Experiences in Heavy Fabrications in TELCO

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Introduction :

The development of fabrication methods and procedures at TELCO seems to represent the growth pattern of the fabrication industry in India. Telco, in the forties, used to manufacture road rollers, under carriages etc. of mostly rivetted construction. When it started manufacturing steam locomotives in 1951, welding of radiographic quality was introduced.

In the fifties, there was a rapid increase in heavy fabrication activities where welding played a major role. Industrial diesel shunters of all-welded construction both for MG and BG were introduced. Subsequently, manufacture of paper and pulp machinery, EOT cranes, furnaces, heavy presses, forklifts and other equipments were taken up in a planned way (Fig. 1). Necessary facilities for training and testing of welders, supervisors, fabrication fitters, facilities for testing of weldments, and latest welding equipments were introduced at a rapid rate.

It was not an easy task, as the welding industry in the fifties was in an infant stage and most of the facilities, equipments and consumables were not available indigenously. Telco had to rely in the early stages mostly on imports, but at the same time encouraged Indian manufacturers for indigenous development of the same.

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1. FABRICATIONS

1.1 Locomotive Project (Fig. 2) :

It was started in 1952 in collaboration with a German firm. The shell plates were rolled on vertical rolling machine after press forming of its ends. They were aligned and drilled in material preparation shop before transporting to fabrication shop. All the fabrications including shell, tenders etc. were done by rivetting except the firebox and the bogie. The firebox seams were back-chipped and welded with electrodes with iron oxide type coating. The welding was fully X-Rayed before the box was despatched to assembly. The channels

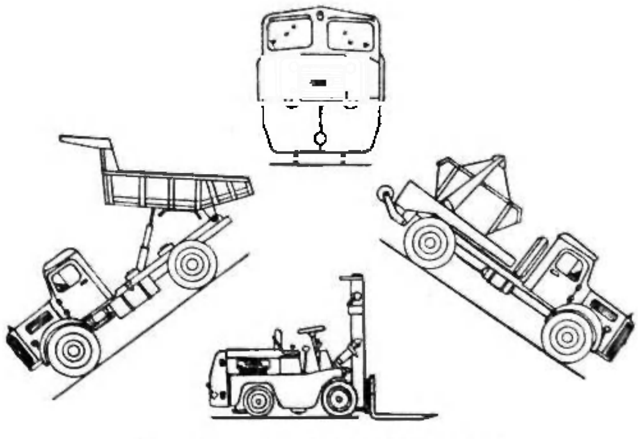

Fig. 1. Major TELCO Products

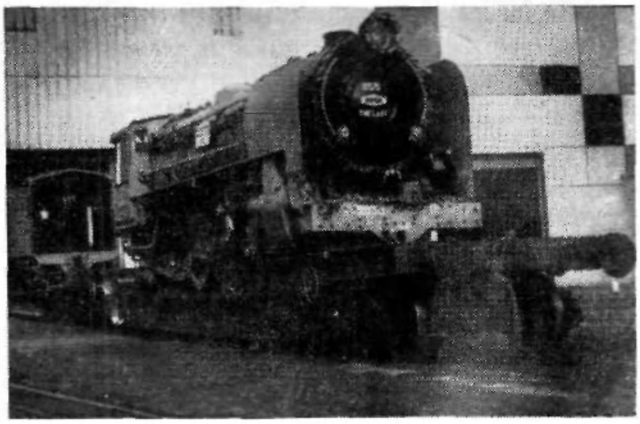

Fig. 2. Steam Locomotive under despatch

for the bogie were hot pressed in the forge division and welded on manipulators after bevelling of edges and assembling in box section. Only indigenous electrodes were used.

1.2 Diesel Shunters :

Along with fabrication of fire-boxes and tender bogies, fabrication of diesel shunter body and its complete gearbox was developed. It was a TELCO Design. The body and its components were all in welded construction execution. Template controlled profile oxy-cutting machines were used for material preparation On heavy plates of the body, the V-Joints were replaced by J-Joints, which were prepared on edge—planing machine. This edge preparation reduced welding distortions and brought considerable savings in material and time. Cold-forming of plates and sheets in various sections was done on 500 and 1000 T brake presses, using less expensive V-male and female dies.

