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Failure analysis of buttress, acme and modified square threaded mild steel (is2062) tie rods

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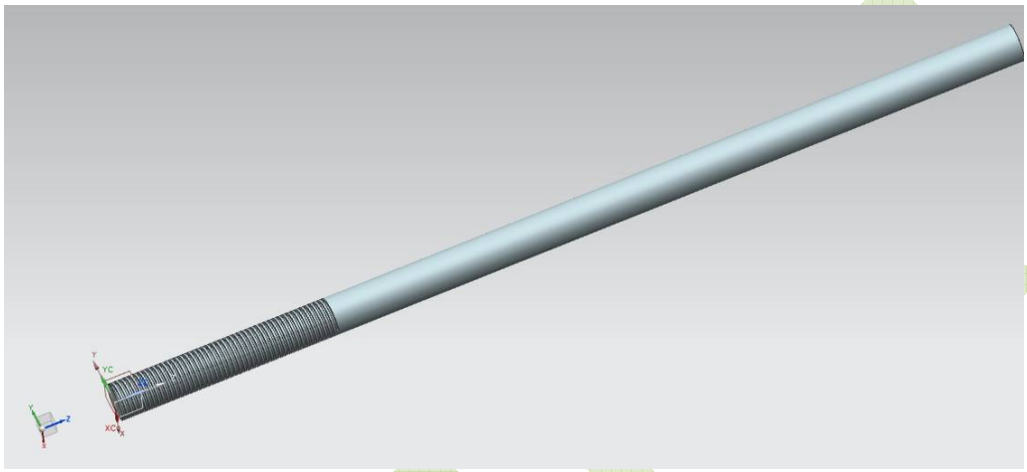
Abstract
Steel tie rods are imperative load bearing capacity segments in applications where high levels of per stresses are needed. The tie rod bearing capacity has not just by the strength of the segment, but also it depends on the thread strength. Investigation of the thread strength connections and finding the best possible amount of threads engagement is crucial to make sure structural protection. In this document the results of tensile rupture experiments on mild steel IS2062 tie rods having threaded connections like Buttress, ACME and Modified square experiment setup provided by jyothi spectro analysis Hyderabad. In this experiment we test on mild steel tie rod specimens to determine ultimate load as well as deformations. The results of these experiments suggest the least number of turns of the thread engagement for prevent the breakdown of threaded mild steel tie rod in realistic applications.

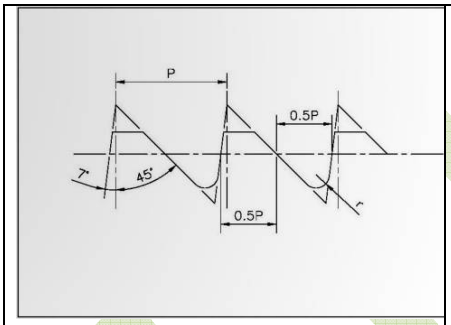
1. Introduction

In steel tie rods these applications are used extensively for requiring structural components such as docks, stadia, bridges and long-span buildings. To resist force in tie rods they are fixed firmly by threaded connections. Steel tie rods bearing capacity is determined by two conditions they are thread connections of rod and strength of the rod body. Three types of threaded links are used in steel tie rods for structural applications they are Buttress, ACME and Modified Square threaded connections. Fig: 1a shows threaded connections of steel tie rod Fig: 1b shows full sectional views of Buttress, ACME and Modified Square threaded connections respectively. The steel tie rods having the diameter of 20mm thread connection. This challenges to determining a suitable type of threaded connection on steel tie rods, for failure on the tie rod body minimum number of thread engagement is considered and it acted on contact pressure, axial force and sliding distance on the threaded teeth. In previous work they have taken triangular and trapezoidal threaded connections on the tie rod are susceptible to failure due to fatigue, dynamic shear loading and tensile [1]. Stresses in threaded and Load distributions relations have been considered widely in the past [2–7] and analysis may be easily divided into three categories: analytical, experimental, and finite element simulation.

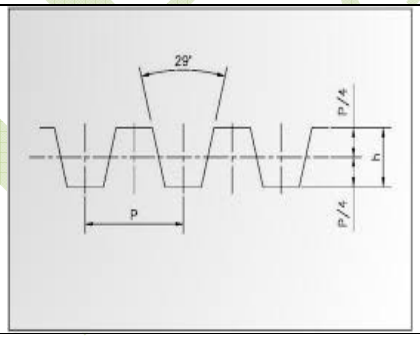
In this study, tensile test experiments used to find out the axial loading under different numbers of turns of thread connection on five tie rods on each mild steel IS2062. Experiment setup provided by jyothi spectro analysis, Hyderabad. Mild steel IS2062 tie rods with Buttress, ACME and Modified Square threaded connections are considered.



