Research Paper Findings, Analysis and Improvements

A Motorised Screw Jack Lift for Industrial Setting

A Novel Solution

MEC318T - Design of Machine Elements

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INTRODUCTION

Screw Jack and Types:

A screw jack is an example of a power screw in which a small force applied in a horizontal plane is used to raise or lower a large load. The principle on which it works is similar to that of an inclined plane. The mechanical advantage of a screw jack is the ratio of the load applied to the effort applied. The screw jack is operated by turning a lead screw. The height of the jack is adjusted by turning a lead screw and this adjustment can be done either manually.

There are two types of jacks most commonly used:

1. Mechanical
2. Hydraulic

There are two types of mechanical jacks:

Scissor Jacks:

Scissors jacks have been in use at least since the 1930s. A scissor jack is a device constructed with a cross-hatch mechanism, much like a scissor, to lift a vehicle for repair or storage. It typically works vertically. The jack opens and folds closed, applying pressure to the bottom supports along the crossed pattern to move the lift. When closed, they have a diamond shape. Scissor jacks are simple mechanisms used to lift large loads to short heights. The power screw design of a common scissor jack reduces the amount of force required by the user to drive the mechanism. Most scissor jacks are similar in design, consisting of four main members driven by a power screw.

Construction:

A scissor jack has four main pieces of metal and two base ends. The four metal pieces are all connected at the corners with a bolt that allows the corners to swivel. A screw thread runs across this assembly and through the corners. As the screw thread is turned, the jack arms travel across it and collapse or come together, forming a straight line when closed. Then, moving back the other way, they raise and come together. When opened, the four metal arms contract, coming together in the middle, raising the jack. When closed, the arms spread back apart and the jack closes or flattens out again.

Functioning:

A scissor jack is operated by turning a small crank that is inserted into one end of the scissor jack. This crank is usually "Z" shaped. The end fits into a ring hole mounted on the end of the screw, which is the object of force on the scissor jack. When this crank is turned, the screw turns and raises the jack. The screw acts like a gear mechanism. It has teeth (the screw thread), which turn and move the two arms, producing work. By turning this screw thread, the scissor jack can lift an object which weighs several thousand pounds.

Design and Lift:

A scissor jack uses a simple theory of gears to get its power. On turning the screw section, the two ends of the jack move closer together. The gears of the screw which drive up the arms cause the amount of force applied gets multiplied. It only takes a small amount of force to turn the crank handle, yet that action causes the brace arms to slide across and together this causes the arms to extend upwards. The car's gravitational weight is not enough to prevent the jack from opening or to stop the screw from turning since it is not applying force directly to it. If you were to put pressure onto the crank or lean your weight against the crank, you will not be able to turn it, even though your weight is a small percentage of the cars.

Bottle (cylindrical) Jacks:

Bottle screws may operate by either

(i) Rotating the screw when the nut is fixed

(ii)Rotating the nut and preventing rotation of the screw.

Travelling Ball Screw Type:

Main components of screw jacks are; trapezoidal lifting screw, worm screw, worm gear and gear housing. Worm screw is rotated manually or by a motor. The worm gear is rotated by a worm screw. The lifting screw moves through the rotating worm gear. If a freeload is connected to the screw jack, the screw will rotate circularly and move up and down. If it is constantly loaded, the screw will move linearly in the vertical direction. The linear motion speed of the lifting screw depends on thread size and rotation ratio of worm gears.


Travelling Ball Screw Type

Travelling Ball Wedge Screw Type:

Main components of screw jacks are; trapezoidal lifting screw, worm screw, worm gear and gear housing. The Worm screw is rotated manually or by a motor and the worm gear by a worm screw. The lifting screw moves through the rotating worm gear. To prevent/block the crew's rotation, a wedge is opened to screw by doing this we ensure that the screw can only move vertically. The linear motion speed of lifting the screw depends on thread size and rotation ratio of worm gears.


Travelling Ball Wedge Screw Type

Travelling Ball Nut Type:

Main components of screw jacks are; trapezoidal lifting screw, worm screw, lifting nut and gear housing. Worm screw is rotated manually or by a motor. With the rotation of the gear, the screw that is inside the screw jack only rotates about its axis. The flange produced from the bronze material on the screw shaft moves linearly upwards or downwards. One of the purposes of using such systems is the lack of ducting or storage for the movement of the screw used in the screw type and screw type cockpit. The linear motion speed of lifting the screw depends on thread size and rotation ratio of worm gears.

Hydraulic jacks

Hydraulic jacks are typically used in warehouses, rather than a jack to lift vehicles. This jack requires more than the usual care in selecting ground conditions, the jacking point on the vehicle, and to ensure stability when the jack extends. Hydraulic jacks are used to lift elevators in low and medium-rise buildings. A hydraulic jack uses a fluid, which is incompressible, that is forced into a cylinder by a pump plunger. Oil is used since it is self-lubricating and stable. When the plunger pulls back, it draws oil out of the reservoir through a suction check valve into the pump chamber. When the plunger moves forward, it pushes the oil through a discharge check valve into the cylinder. The suction valve ball is within the chamber and opens with each draw of the plunger. The discharge valve ball is outside the chamber and opens when the oil is pushed into the cylinder. At this point, the suction ball within the chamber is forced shut, leading to a build-up of oil pressure in the cylinder.

Types:

1) Bottle jack:

The piston is vertical and directly supports a bearing pad that contacts the object being lifted. With a single action piston, the lift is somewhat less than twice the collapsed height of the jack, making it suitable only for vehicles with relatively high clearance. For lifting structures the hydraulic interconnection of multiple vertical jacks through valves enables the even distribution of forces while enabling close control of the lift.

2) Floor jack:

A horizontal piston pushes on the short end of a bellcrank, with the long arm providing the vertical motion to a lifting pad, kept horizontal with a horizontal linkage. Floor jacks usually include castors and wheels, allowing compensation for the arc taken by the lifting pad. This mechanism provides a low profile when collapsed, for easy manoeuvring underneath the vehicle, while allowing considerable extension

Demerits of screw jack:

- Chances of dropping and Tipping or slipping of the load.
- This failure is not “SAFE FAIL”& can cause serious accidents. Proper size, strength and stability are the essential requirements for the design of the screw jack from safety considerations
- A good number of operational staff in manufacturing, bottling, oil and gas and other multinational companies perform tasks in a squatting or cowering position for a long period. These results in inefficiency at the workplace due to ergonomically imbalance positions they encounter which often give rise to backache and poor body architecture in the future.
- The presently available jacks further require the operator to remain in a prolonged bent or squatting position to operate the jack. Due to its difficulties, body pains, backache and others can emerge as a result of the continuous turning of the wrench or crankshaft in an uncomfortable position for a long period.

Operational Constraints of a screw jack:

• Maintain low surface contact pressure: Increasing the screw size and nut size will reduce thread contact pressure for the same working load. The higher the unit pressure and the higher the surface speed, the more rapid the wear will be.

• Maintain low surface speed: Increasing the screw head will reduce the surface speed for the same linear speed. And Keep the mating surfaces well lubricated: better the lubrication, longer would be the service life. Grease fittings or other lubrication must be provided for the power screw and nut.