Gearboxes for shunters as well as for Atomic Energy Commission were fabricated using LH Electrodes. 60 mm thick plates and semi-finished oxy-cut blocks were used for fabrication. After fabrication, they were stress relieved before final machining.

1.3 Paper and Pulp Project :

The manufacture of the machinery for this project was started in 1961.

38 mm thick plates to ASTM 285C were used for the main shell of the Digestor. The diameter of the shell was about 4.8 m. The plates were welded with submerged arc-welding as well as by MMAW. The equipment as well as consumables had to be imported in the beginning. When the consumables were developed by an Indian firm at a later stage, they were successfully substituted. The hot forming of the shell-ends was done with temporary male and female dies made up of rib-re-inforced plate contours. With the help of these dies, processing of spherical ends of the shell could be started in a very short period, saving thereby considerable amount of time and money. Although form dies were called for to prepare some other components, they were processed on brake presses with excellent workmanship.

In bamboo chippers, Nass pumps etc. stainless steel was used extensively. However, in absence of suitable indigenous electrodes, imported electrodes were used for the welding of these equipments.

All these vessels and equipments were manufactured to stringent Lloyd's and Swedish Codes. Express plans were drawn to train the available welder force to highest standards of manual metal arc welding as well as of submerged arc welding. A separate welders' training school was opened and welders were given training in batches. They were tested by Lloyds to Swedish Codes. All these welders proved to be a valuable asset at a later stage for higher standards of quality, when production of excavators was undertaken. Special rotators and manipulators were designed and manufactured for mechanising the submerged arc welding of the shells.

The design of the shell joints was modified to improve upon distortion defects. The double V—joints of the shell were welded first from inside. The joint preparation was done in such a way that after back chipping, half the plate thickness was exposed from outside. This was filled subsequently with weldmetal. This avoided sagging defects around the seams.

Thus the use of latest technology, blended with simple but imaginative fixtures helped to hasten the project schedules.

1.4 Hot Metal Pouring Ladles (Fig. 3) :

Fabrication of 90 T ladles and ladle cars for Tata Iron & Steel Co. was undertaken as a development item. This involved manufacturing of temporary, inexpensive and primitive fixtures. After completion of the project, these fixtures were dismantled and their materials were reused for making fixtures for other equipments like furnaces etc.

Mostly indigenous machines and consumables were used and the fabrication was done by manual metal arc welding using LH electrodes. The shell thickness varied between 28 to 40 mm.