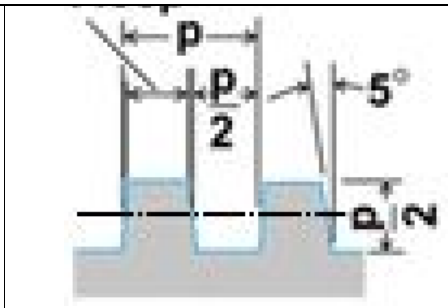
(a) Threaded tie rod



(b)Buttress thread



(c) ACME thread



(d) Modified square thread

Fig: 1. Buttress thread, ACME thread and Modified square threads

2. Mechanical Properties of Mild Steel IS2062 Tie Rod

Specimen	ultimate strength	Young's modulus	Yield strength	Poisons ratio	Elongation (%)	Density g/cm^3
Mild steel IS2062	410(Mpa)	210(Gpa)	240(Mpa)	0.27	23	7.85

3. Experimental analysis of tie rod connection

In the tensile test of the threaded links, the material and size then procedure of test specimens were engaged the same to that of a steel tie rod in every practical purpose. The test equipment has a 1000kN vertical tensile testing machine use to calculate the axial loads in thread connections and also thread engagement for different number of turns. For finding the mechanical properties of the material universal testing machine is used. In jyothi spectro analysis Hyderabad, we have taken five test pieces for the experiment were used to calculate the mechanical properties of mild steel IS2062 tie rods for Buttress, ACME and Modified square threaded connection.

The base material having chemical compositions mild steel IS2062 of steel tie rods were determined. For base material of tie rod having good purity required. The chemicals like phosphorus and sulphur have percentages are mutually very low.

4. Tensile test of threaded connections

The assembly diagram of a mild steel IS2062 tie rod is considered. Then tensile tests were conducted for two, three, four, five and six engaged thread turns, and in order to consecutive specimens.

Fig: 2. specimens of mild steel IS2062 tie rods

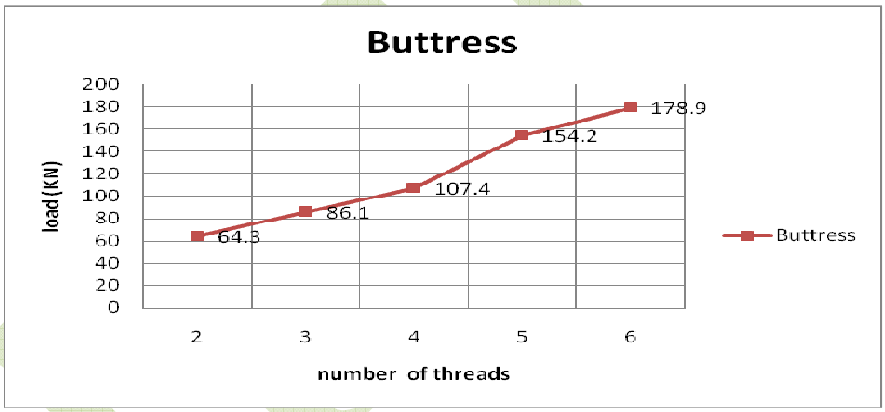
4.1. Tensile test of Buttress steel tie rod

Fig: 3 five specimens of Buttress threaded mild steel IS2062 tie rods

(I) While the number of buttress thread connections is engaged at two, three and four turns separately, the thread cutting location has occurred in all cases on the threaded link tie rod and then the failure occur on thread teeth in the form of shear and pull out.

(II) While the number of engaged turns of five and six with a strength pulling of 154.2kN and 178.9kN breaking occurred in this position on tie rod body forming necking and ultimate breaking of the unengaged thread tooth. The internal thread teeth on sleeve and the external thread teeth on the tie rod body were still engaged in good condition. In five threads and six threads the break position was occurred in 11turns and 22 turns, in both cases the break position is placed away from the end face. These shows buttress thread steel tie rod having less strength to bare the load on five and sixth engaged thread turn position.

(III) The critical value was occurred on the four engaged thread position. Where the damaged portion of the tie rod body in thread position is more than fourth thread is engaged. In case of buttress threads to maintain the safe position four engaged thread is considered. Otherwise the failure position occurs at the fifth and sixth threaded connection.