• Keep the mating surfaces clean: Dirt can easily embed itself in the soft nut material. It will act as a file and abrade the mating screw surface. The soft nut material backs away during contact leaving the hard dirt particles to scrap away the mating screw material.

• Keep heat away: When the mating surfaces heat up, they become much softer and are more easily worn away, to counter this, heat removal methods such as limited duty cycles or heat sinks must be provided to avoid rapid wear of over-heated materials

Modified Screw Jack for Lifting Operation in Industrial Setting using Quick Return Mechanism - Research Paper 1

Introduction:

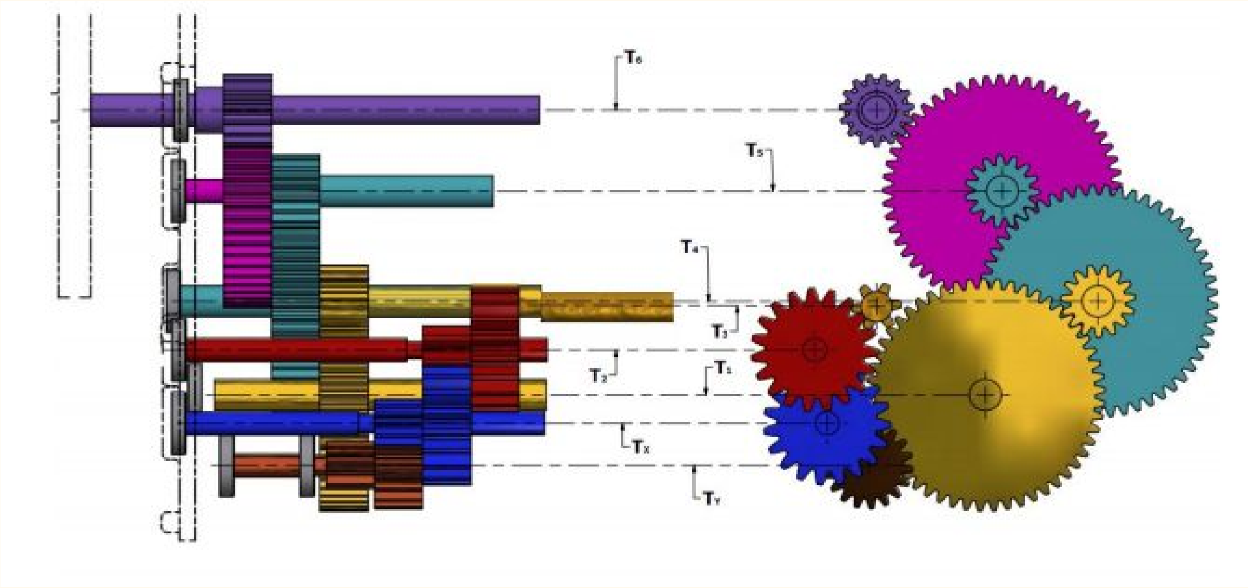
The modified screw jack here exploits the use of quick return crank mechanism in the process of bevel gear movement as it seems to be more efficient than the conventional type screw jacks whilst the user has ease in operating it.

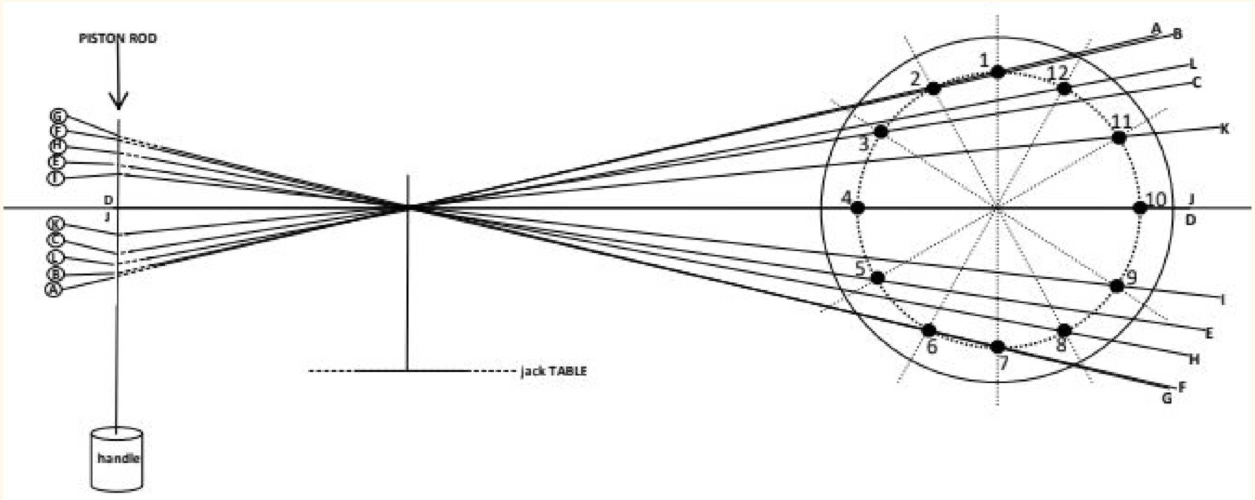
Detail of Mechanism:

During usage, the screw jack is assembled for operation extended properly. The jack is then placed perfectly under the vehicle loading platform serving as a base for support.

During the process of lifting the power screw rotates in clockwise direction allowing the crank to rotate as well (engaging gearing motion) which aids in the upward movement of the gear drive.

The reverse is the case when it is turned counter clockwise, allowing downward movement thereby lowering the load. Doing all these like the conventional screw jack (scissors jack), the operator must carefully inspect the operation making sure the load sits perfectly on the loading platform to prevent unsafe conditions i.e. slippage of the vehicle from the jack.





Above image depicts the Quick Return Mechanism used for the crank shaft.It is used such that the time taken for the crankshaft to return to 360 degrees from 170 degrees in lesser time. The movement from 0 degrees to 170 degrees is manual and acts as the power stroke for the Screw jack mechanism.

DESIGN CALCULATIONS:

Determination of a Velocity Ratio

$$VR = \frac{N}{n} = \frac{t}{T},$$

Allowable tooth stress

$$S_a = S_o\left(\frac{3}{3+V}\right),$$

Wear tooth load

$$F_w = D_p bkQ$$

In design of conventional conventional lifting jacks, the total force required to lift the piston during the upward stroke is equal to the sum of the following

$$F_L = F_P + F_r + F_W,$$

where Fp = Force due to the weight of the piston, Fr = Force due to the weight of the piston rod,

Fw = Force due to the weight of the vehicle having a cross-section equal to that of the jack.