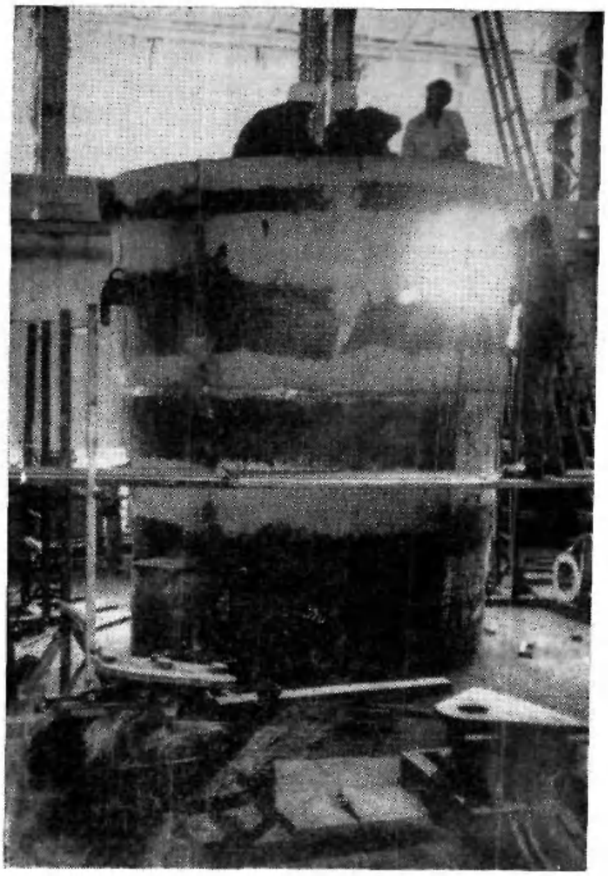

Fig. 3. Fabrication of 90T Hot Metal Ladle

Accuracy was important to avoid stresses, distortions and to get proper alignments. The 5" thick slab-frames used for ladle car were joined together with slant joints. Sequence of welding was adjusted to minimise distortion as no straightening of these frames could be possible once they were welded. Corner-rings of the shell-end were made up of segments machined out of solid pieces. Ladles were assembled on simple fixtures erected upside down to get dimensional and form accuracy. Stresses and strains were controlled by welding techniques only as no stress-relieving facilities were available. Welding with thicker electrodes, proper sequence, and minimum possible layers helped to achieve this goal.

Special fixures were designed for alignment and assembly of bogey and frame assembly. As these temporary fixtures did not require storage, these could also be dismantled and reused in other projects.

1.5 Heat Treatment Furnaces :

Design of 55' ,70' and 90' long heat treatment furnaces for our foundry was supplied by an American firm. Assembly was done in shop-designed fixtures to complete the fabrication in the shortest possible time. Due to proper sequence of welding, the close tolerances over its dimensions and its proper alignment could be achieved. This has also helped in reduction of internal stresses and of setting time by thermal and mechanical means. The completed furnaces were certified by the American company. Only indigenous welding consumables and machines were used.

1.6 Excavators :

Manufacture of 4 models of excavators was started in collaboration with an American firm. The design, manufacturing standards, techniques and consumables had to be certified by the collaborators. Gradually all the consumables were substituted by indigenous ones after proper tests and approval by the collaborators. When import of certain critical castings like hoist gears etc. was adversely affected due to closure of Suez Canal, fabrication of the same was developed indigenously by welding. After radiography and other tests of the fabrications, this method was made permanent and the imports were stopped.

Heavy lattice booms (braced with pipes) are fabricated to close tolerances in proper fixtures. The ends of pipe-members require accurate curvatures, which are achieved by cropping. Components are formed on brake-presses to the maximum possible extent to minimise welding seam lengths.

Experience has been gained on certain heavy box-type of fabrications to provide pre-fab. curvature to take care of distortions due to unsymmetrical heavy welding.

Revolving frames, dippers, booms, car bodies etc. are made up of a variety of materials including mild steel, T-1 ,Austenitic Manganese and low alloy steels. The standards of welding quality attained in the beginning stage itself were so high that they attracted spontaneous appreciation from the collaborators, enhancing thereby, the confidence in the Indian welders and the fabrications.

Extensive use of manipulators is made to minimise handling delays and improving productivity (Fig. 4). Mostly MMAW process is used.

Big ring gears for carbody having a tolerance of 0.3 mm over the 2 mm dia. are prone to become oval during heat treatment. Special attachements are made to bring the gear in position for assembly. Tack-welding sequence itself balances the ovality and brings the gear within the close acceptable tolerances.

