 | Battery Operated Platform Truck 200 KG | 1 | 2008 |
| 16 | Double Door Hanger Type Shot Blasting M/C | 1 | 2019 |
| 17 | Single Door Swing Table Type Shot Blasting M/C | 1 | 2019 |

**Different work done at Black Smith Shop are as follows :**

1. Cleaning of coil Spring in Phospating plant.
2. Check for crack in coil spring in shot blasting M/c.
3. Load testing of coil spring for tensile test.
4. Painting of coil spring.
5. Giving shape and size as per requirement in power hammer.
6. Cutting plate and rod as per requirement and giving shape and size as per requirement in shearing M/C.
7. Annealing and tampering of material in furnace.
8. Platform truck is use to transport the materials.
9. Grinding machine is use to grind the.

**TABLE-1**

**SUMMARY OF WORK LOAD (LAST 3 YEARS) AND PROPOSED REQUIRED MAN POWER OF BLACK SMITH SHOP**

| I | II | III | IV | V | VI |
|---|---|---|---|---|---|
| **SN** | **NAME OF WORK** | **April/17 –March/18** | **April/18 –March/19** | **April/19 –March/20** | **Man power reqd. Based on M/H (April/19 –March/20) & Avg. Trend Factor** |
| 1 | BG POH PCV NAC-07106231 | 47208 Man.hours | 41596 Man.hours (Reduced by 11.88% from last year) | 28266 Man.hours (Reduced by 32.04% from last year) | **11.89-2.57=9.32(Reduced by Avg percentage 21.96% (A.T.F=21.96%))** |
| 2 | BG POH PCV AC - 07106233 | 6105 Man.hours | 6815 Man.hours (Increased by 11.62% from last year) | 9731 Man.hours (Increased by 42.78% from last year) | **4.09+1.09 =5.18 Increased by 27.2% (A.T.F=27.2%) )** |
| 3 | BG POH OCV NAC-07106235 | 0 Man.hours | 853 Man.hours | 202 Man.hours (Reduced by 75.43% from last year) | **0.085-0.0169= 0.068 Reduced by Avg percentage 19.88% (A.T.F=19.88%))** |
| 4 | BG IOH PCV NAC-07106261 | 692 Man.hours | 20868 Man.hours | 11352 Man.hours (Reduced by 45.60% from last year) | **4.77-2.18=2.59 Reduced by Avg percentage 45.60% (A.T.F=45.60%))** |
| 5 | BG IOH PCVAC- 07106262 | 1236 Man.hours | 2631 Man.hours | 4051 Man.hours | **1.68** |
| 6 | DEMU POH TC-07106730 | 0 Man.hours | 2483 Man.hours | 3984 Man.hours | **1.65** |
| **7** | DEMU POH DPC-07106732 | 4574 Man.hours | 2561 Man.hours | 935 Man.hours | **0.38** |
| 8 | DEMU IOH TC-07106740 | 0 Man.hours | 948 Man.hours | 0 Man.hours | |
| 9 | DEMU IOH DPC-07106741 | 0 Man.hours | 215 Man.hours | 0 Man.hours | |
| 10 | BG Wagon POH-07506331 | 68686 Man.hours | 54094 Man.hours (Reduced by 21.24% from last year) | 44066 Man.hours (Reduced by 18.53% from last year) | **18.54-3.68=14.86 Reduced by Avg percentage 19.88% (A.T.F=19.88%)** |
| 11 | Store | 1414 Man.hours | 0 Man.hours | 0 Man.hours | |
| 12 | Division | 0 Man.hours | 0 Man.hours | 12 Man.hours | |
| 13 | Shop on Shop | 0 Man.hours | 979 Man.hours | 6015 Man.hours | |
| 14 | Corr Repair PCV NAC-07106232 | 0 Man.hours | 0 Man.hours | 0 Man.hours | |
| | **TOTAL** | **129915 Man.hours** | **134043 Man.hours** | **65054 Man.hours** | **35.72 (Say 35)** |