Safety of lead screw, compressive stress induced in the screw due to load

$$F_c = \frac{W}{\frac{\pi}{4} d_c^2}.$$

Factor of safety

$$\text{factor of safety} = \frac{yieldstress}{F_c}.$$

Outside diameter of screw,

$$d_o = d_c + P.$$

Mean diameter of screw,

$$(d_m) \quad d_m = \frac{1}{2}(d_c + d_o).$$

Helix angle of screw ,

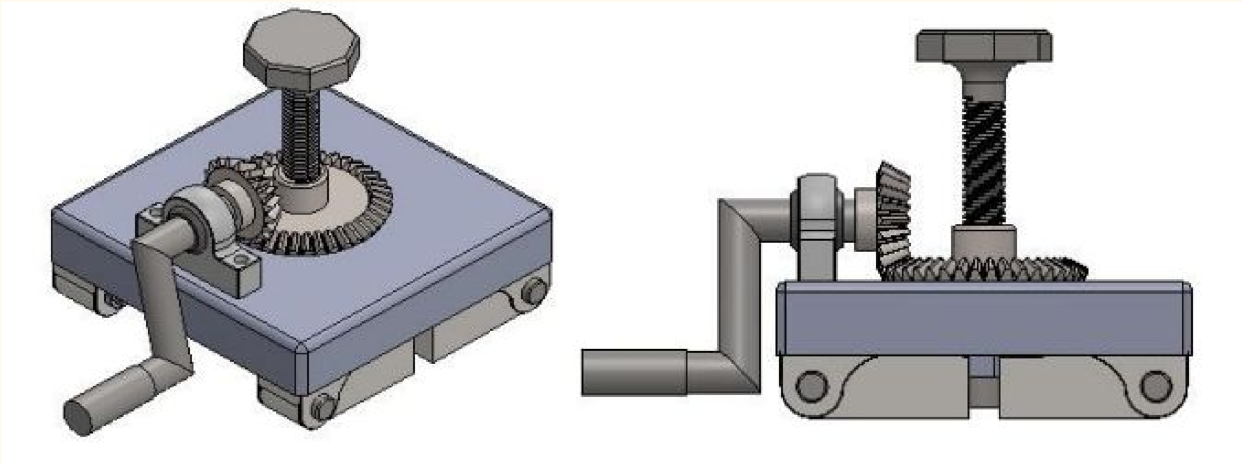
$$\alpha = \tan^{-1}\left(\frac{p}{\pi d_m}\right).$$

Angle of friction,

$$\theta = \tan^{-1}\mu ,$$

In designing an acme thread power screw for jack operation, the screw must be self-locking and have strength to prevent buckling and safe enough to prevent harm. The coefficient of friction in screw thread is independent of axial load, practically independent of speed, decreases with heavier lubricants, and shows little variation with combination of materials. The screw also should have a safe bearing pressure (Pb) on threads to protect the moving surfaces from abnormal wear.

For safe International Journal of Engineering and Technologies Vol. 13 45 bearing pressure, Pb = 17.2 - 24.1MPa. Coefficient of friction = 0.15 – 0.23 for steel because the material is known under reasonably constant service conditions subjected to loads and stresses that can be determined easily.



Conclusion :

Here after seeking all the formulas given the research paper has these given statistics regarding the experimentations done by their grace the result is below :

The experimental result shows that Very little effort (5.280N minimum and 102.76N maximum) and torque (0.597Nm and 51.38Nm maximum) is required to lift a load using the modified screw jack compared with the classical method which requires effort of 127.4N and torque of 135.04Nm.

Also, the time required to lift a car using the modified method is lesser (2.025s) compared to the time required to lift the same weight of car using the traditional method (4.094s). Conclusively, the modified design provides a good alternative to the lever lift mechanism as other existing conventional lifting jacks require more effort, capacity, power generating sources and maintenance cost. The proposed quick lifting jack prototype was made up of a gear drive and a quick-return crank mechanism.

An Experimental Investigation on Motorised Screw Jack - Research Paper 2

Introduction:

Motorised Screw Jack is aimed at reducing the effort as well as the time taken to lift the load in comparison to the ordinary screw jack.

Challenges in Motorising a Traditional Screw Jack:

- The difficult part of the project may be finding a low-speed motor that is able to work at 12V. This is because the battery output of an automobile is 12V, and the electricity needed for the operation of the screw jack is taken from this battery.
- Another problem will be regarding speed reduction. 12V motors usually operate at higher speeds, likely at 4000 or 5300 rpm. So reducing this high rpm to the required lower RPMs for the operation of screw jack without bulky accessories or power loss can be challenging.

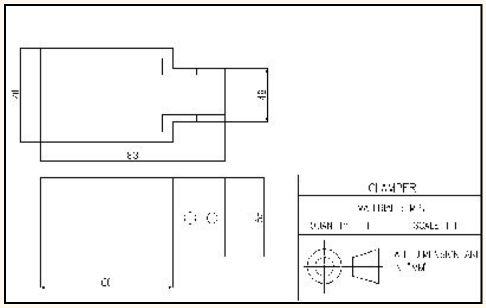
Firstly, a mechanized jack will be put under the car body with some freedom between top plate and skeleton. At the point when a course of development will be given by a joystick, the power will be taken and Motor begins turning. The motor will exchange its shaft velocity to the pinion equip coinciding with a greater apparatus which is associated with the screw jack and it will turn. At the point when the case will interact with jack, the heaviness of auto will step by step exchange to jack. These created strengths will be disseminated among connections and cubical bore. The drive transmitted to cube shape will be exchanged to screw strings.

Material Selection is of utmost importance and mild steel is generally preferred. The properties that are looked into are **Good Machinability, Good Ductility, High Strength, Wear Resistance and Ease of delivering**.

Parts Used in a Motorized Screw Jack:

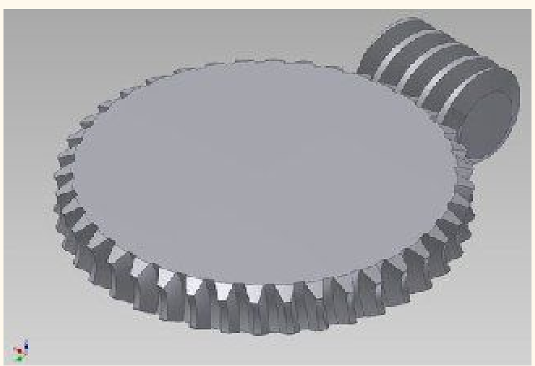
A. Clamper:

A clamp is a fastening device to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. Clamper views are shown below.

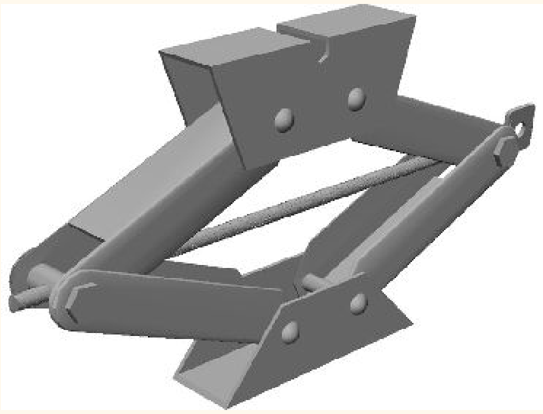


The clamper here is used to hold the motor with the jack. It is the most important component of the motorized screw jack. In this project the clamper is being welded to the screw jack, it prevents the jack from vibrations produced from the motor.