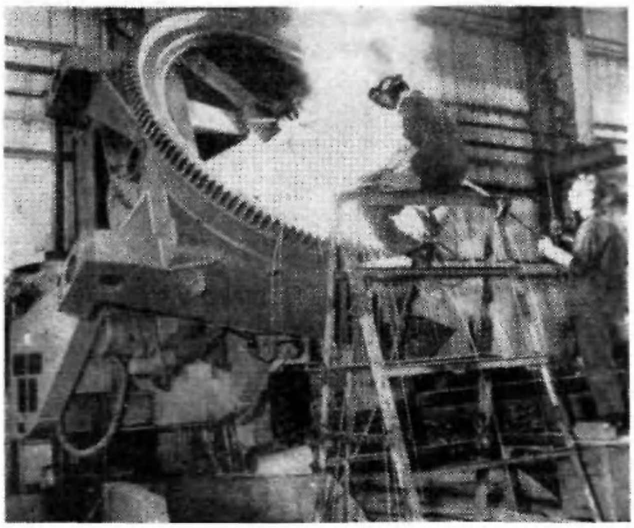

Fig. 4. Welding of car body (Excavator) on Manipulator

Dye-penetrants are used to check the soundness of castings etc. after its defects are gouged out. Magnaflux is used to check the soundness of welding of gears etc. Certain critical components like clutch drive sleeve etc. are X-Rayed for welding defects.

Proper fixtures are used wherever possible for assembly as well as welding to control distortions. This also allows the maximum use of premachined or semi-machined parts before welding to reduce subsequent load on heavy boring machines after completion of the fabrications.

1.7 Growth Items :

Complete design, manufacturing etc. for overhead cranes required by the company have been developed from within. The first all-welded 10 T EOT Crane was fabricated in 1959. Cranes upto 40T were manufactured subsequently by the company. Various types of girders like box, lattice etc. were designed and fabricated. All the consumables used for welding were indigenous. Complete plants like Sand-Cooling, Sand-Drying (Fig. 5) and Sand Mulling etc. for Foundry Division were developed and manufactured within the company. The accent was to rely on indigenous technology and equipment.

Heavy press-bodies for upto 500 T hydraulic presses are fabricated in all-welded execution. All the materials and consumables used are indigenous.

1.8 Heavy Structures :

One of our associated companies got heavy structural supports for conveyors fabricated by a fairly well

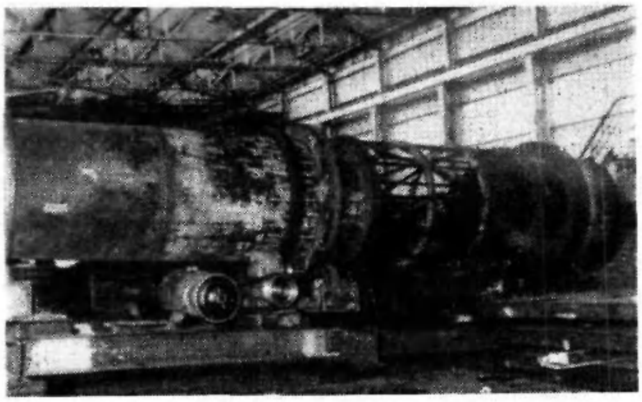

Fig. 5. Sand Cooling and Drying Drums under assembly

experienced Indian firm. The size of the individual structure was 13.4 m × 1.5 m × 0.25 m. These were made in two pieces to facilitate handling and machining. (fig. 6) The main sections used were heavy I-Beams.

However, after fabrication by the contractors, the structures had a lot of distortion. Machining and alignment of both parts to close tolerances became a problem. Clamping plates made of stainless steel could not be welded to it due to warpage in the structure. To salvage such structures, their design was modified to simplify machining in 2 settings of 4 sides. Reference pads were included at design stage. Some parts were recut and reassembled in fixtures to maintain close tolerances. The S. S. plates could subsequently be welded on the structures and aligned. The structures were delivered with close dimensional tolerances of 0.1 mm after proper alignment. The workmanship and the maintenance of close tolerances on the structures after salvaging operation were considered an achievement. This has imparted a good experience to structural

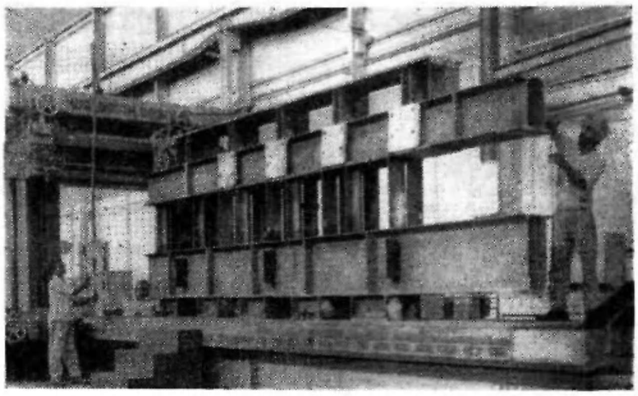

Fig. 6. Structural support for conveyor system (M/S Tinplate)