Graph: 1. Graph between numbers of thread turns Vs load in Buttress thread connection

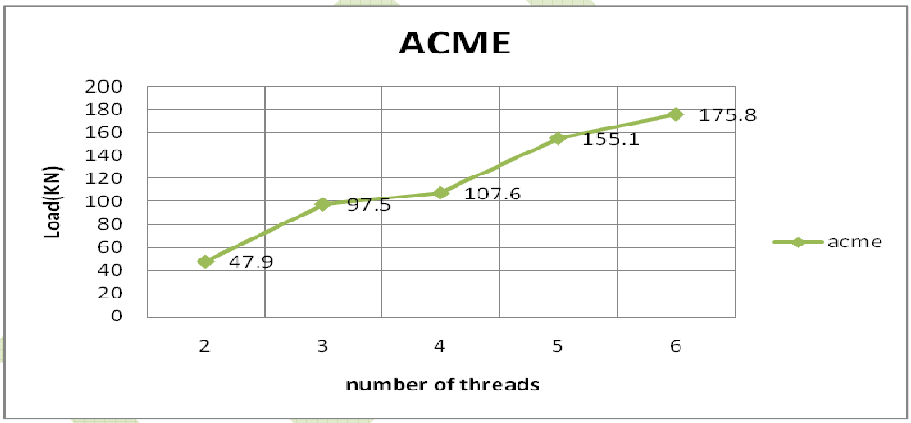
4.2. Tensile test of ACME steel tie rod

Fig: 4.five specimens of ACME threaded mild steel IS2062 tie rods

(I) While the number of acme thread connections is engaged at two, three, four and five turns separately, the thread cutting location has occurred in all cases on the threaded link tie rod and then the failure occur on thread teeth in the form of shear and pull out.

(II) While the number of engaged turns of six with a strength pulling of 175.8kN breaking occurred in this position on tie rod body forming necking and ultimate breaking of the unengaged thread tooth.. The internal thread teeth on sleeve and the external thread teeth on the tie rod body were still engaged in good condition. In six threads the break position was occurred in 22 turns, in this case the break position is placed away from the end face. These shows acme thread steel tie rod having less strength to bare the load on sixth engaged thread turn position.

(III) The critical value was occurred on the five engaged thread position. Where the damaged portion of the tie rod body in thread position is more than five threads is engaged. In case of acme threads to maintain the safe position five engaged thread is considered. Otherwise the failure position occurs at the sixth threaded connection.



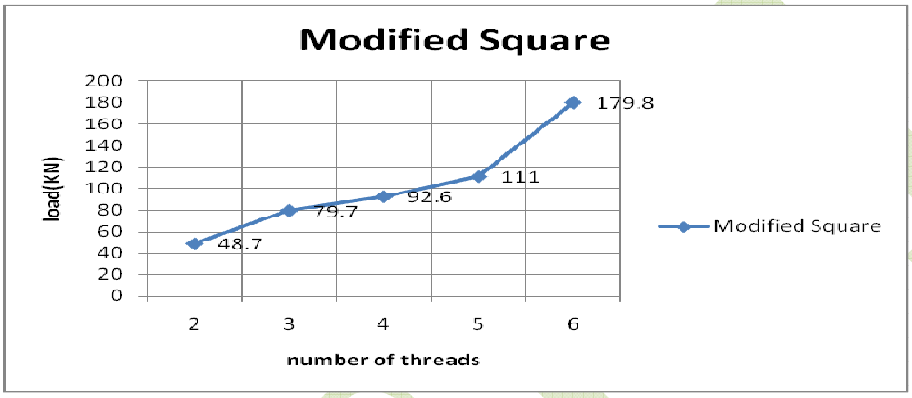
Graph: 2 Graph between numbers of thread turns Vs load in ACME thread connection

4.3. Tensile test of Modified Square steel tie rod

Fig: 5.five specimens of Modified Square threaded mild steel IS2062 tie rods

(I) While the number of Modified Square thread links is engaged at two, three, four, five and six turns, the thread cutting location has occurred in all cases occurred on the threaded link and then failure occur on thread teeth in the form of shear and pull out.

(II) In case of modified square thread connection a six engaged thread turns in a steel tie rod does not having a failure position. So then the modified square should have more strength than comparing to other threads.



Graph: 3 Graph between number of thread turns Vs load in Modified square thread connection

5. Conclusion

(I) In steel tie rods the failure takes place at the thread teeth engaged portion then shear and bending failure occurred on it. We are strongly recommended that modified square thread connection having a nominal diameter of 20mm.

(II) While the fifth and sixth threads are engaged in Buttress thread connection failure occurs at unengaged threads and necking and breaking occurs at 11^{th} and 22^{nd} turns. While the sixth engagement in ACME thread connection failure occurs at unengaged threads and necking and breaking occurs at 22^{nd} turn. Therefore the recommendations of number of turns of threaded engagement should be failed in fifth and sixth position in Buttress and sixth position in ACME thread.

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