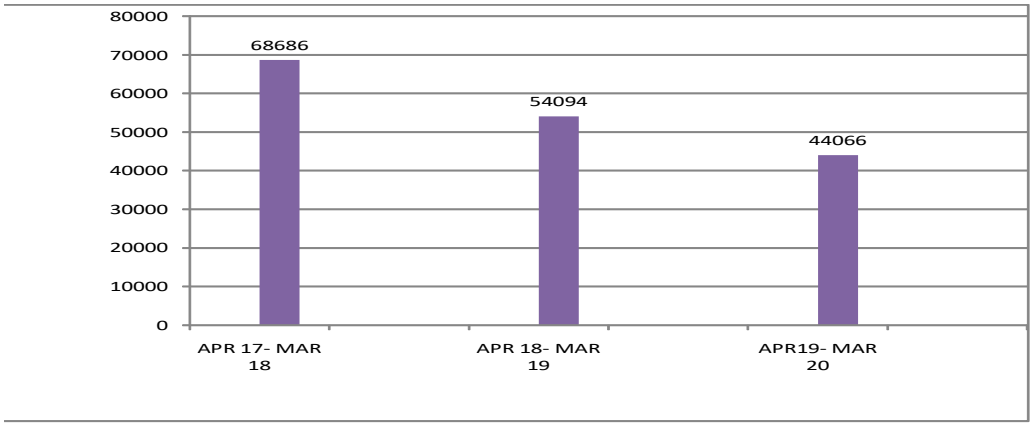


**Fig 1:** Work load BG Wagon POH for FY (2017-18), (2018-19) & (2019-20)

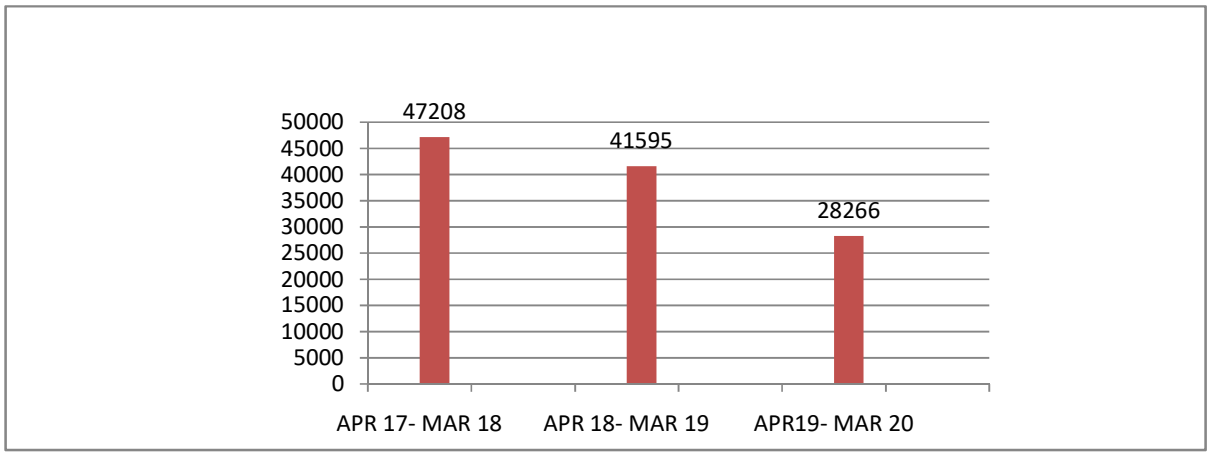


**Fig 2:** Work load BG POH PCV NAC for FY (2017-18), (2018-19) & (2019-20)

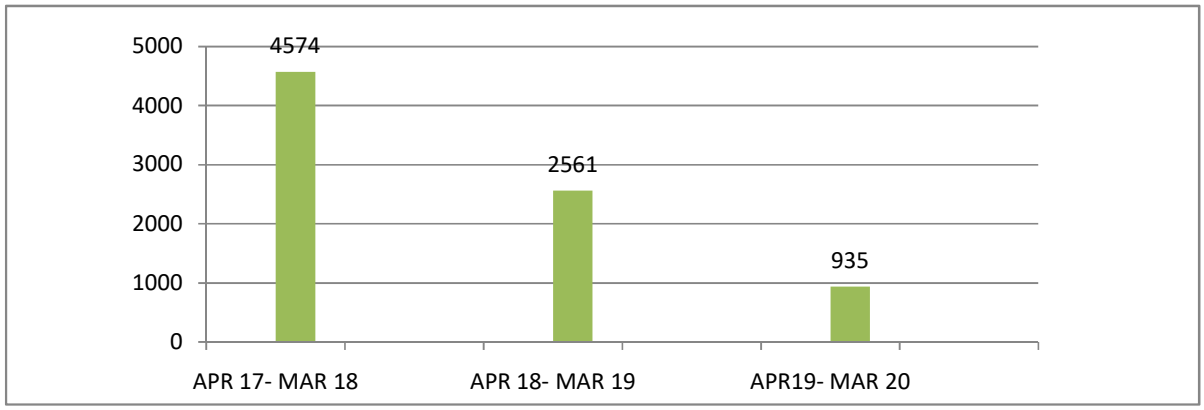


**Fig 3:** Work load DEMU POH DPC for FY (2017-18), (2018-19) & (2019-2020)

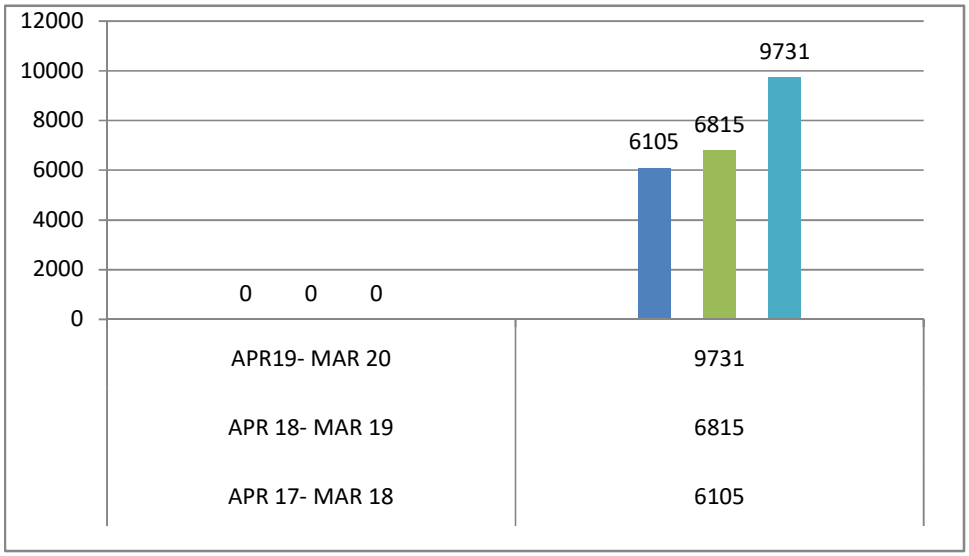


**Fig 4:** Work load BG POH PCV AC for FY (2017-18), (2018-19) & (2019-2020)

From the above data and corresponding bar chart , it is observed that work load in terms of annual out turn have been reduced in the following activities-

(1) BG POH PCV NAC, (2) BG Wagon POH, (3) DEMU POH DPC

And work load in terms of annual out turn have been increased in the following activities -

(1) BG IOH PCVAC, (2) DEMU POH TC, (3) BG POH PCV

**CALCULATION OF MAN HOURS PER MAN PER YEAR**

**TOTAL DAYS IN A YEAR = 365**

**TOTAL HOLI DAYS IN A YEAR = -52**

**TOTAL NATIONAL HOLI DAYS IN A YEAR = -16**

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**TOTAL WORKING DAYS IN A YEAR = 297**