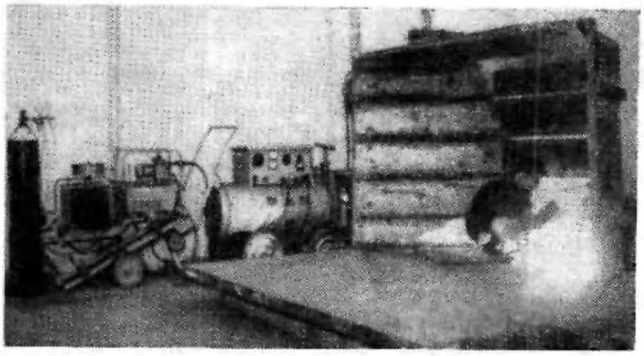

Fig. 7. MIG Welding Dumper Placer Buckets

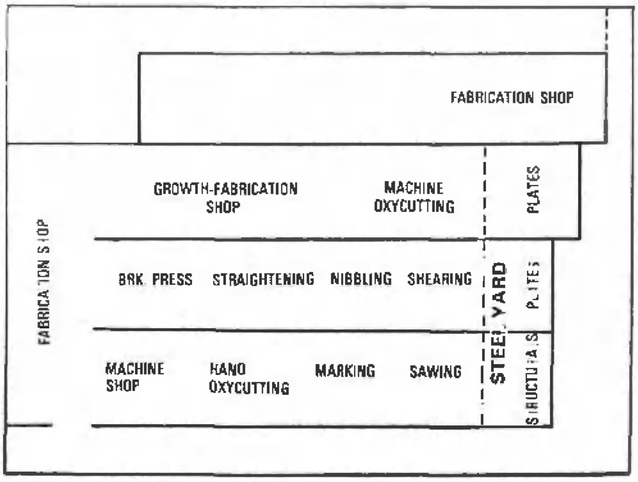

Fig. 8. Schematic layout of Cutting & Fabrication Shops

designers as well as to fabricators in techniques to simplify the system.

2. FACILITIES :

Apart from normal material preparation machines like sawing, cropping, shearing, nibbling, rolling, template profile oxy-cutting, the cutting shop of the company has got flanging, end-forming and edge-planing machines as well as bull-dozer machine for straightening. Hydraulic as well as mechanical brakepresses are available for cold forming of sheets and plates.

Although manual metal arc welding method is predominant, submerged arc welding method was used substantially in Paper and Pulp project. Efforts are being made to encourage development and introduction of indigenous equipment for automatic welding. Submerged arc welding is being developed for excavator and CO_2 welding process (Fig. 7) for sheet metal welding with 0.6 mm dia. wire. These facilities are backed by excellent training facilities, destructive and non-destructive testing laboratories, heat treatment furnaces and