B. Worm and Worm Gear Arrangement:



Worm and worm gear arrangement is being employed in this project. The worm is connected to the motor shaft while the worm gear is connected to the lead screw. Rotation of the lead screw is done by the worm gear.



C. Screw Jack:

A Screw jack is a type of jack that is operated by turning a lead screw. In the form of a screw jack, it is commonly used to lift moderately heavyweights such as vehicles.

Detail of Mechanism:

When a high pulse is given to the motor, the motor rotates in a clockwise direction and when a low pulse is given it rotates in an anticlockwise direction. Thus the worm gear rotates and enables the lead screw to rotate in both directions as shown above.

DESIGN CALCULATIONS:

A. Design of screw jack

To find out the power of the motor that can lift load of 30 kg

Taking dimensions to be, Major Screw diameter (d_o) =12 mm

Pitch of screw (ρ) = 3 mm

Mean diameter, $d = d_o - \rho/2 = 12-3/2$

$d = 10.5$ mm

$\tan \infty = \rho/ \pi d$

$\tan \infty = 3/\pi \times 10.5$

$\tan \infty = 0.091$

Assuming coefficient of friction, $\tan \theta = 0.1$

Load to be raised = 30 kg

W = 300 N

P = Effort required to raise the load = W x tan (∞+θ)

= W x (tan ∞+ tan θ)/ (1-tan∞ x tan θ)

= 300 x (0.091+0.1)/ (1-0.091 x 0.1)

=300 x (0.191/0.99)

P = 57.82 N

B. Torque required operating the screw

T=P x d/2

T =57.82 x10.5/2

T = 303.58x10 -3 Nm

Since the screw moves in the nut at a speed of 65mm/min of speed of revolutions is minute is, N = speed in mm/min/pitch in mm

N = 65/3(pitch) **= 21.6** (22 rpm)

C. Power of the motors required

ρ = T x ω (7)

Where ω is = 2 x π x N/60

ρ = T x ω

ρ = 303.58 x10 -3 x 2 x π x 22/60

ρ = 0.699 watts

Advantages:

- It possesses a self-locking property
- No radial thrust acts since the square thread is used
- A higher range of speed control is obtained.

The Proposed Novel Solution/ Improvements:

Concept:

Having identified that a motorised screw jack is of utmost importance to make the load-carrying capacity easier and less cumbersome, we have tried to use the DC motor driving the screw jack via gear drive and attaching a **Hypoid gear system** (innovating the idea of research paper 2).

This Hypoid Gear can then be attached to the torque transferring mechanism using chain gear drive from research paper 1 for greater Power transmission.

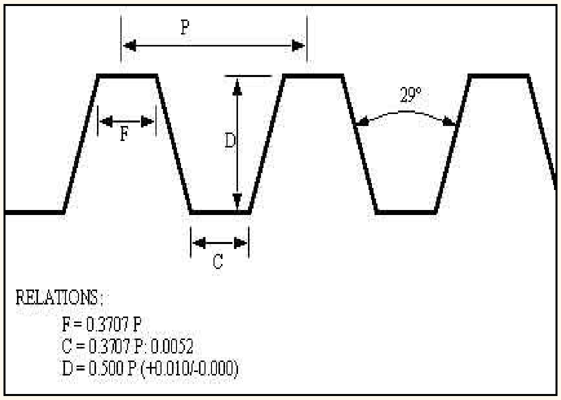
We use **Needle bearings** compared to spherical ball bearings used in research paper 1 because needle bearings have the ability to withstand high radial force and also have nominal axial strength. The increase in the contact surface area because of its cylindrical dimensions, the friction of needle bearings are 3-4 times higher than that of Spherical ball bearings. Due to which the Torque capacity is higher than that of the latter.

Power transmission is from the crankshaft to the hypoid gear and from the hypoid's driven shaft to the screw jack (innovating research paper 1 and 2). Hypoid gear is better than the bevel gear and worm gear because of the higher load-carrying capacity of the former. Hypoid gear motors can handle higher initial inertia loads and transfer more torque with a smaller motor than a comparable worm gear motor.

Improvising on the ACME threads (trapezoidal threads of angle 29 deg) being used in the traditional power screw of Paper 1, **Buttress threads** can be used to transfer the axial force along the screw which can lift the load easily.

Supporting Material for above-stated Improvements:

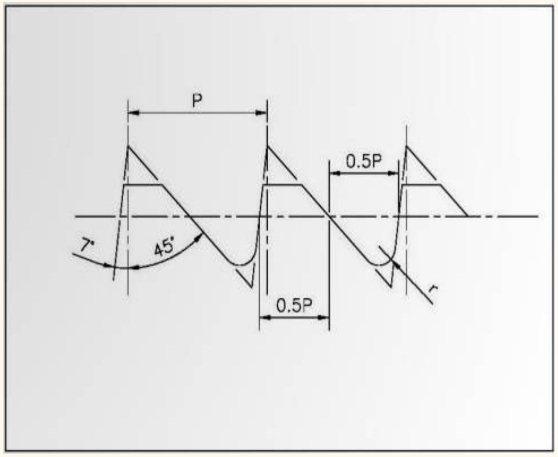
ACME Threads:



The Acme thread form has a 29° thread angle with a thread height half of the pitch, the apex (or crest) and valley (or root) are flat. This shape is easier to machine (faster cutting, longer tool life) than a square thread. The tooth shape also has a wider base which means it is stronger (thus, the screw can carry a greater load) than a similarly sized square thread. This thread form also allows for the use of a split nut, which can compensate for nut wear.

Buttress Threads:

The buttress thread form, also known as the breech-lock thread form, refers to two different thread profiles. One is a type of leadscrew and the other is a type of hydraulic sealing thread form. The leadscrew type is often used in machinery and the sealing type is often used in oil fields. This is typically a 7° **angle** on the weight bearing surface and a 45°**angle** on the trailing flank, which provides a form with good shear strength.

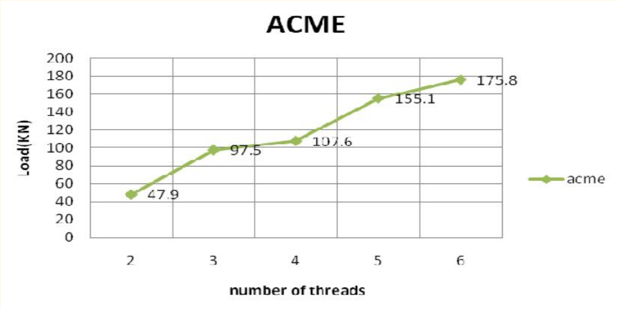


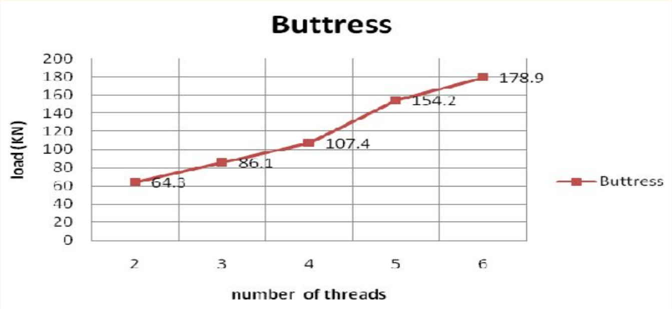
The asymmetric thread form allows the thread to have low friction and withstand greater loads than other forms in one direction, but at the cost of higher friction and inferior load bearing in the opposite direction.

