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**TWIN RAM SINGLE PULL HYDRAULIC JACK FOR PRESTRESSING**

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**ABSTRACT**

This paper presents the importance of hydraulic jack for prestressing of strands on construction site. Now a day's various jacks are used for prestressing based on how many strands we have to prestress. Earlier used jack is "single ram single pull hydraulic jack". This paper gives details of Twin ram slotted hydraulic jack and how it is more suitable for building construction site. This jack is used to overcome the disadvantages of single ram single pull hydraulic jack.

**KEYWORDS:** Prestressing strand, wedge, Releasing spring, Pre-tensioning, Post-tensioning

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**INTRODUCTION**

Prestressing is the process of inputting stress into a concrete member before the concrete is stressed and overcoming concrete's natural weakness in tension. In other words, prestressing is a technology in construction in which internal stresses of suitable magnitude and distribution are introduced in member, so that the resultant stresses are counteracted to desired degree. The prestressing technology is fast growing field in construction industry particularly for buildings, bridges, metro rail, nuclear power plant, LNG tanks, cement plant etc.[1]

Single ram single pull hydraulic jack is used for prestressing in building construction. It facilitates a larger span between the columns, thus reduces the number of columns. This also makes the construction more durable and versatile. Therefore prestressing is widely used for long span beams to achieve a light weight, elegant looking and much economical structure.

Single ram single pull hydraulic jack has some limitations that it can be used on ground floor for prestressing the strands on construction site but when we want construction for n+1 floor, it requires extra construction to insert hydraulic jack on strands. This increases the cost of project and also not flexible to handle and working also. Hence, to avoid this certain modifications are done in this jack by which we can put hydraulic jack directly on the strands for prestressing.

So to overcome the limitations of old jack, the new jack has to be design in such a way that single ram with hollow center is replaced by two cylinders with providing rectangular slot between them for effective placing of jack on the strand instead of inserting a jack into the strand.

**THEORY**

**A) About Old Jack:**

For prestressing operation certain accessories are required like prestressing strands, Anchorage, Gripping Devices i.e. wedges/yokes, Duct/sheathing pipes etc.[1][4]

The stressing equipment consists of hydraulic jack and hydraulic power pack (pump) for stressing strands. In single strand stressing each wire or strand is stressed individually by using a special jack that is “Single Ram Single pull Hydraulic jack or Center Hollow Jack” and hydraulic power pack is connected to hydraulic jack with flexible hose.

**B)Twin Ram Single pull Hydraulic Jack :**Twin Ram Single pull Hydraulic Jack is used for the prestressing of single strand. Working of this jack is similar to previous jack but only difference is that this jack is easily operate on n+1 floor on construction site.

We know that in case of single ram single pull hydraulic jack, the jack is inserted into the strand and prestressing operation is carried out



*Fig: single ram single pull hydraulic jack*

but in case of this jack, the jack itself placed on to the strand and then prestressing operation is carried out. A gripping device is used to fit the strand into the wedge and hence in jack during stressing operation. A releasing spring is use for the movement of the wedge in forward and backward direction. When movement of spring in forward direction the wedge is fixing into the slot and while movement of spring in backward direction the wedge is free from slot. Hence by using this arrangement we can fix the strand into the slot and then by applying pressure prestressing is carried out.

### DESIGN CONSIDERATIONS OF JACK

Basically performance of twin ram single pull hydraulic jack is depends on pressure to be applied and required load.

#### A) Cylinder:

If load and pressure is given then by using relation, area required for cylinder is calculated and hence the diameter of cylinder.

$$p = \frac{F}{A}$$

Where,

P=pressure in kg/cm<sup>2</sup>

F=force in N

A=ram area in cm<sup>2</sup>

And inner diameter of cylinder is given by,

$$A = \frac{\pi}{4} d^2$$

#### B) Material selection:

Hardening of mild steel is not possible hence selecting other material instead of mild steel. Hardening is used to increase the strength of material and remove the flows or defects from the material; hence we have not select mild steel.

Hardening of carbon steel is possible so we select either EN8 or EN24 for the manufacturing of cylinder.

*Table1: Yield strength for material*

Materials	Yield stress	
EN8	465 N/mm <sup>2</sup>	4742 kg/cm <sup>2</sup>
EN24	680N/mm <sup>2</sup>	6934 kg/cm <sup>2</sup>

In thin cylinder subjected to internal pressure, three principal stresses are induced:

1. Circumferential or Tangential or Hoop stress,
2. Longitudinal or Axial stress,
3. Radial stress

The magnitude of radial stress is equal to the internal pressure and it is very small and hence neglected. Therefore calculate thickness considering other two stresses by using following relations.

Hoop stress:

$$t = \frac{P \times D}{2f_t}$$

Axial stress:

$$t = \frac{P \times D}{4f_t}$$

#### C) Piston:

According to the ID of cylinder dimensions of piston head has been decide. 0.5 clearance is provided for the mounting of seals on piston head and, if stroke length of piston is given then according to that length of piston will be decided.

#### D) Top Bush:

Top Bush is used for proper positioning of piston into the cylinder

#### E) Front Head:

Front head is mounted on cylinder. It provides space for mounting of the stressing nose.

#### F) Stressing Nose:

It is used to insert into the pocket former & also for the proper positioning of strand.

### ASSEMBLY OF JACK



*Fig: Assembly of Twin Ram Single pull Hydraulic Jack*

## STRESSING OPERATION

Operation of this jack is similar to that of single ram single pull hydraulic jack.

Detailed operation of hydraulic jack is as below:

- First fix layout of tendons.
- Laying and profiling of ducts. Fix the HDPE sheathing pipe (duct) as per the ordinate given.
- Fixing of anchor head and wedges is done before stressing. It is ensured that the tapered holes in anchor head and wedge are free of rust and oil.
- Insert strands inside the ducts.
- Installation of jack in such a way that jack is placed on strand instead of inserting into it and then prestressing force is transferred to the concrete by using jack. After this the force exerted by jack will vary from zero to constant maximum value that is effective prestressing force in the prestressing reinforcement.
- The load induced into the strand is determined from the pressure in the hydraulic oil supplied to the jack or from the extension of strands.
- Now the ram of the jack will start extending out and in-turn it will hold the strand with the help of grip and simultaneously the pressure gauge (mounted on the power pack) will start showing pressure.
- Wedge grips are used to grip each strand during stressing and to hold the strand permanently in the anchor after stressing.
- Then jack is removed and concreting is carried out

## CONCLUSION

The conclusion from this study is:

Twin ram single pull hydraulic jack overcomes the problem regarding old jack.

The Problem is: it can be used easily on ground floor for prestressing the strands on construction site but when we want construction for n+1 floor, it requires extra construction to insert hydraulic jack on strands. This increases the cost of project and also not flexible to handle and working also so to overcome these problems twin ram hydraulic jack is effectively used, it also increases the efficiency of jack and safety for workers also.

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