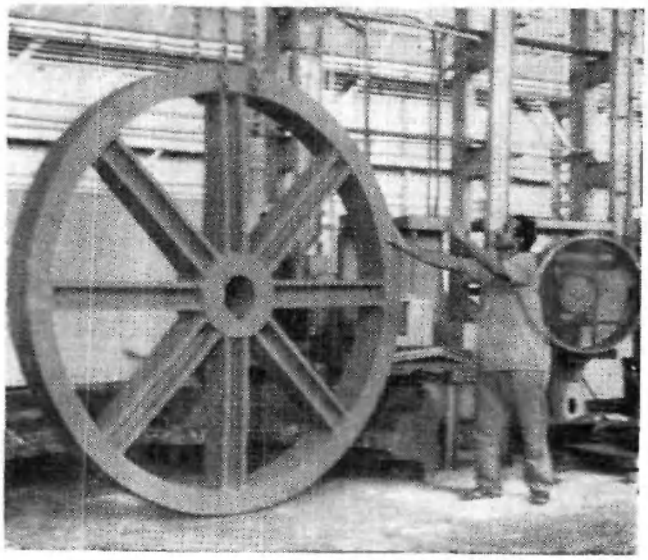

Fig. 9. Bull Gear Blank Fabricated for 400T Trimming Press

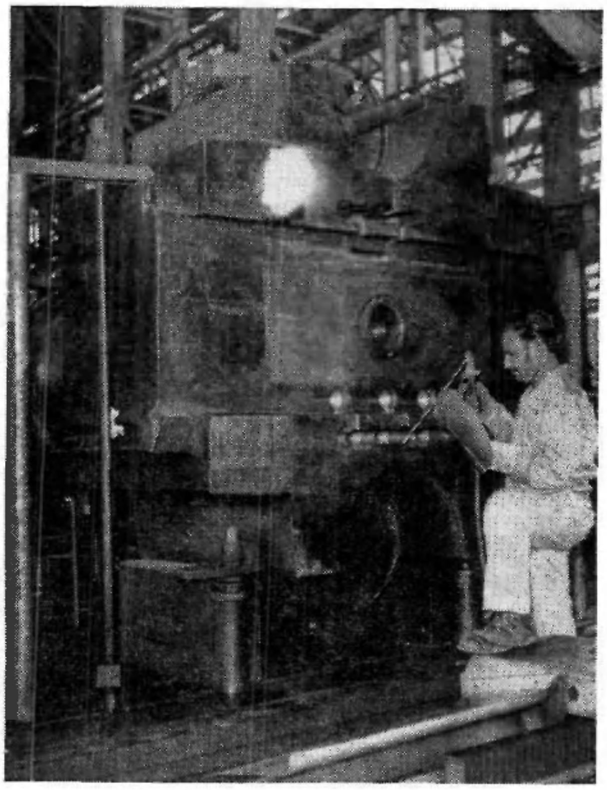

Fig. 10. Repair of D.G.H. 25 TUP with Key-Lock Fusion Welding

mechanical handling facilities. Shop layout is shown in fig. 8.

3. MAINTENANCE WELDING :

Repair of heavy imported machines and renovation and replacement of heavy components or assemblies played a major role in conservation of foreign exchange. Certain heavy cast-gears upto 2.7 m diameter have been successfully replaced by fabricated ones (Fig. 9). Heavy machine bodies, forge hammers, 3000 T hydraulic press bodies have been repaired by improved design and welding. Heavy tups of hammers weighing 15 T have been joined by mechanical forge welding with mushroom joint when the shaft and block were broken apart. 25 T and 40 T tups of hammers and cast bodies have been successfully joined together by Key-Lock Fusion Welding process (Fig. 10). This unique process has enabled us to put the machines back into operation with confidence and guarantee. Advantage of reduced downtime is of course inherent in it.

4. FUTURE NEEDS AND POTENTIAL :

To enable the fabricators to rely more and more on indigenous resources, the equipment and welding consumable manufacturers should develop reliable

(i) Variable characteristic power sources, which can be used for MMAW as well as for Automatic Welding Processes at reasonable investment.

(ii) Automatic welding process machines like CO_2 Welding and Flux-Cored wire welding machines with complete system of fixtures and manipulators ensuring reasonably high machine availability.

In India, we are still far behind in introduction of highly productive welding and cutting equipments. The manufacturers and fabricators should not look backward. They should adopt a strategy to encourage the introduction of the latest cutting and welding technology and equipments to enhance quality and productivity. Import of relevant technology by progressive fabricators we are sure, is bound to throw a challenge to Indian manufacturers to catch up with the fast developing technology abroad and put in vigorous efforts to develop and bring out the latest equipment at reasonable prices in India itself. This would enable a wider section of the fabricators to enjoy the fruits of the up-to-date technology.

Only such adventurous spirit of forward-looking manufacturers and fabricators can keep the country abreast of the current developments and the highest possible productivity standards.