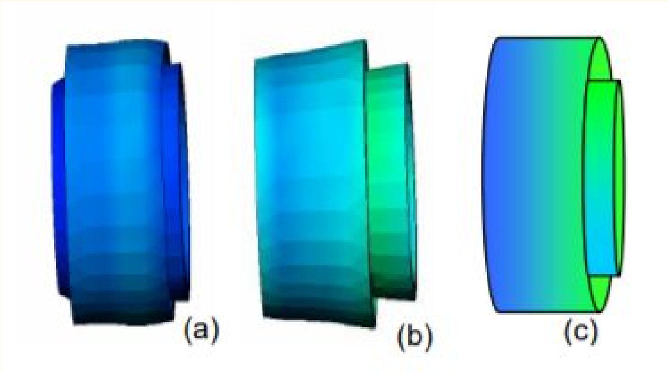
Why do Buttress Threads better than ACME threads?

Buttress screws are designed to handle extremely high axial thrust. The thread shares the low friction properties of a square thread form at roughly twice the shear strength.

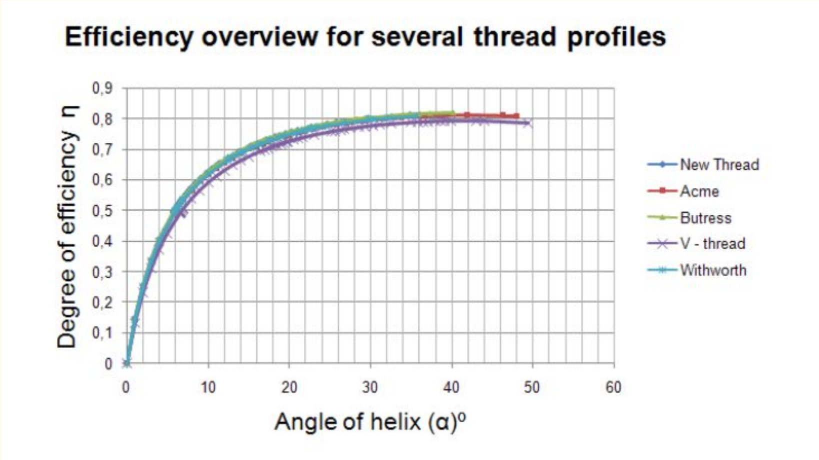
Typical buttress screw applications include large screw presses, jacks, and vertical lifts due to their ability to handle high unidirectional loads with relatively low applied torque.

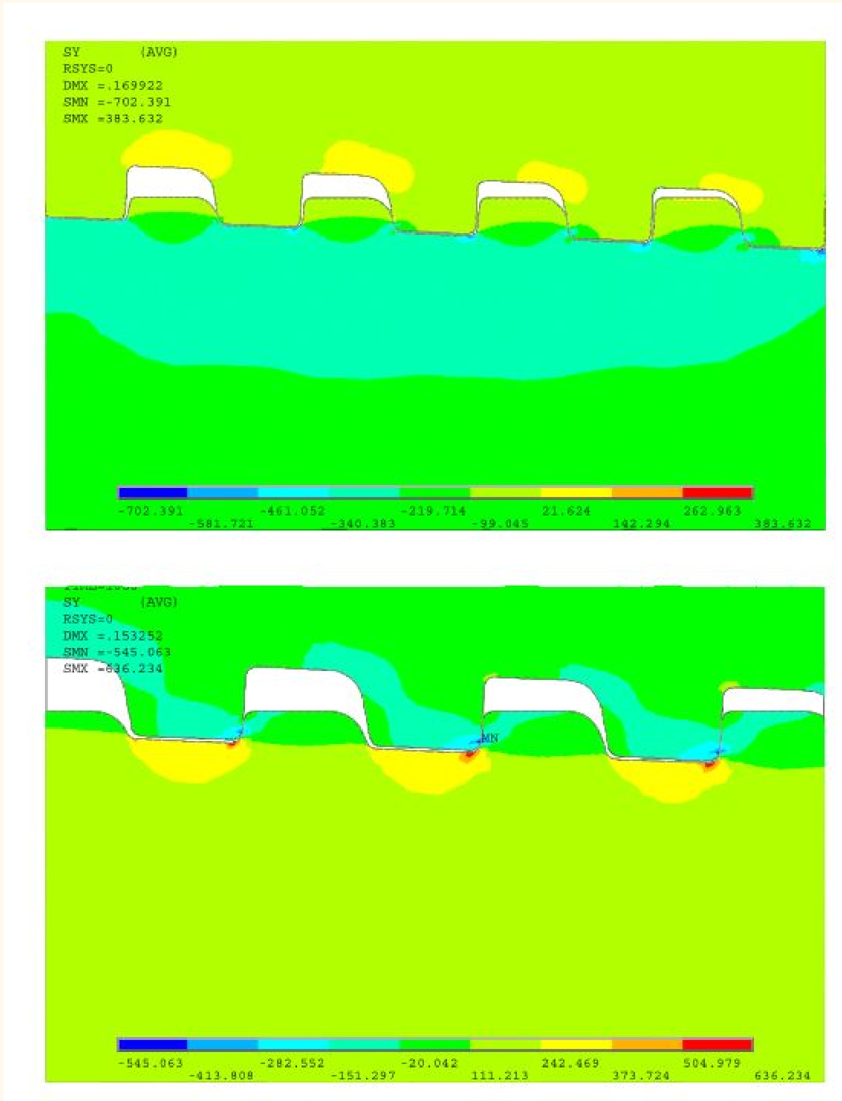






The qualitative representation of the deformation of a
(a) compression loaded
(b) tension loaded
(c) threaded connection compared to the non-deformed status



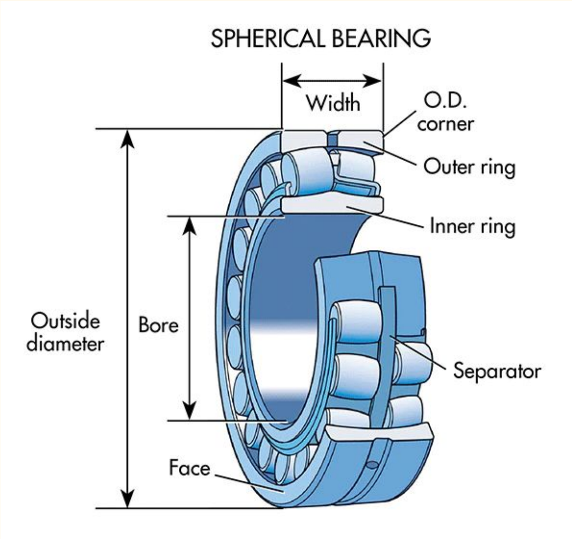


Stress distribution at the thread root for the compression (top) and tension (bottom) load cases, as simulated with FEM.

