DESIGN AND DEVELOPMENT OF FIXTURE WITH CANTILEVER BEAM FOR INTER MEDIATE GEAR BOX

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Abstract The steel industry involves various production methods and processes for steel manufacturing and end products. This in turn is done with the help of heavy duty industrial machines and equipment. Heavy-duty and powerful industrial machines including Converters, Continuous casting machines, crane slew drives, conveyors and winches are used in the steel industry. Various components including powerful gearboxes are used in these machines for ensuring a smooth power transmission. Our team successfully reduced repair time by crashing the dismantling time of both halves of gear box casing and in turn reduced man-hours consumption. This was achieved by design and manufacturing a fixture which can separate both halves of gearbox casing within minutes using a 100 The hydraulic jack.

Keywords— fixture, hydraulic jack, intermediate gear box, development.

INTRODUCTION:

Industrial gearboxes used in the steel industry provide high torque with high reduction ratios. They are available in a range of sizes, specifications and configurations to suit the different needs of the industry. Intermediate gear box of concast stand is one of the gear boxes which drive the roller of stand. As the service conditions at continuous casting department not favorable to equipment like gear boxes, the maintenance of these gear boxes is toughest task. The damaged gear boxes along with concast stands are being repaired at Central Machine Shop. Our project work involves study the existing procedure of repair of gear box. Analyze the existing process and suggest improved method of repairing the gear box slashing both time and man-hours consumption.

The life of strand 1&4 TK stands are more compared to strand 2&3 due to simplicity in its arrangement and direct connection to co-axial reduction gear boxes, but in strand 2&3 TK stands the bottom rollers are driven by Intermediate Gear Box through spline mechanism.

The IGB is only a power transfer unit; it does not either reduce or increase speed. The IGB consists of input gear, intermediate gear and an output gear. The output gear is mounted on a hollow output shaft, which is having internal splines. These splines are matched with the bottom roller external splines.

METHODOLOGY

Specification:

Reduction Ratio: 1:1
No. of Stages : 2
Power transmitted : 30 KW
Input : Z1=50; m=10
Intermediate : Z2=70; m=10
Output : Z3 = 50; m=10
RPM : 1
No. of gear boxes installed : 48
Type of casing : Split
Material of Casing : Fabricated steel structure

Type of Bearings mounted on shafts: Deep groove Ball bearing No.6244-2nos on each shaft

Type of Oil seals mounted on O/P: A type size 220-250-16 (4 nos).

Type of Oil seals mounted on I/P: A type size 220-255-18 (3 nos).

**Data regarding no. of IGB repaired at CMS/ESF**

Financial year 2007-2008  ----------- 18

Financial year 2008-2009  ----------- 28

Financial year 2009-2010  ----------- 26

Average per annum  -------------- 24

**Commonly observed Failure pattern:**

1. Seizure of bearings
2. Jammed rotation
3. Oil/grease leakage
4. Wear out of bearing seats of all shafts
5. Wear out of oil seal seats of output and input shafts
6. Wear out of through covers at bore
7. Shearing of retainer ring screws
8. Torn out of oil seal inner lip and or expiry of shelf life
9. Deformed casing
10. Damaged fasteners

**Existing process of Repair**

The damaged intermediate gear boxes along with TK stands are being sent to CMS/ES&F for carrying out necessary repair. Sequence of repair process as follows

**Dismantling Activity.**

1. Dismounting of IGB from the TK Stand
2. Unbolting of all fasteners of gear box casing
3. Separation of top casing from bottom
4. Dismounting of Input, Intermediate and Output shaft assemblies from the bottom casing.
5. Dismantling of all components from Input, Intermediate and Output shafts.

**Analysis/Remedial action**

1. Thorough cleaning of all components including casing halves
2. Visual inspection for damage to components
3. Reclamation plan if the damaged parts are repairable
   
   E.g. Worn out of output and input shafts at oil seat and bearing seat area can be reclaimed by surfacing and machining

4. Decision making for parts that can be replaced by new.
   
   E.g. a) Worn out of output shaft internal splines need replacement of shaft with new.
   b) Replacement of gears if teeth were worn out, cracked, sheared and bent
   c) Consumables like oil seals and bearings to be replaced with new as they are irreparable.
Assembling

1. Assembling of input, output and intermediate shafts, replacing damaged components with new or repaired parts
2. Mounting of all three internals on bottom casing of gear box.
3. Positioning of blind and through covers along with rubber cords to arrest lubricant leakage.
4. Mounting of top casing on bottom casing. Clamping both halves of casing by bolting.
5. Checking proper mating of both casing parts
6. Inspection of gear box for free rotation of shafts and lubricant leak
7. Deliver the gear box for fixing it to TK Stand.

It is clear from the data that maximum load applied is 63T. As there is only 100T jack above 63T in CMS; we selected this jack for the unit.

I) the fabricated fixture contains the following parts assembled together

1. Base frame
2. Supporting column with braces
3. cantilever
4. fulcrum pin
5. Jack support base
6. Hook
7. Tie bar
8. Circular support over cantilever
9. Packing pad for hollow shaft

II) Hydraulic Jack

The jacking system consists of double acting (oil return) jack of lightweight design, working at high pressure. The jack is provided with collar threading to fit flange for mounting. Return line relief valve is provided on cylinder set at 100 kg/cm²

Specifications:
- Capacity : 100T
- Stroke : 125mm
- Effective area : 154 cm²
- Working pressure : 637 kg/cm²
- Oil capacity : 4715 cc
- Acting : Double acting
- Return : Oil return

III) Hydraulic Power Pack

An electric motor driven hydraulic power pack of ship capacity supplies pressurized oil to the jacks. The power pack is of mobile type with two wheels. The top plate of the power pack is removable for maintenance. Manifold with valves, motor & motor starter, are mounted on the top plate.

Power Pack Specifications:
- Electric motor capacity: 5hp / 3ph / 1450 rpm
- Direction control: By Hand Lever
- Working pressure: 700 kg/cm²
- Pump flow up to 120 Bar: 12.3 ltrs/min
- Pump flow above 120 Bar: 2.6 Liters /min
Test pressure: 700 kg/cm²

Tank capacity: 50 liters

**Benefits of modified System:**

Modified Vs Existing dismantling process

Drive the wedges between parting surfaces of gear box by heavy hammering.

Place, clamp and assemble the cantilever after placing the gear box on base frame of fixture. Jack the lever with hydraulic jack to separate both halves of the casing.

Comparison between two methods:

A. **Figure.**

![Figure showing modified system components](image)

B. **Table**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Existing process</th>
<th>Modified process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man power</td>
<td>3T+1W+1K+1C</td>
<td>1T+1W+1K+1C</td>
</tr>
<tr>
<td>Time consumed</td>
<td>16 hours</td>
<td>1 hour</td>
</tr>
<tr>
<td>Man-hours</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>Tools/tackles</td>
<td>Wedges, sledgehammers</td>
<td>Hydraulic jack100T and Developed Fixture</td>
</tr>
</tbody>
</table>
CONCLUSION

This paper dealt with repair activity of Intermediate gear box and Development of Fixture with cantilever beam using hydraulic jack in the process of repair. The remedial action for preventing injury to workmen as well as damage to Gear box casing and other components in is addressed with modified procedure for dismantling Gear box Casing through specialized Fixture in combination with hydraulic jack.

C. References :
[3] www.fixtures.cm