**TOTAL WORKING HOURS IN A DAY = 8**

**TOTAL MAN HOURS PER YEAR PER MAN= 297 x 8 = 2376 MH**

**CALCULATION REQUIRED MAN POWER ON THE BASIS OF WORK LOAD( OUT TURN) OF FY (April/19 – March/20) IN MAN HOURS AND CALCULATED AVERAGE TREND FACTOR (ATF)**

As there is no yardstick available for requirement of man power against work load (in terms of out turn) for any workshop. So on the basis of trend of increase or decrease of work load (in terms of out turn) for last three years, an average trend factor (**ATF**) is derived from Table-1 as below-

$$ATF = \left( \frac{\text{Difference of Column III \& Column IV}}{\text{Column III}} + \frac{\text{Difference of Column IV \& Column V}}{\text{Column IV}} \right) X100\% / 2$$

**In Column-VI of Table-1, the required man power is calculated as below-**

$$\text{Man Power Reqd} = \frac{\text{Column V \{Annual Out Turn (Work Load) of (April/19 –March/20) in Man Hrs\}}}{\text{2376 MH (Average Annual working Hrs) per Man}} \pm \frac{\text{Column V x ATF}}{\text{2376}}$$

Result of Required Man Power Calculation is **35 as shown** in Column VI of Table-1 above.

**SURPLUS POSITION AT BLACKSMITH SHOP UNDER CWM/NBQ'S**

| SN | Category | Pay Band | G/Pay | Sanctioned strength | On Roll | Proposed Man Power | Vacancies | Surplus | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sr Tech. | 9300-34800/- | 4200/- | 17 | 16 | 17 | 1 | 0 | Surplus not declared as it is Higher Grade Post |
| 2 | Tech -1 | 5200-20200/- | 2800/- | 18 | 10 | 13 | 8 | 5 | |
| 3 | Tech -II | 5200-20200/- | 1900/- | 5 | 6 | 5 | -1 | 0 | |
| 4 | Tech -III | 5200-20200/- | 8800/- | 0 | 0 | 0 | 0 | 0 | |
| | | **TOTAL** | | **40** | **32** | **35** | **8** | **5** | |

## CHAPTER-IV
## RECOMMENDATION

In this work study 5 nos. of vacant posts of Tech-I - 5 has identified as surplus and proposed for surrender, which may be deleted from the working BOS.

## CHAPTER- V

| S N | Category | Pay Band | G/Pay | Basic Pay in Rs | Revised Pay as per 7th CPC | Salary per annum in INR | Nos. of posts proposed for surrender | Total amount in Rs |
|---|---|---|---|---|---|---|---|---|
| 1 | Tech -1 | 5200-20200/- | 2800/- | 15,500 | 39,835 | 4,78,020 | 5 | 2390100 |
| | | | | | | | TOTAL | 23,90,100Lakh/Annum = 23.90 Lakh/Annum |

## FINANCIAL IMPLICATION

### 5.1. PROJECTED FINANCIAL SAVINGS PER ANNUM

Rs. 23.90Lakhs (say) per annum.

## CHAPTER - VI

### 6.0. READY RECKONER

| Pay Band | GP | Mean pay | Basic Pay in Rs | M.F. of 7th CPC(2.57) & revised Pay | Salary per annum in INR |
|---|---|---|---|---|---|
| **9300-34800** | **4600** | **22050** | **26,650** | **68,490.5** | **8,21,886** |
| **9300-34800** | **4200** | **22050** | **26,250** | **67,462.5** | **8,09,550** |
| **5200-20200** | **2800** | **12700** | **15,500** | **39,835** | **4,78,020** |
| **5200-20200** | **2400** | **12700** | **15,100** | **38,807** | **4,65,684** |
| **5200-20200** | **2000** | **12700** | **14,700** | **37,779** | **4,53,348** |
| **5200-20200** | **1900** | **12700** | **14,600** | **37,522** | **4,50,264** |
| **5200-20200** | **1800** | **12700** | **14,500** | **37,265** | **4,47,180** |