The above analysis is for the 18-5/8 inch diameter casing with Buttress thread connections.

The results showed that the LCF resistance of the buttress thread connection can be increased over a 1000 cycles for lower stress concentration factor and under extreme loads, the buttress threads can be as low as 10 cycles.

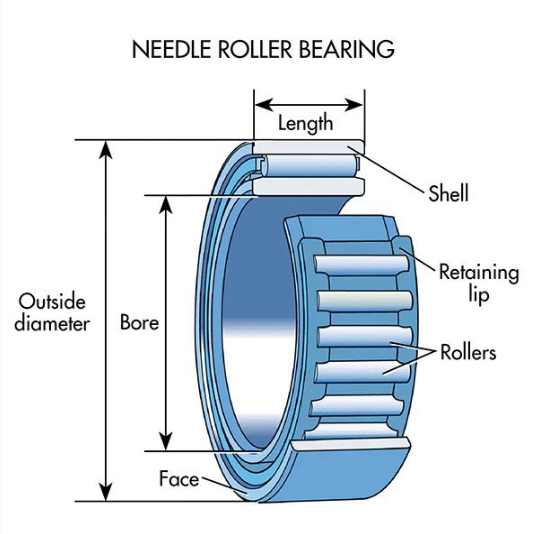
Spherical Ball Bearings:



A spherical roller bearing is a rolling-element bearing that permits rotation with low friction and permits angular misalignment. Typically these bearings support a rotating shaft in the bore of the inner ring that may be misaligned in respect to the outer ring. The misalignment is possible due to the spherical internal shape of the outer ring and spherical rollers.

Needle/ Quill Bearings:

Needle Bearings have a small outer diameter. It is due to this reason that they are often used to replace sleeve bearings. This allows replacement with little or no changes in design. They are compact and lightweight compared with other types of bearings. They have a large load carrying capacity compared to their size. They have a large load-carrying capacity, particularly at low peripheral speeds.

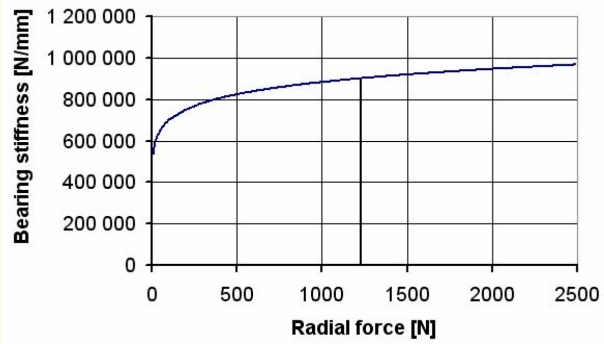


Why are Needle Roller Bearings better than Spherical Ball Bearing?

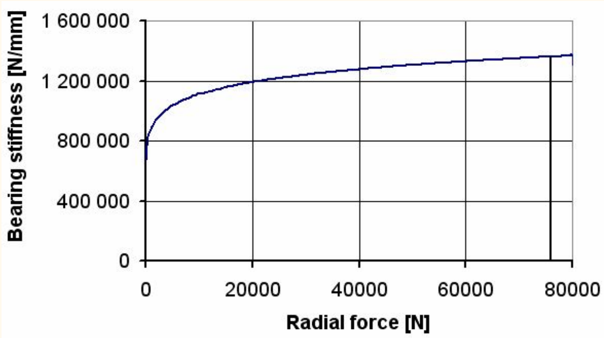
Ordinary roller bearings' rollers are only slightly longer than their diameter, but needle bearings typically have rollers that are at least four times longer than their diameter. Like all bearings, they are used to reduce the friction of a rotating surface.

Compared to ball bearings and ordinary roller bearings, needle bearings have a greater surface area in contact with the races, so they can support a greater load. They are also thinner, so they require less clearance between the axle and the surrounding structure.

Bearing Stiffness vs Radial Force for Needle Bearings:



ZOOMED VIEW:

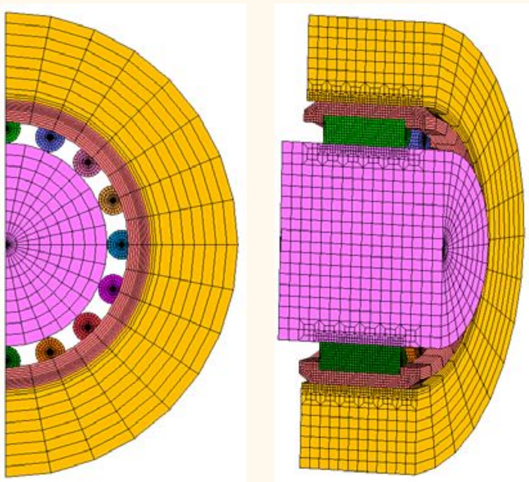


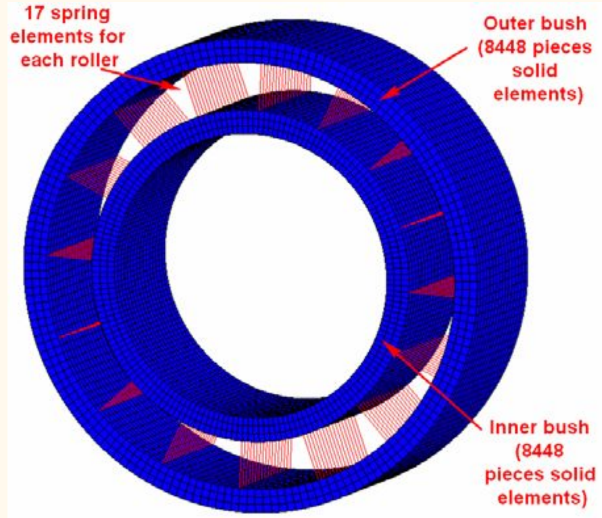
Analytical and numerical models used to calculate the Hertz mechanical characteristics and the results are compared in Table 1. The compressive force of the two cylinders is: 315 N. For the elastic deformation the analytic model was based on the Palmgren model. For the FE calculation the MSC. Marc program was used.

Tab. 1. Comparing the results of analytic and FE calculation

Contacting cylinders	Ø35 - Ø5 convex-convex		
Hertz characteristics	b [mm]	p_{max} [MPa]	u [mm]
Analytic model	0.044502	559	0.0007564
FE model	0.048433	549	0.0007345

The FEA Model:





The bearing load is 1250 N which is applied through the shaft.Three different adaptive mesh density level examinations were carried out for the given model and conditions.

The analytical model is done below:

In case of two cylinders having parallel axes the elastic deformation, i.e. the approximation of two (for located) distant stress-less points of the bodies is

$$\delta = 1.360 \frac{1}{L^{0.8}} \frac{Q^{0.9}}{E_r^{0.9}} \quad [\mathrm{mm}].$$

where Q [N] is the compressive force, L [mm] is the effective length of the two cylinders, E r is the equivalent modulus of elasticity having the value for steel-steel cylinders:

$$E_r = 109\ 890\ \mathrm{MPa}.$$

As it is seen in the above formula the Hertz-kind elastic deformation does not depend on the radii of the cylinders in case of two conducting cylinders. According to Kovalszkij, the elastic deformation can be calculated by the next formula:

$$\delta = p_{\max} b \frac{1-\nu^2}{E} \left(\ln \frac{d_1}{b} + 0.407 + \ln \frac{d_2}{b} + 0.407 \right)$$

where ρ_{max} [MPa] is the maximum surface pressure formed, such as the Hertz-stress, b [mm] is the half-width of the contact surface, d_1 and d_2 [mm] are the diameters of the two cylinders, E [MPa] is the modulus of elasticity, and υ is the Poisson's ratio. Eschmann gives the elastic deformation of the inner and outer rings together:

$$\delta_b + \delta_k = \left(\frac{1}{26300} \cdot \frac{1}{L^{0.92}} \right)^{1/1.08} Q^{1/1.08} \text{ [mm]}.$$

The spring stiffness of the needle roller (considering both the inner and the outer contact together) is:

$$s_g = \frac{\partial Q}{\partial \delta}$$

where $\delta = \delta_b + \delta_k$.

We carried out calculations for one RNA 35×50×27.7 type needle roller bearing having the following geometric parameters: inner race diameter is D_b = 35 mm; outer race diameter is D_k = 45 mm; rolling element diameter is D_g = 5 mm, the length of the needle roller is L = 16 mm. According to these three authors the change of the spring stiffness in terms of the roller load.

At F_r = 1250 N radial load of the bearing the highest spring stiffness values of the examined bearings – according to the authors are as follows:

- Palmgren: s g = 229 600 N/mm
- Kovalszkij: s g = 219 400 N/mm
- Eschmann: s g = 217 000 N/mm

According to the recommendation of the three authors the spring stiffness values of the roller at F_r = 76 000 N radial load are:

- Palmgren: s g = 347 000 N/mm
- Kovalszkij: s g = 326 000 N/mm
- Echmann: s g = 295 000 N/mm

The relationship between the radial bearing load and the elastic deformation

$$F_r = K_n \delta^n,$$

where $\delta = \delta_b + \delta_k$, and the coefficient K_n is:

$$K_n = \left[\frac{1}{\left(\frac{1}{K_b}\right)^{1/n} + \left(\frac{1}{K_k}\right)^{1/n}} \right]^n$$

where n = 10/9 (in case of ball bearing n = 3/2). For the inside and the outside rings, K_b and K_k are the contacting constants and their values can be determined – according to Palmgren by the following formula:

$$K_b = K_k = \left(\frac{1}{1.360} \cdot L^{0.8} \cdot E_r^{0.9} \right)^n.$$

If $K_b = K_k$ then the former relationship is changed to

$$K_n = \frac{K_b}{2^n}$$

The relationship between the F_r radial load and the maximum load Q max on the rolling element is:

F_r = ZQ max J_r

where Z is the number of the rolling elements and J r is the so-called Sjövall integral, which provides the value for line contact clearance-free bearing as follows:

$J_r = 0.2453.$

The radial elastic displacement of the inner ring centre (shaft) is:

$$u = \left(\frac{Q_{\max}}{K_n} \right)^{1/n}.$$

The spring stiffness of the bearing can be calculated from the following relationship:

$$s_{cs} = \frac{\partial F_r}{\partial u}.$$

For example, the spring stiffness of RNA 35 × 50 × 27.7 type needle roller bearing is shown in the function of radial load.

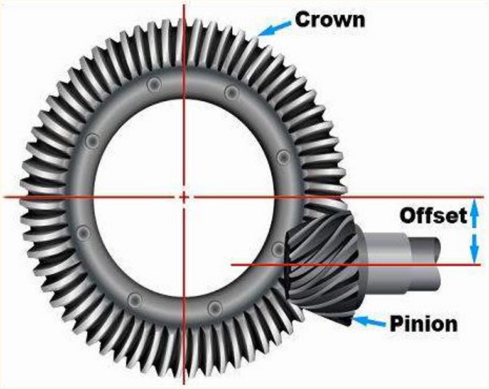
For F_r = 1250 N radial load the spring stiffness of the bearing is:

$$s_{cs} = 900\ 700 \text{ N/mm},$$

and in case of radial load $F_r = 76\ 000$ N

$$s_{cs} = 1\ 360\ 000 \text{ N/mm}.$$

Hypoid Gears:



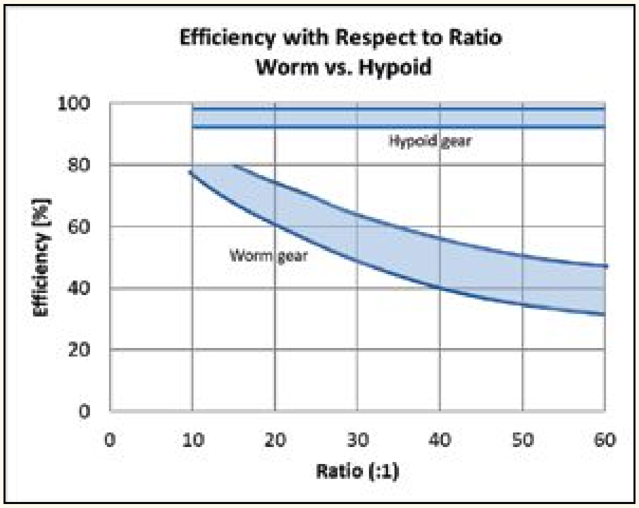
The hypoid gear set is a hybrid of bevel and worm gear technologies. They experience friction losses due to the meshing of the gear teeth, with minimal sliding involved. These losses are minimized using the hypoid tooth pattern which allows torque to be transferred smoothly and evenly across the interfacing surfaces. This is what gives the hypoid reducer a mechanical advantage over worm reducers.

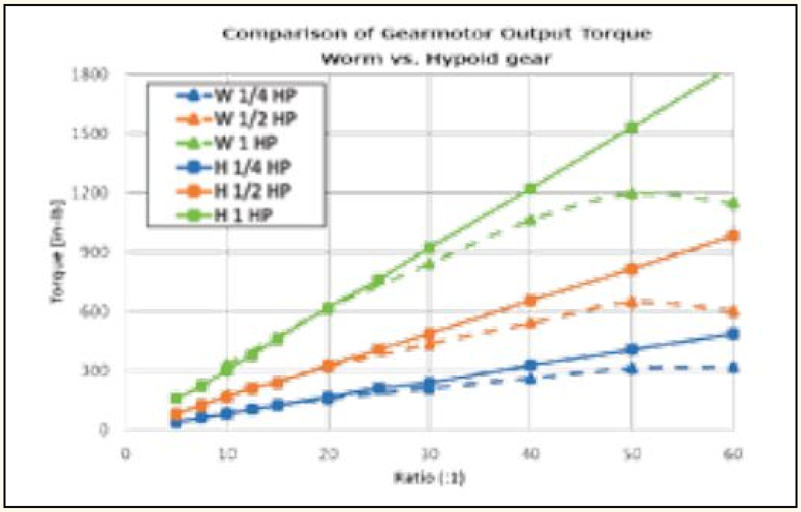
Comparison of Efficiency:

One of the biggest problems posed by worm gear sets is their lack of efficiency, chiefly at high reductions and low speeds. Typical efficiencies can vary from 40% to 85% for ratios of 60:1 to 10:1 respectively. Conversely, hypoid gear sets are typically 95% to 99% efficient.

Smaller motors can be used in hypoid gear motors due to the more efficient transfer of energy through the gearbox. Another benefit of hypoid gear motors is that they are symmetrical along their centerline.

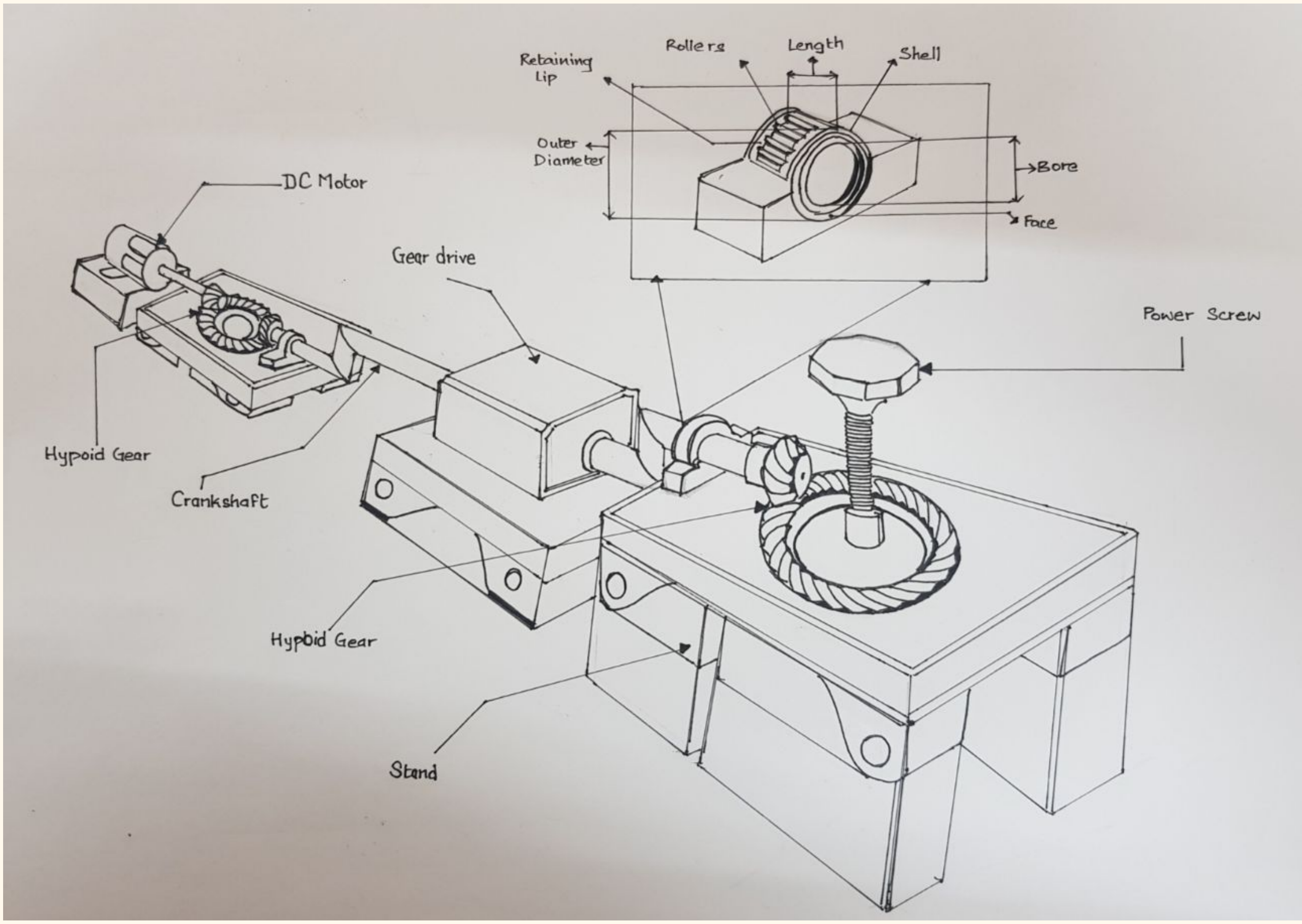
Worm gear motors are asymmetrical and result in machines that are not as aesthetically pleasing and limit the amount of possible mounting positions.





Hypoid reducers can move loads from a dead stop with more ease than worm reducers. Hypoid gear motors can handle higher initial inertia loads and transfer more torque with a smaller motor than a comparable worm Gearmotor.

Our Model:


Retaining Lip
Rollers
Length
Shell
Outer Diameter
Bore
Face
DC Motor
Gear drive
Power Screw
Hypoid Gear
Crankshaft
Hypbid Gear
Stand

Conclusion:

Inspired from the design of a Screw Jack from Papers 1 and 2, we have identified that certain components of Paper 1 can be modified as mentioned above and the manual Quick Return Mechanism can be replaced by using a Motorised Screw Jack. Analysing fatigue and load cycle graphs, buttress threads are used in the proposed application. The behaviour of needle roller bearing for radial load and for bending load was examined too and it is shown that needle bearings prove better in radial loads than the spherical bearings. The efficiency of worm gears and hypoid gears was compared for various horsepowers, Hypoid Gears was found to be most efficient and the above-mentioned design modifications were made.

As the friction of the needle bearings is 3-4 times higher than the conventional bearings , a good lubrication system is to be used.This lubrication system should lubricate each and every part of the screw jack system (i.e) for the gears, needle bearings, threaded power screw and other components.So , the lubrication system used for this setup should be analogous to the Dry Sump Lubrication system used for Engines.

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Research Paper 1: Modified Screw Jack for Lifting Operation in Industrial Setting - Benjamin Ezurike1a, Modestus Okwub

Research Paper 2: Experimental Investigation of Motorized Screw Jack - Maniam Ramasamy, Kaviyarasu, Luke Justin Johnson

Research Paper 3: Motorized Screw Jack - Mohammed Yousuf, Shaik Ashraf, Yaaseen Shahid Iqbal for introduction purposes

Research Paper 4: Fatigue Life Prediction of a Buttress casing connection exposed to large temperature variations by C. Teodoriu, G. Falcone.

Research Paper 5:

https://www.orientalmotor.com/ac-motors-gear-motors/technology/pdf/Brother%20Hypoid%20vs%20Worm.pdf

Research Paper 6:

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Research Paper 7:

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Research Paper 8:

Failure analysis of buttress, acme and modified square threaded mild steel (is2062) tie rods by THEJA. N, Sreenivasulu Bezawada and S Praveen Kumar.