STUDY THE MATERIAL OF FISHING ROD AND THEIR STIFFNESS AND ELASTICITY STRENGTH USING BENDING TEST

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BACHELOR OF ENGINEERING TECHNOLOGY MANUFACTURING WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this research entitled " Study the material of fishing rod and their elasticity and stiffness using bending test" excepted as noted in the references, this is the result of my own research. This research has not been accepted for any degree and is not being considered for any other degree.

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Date	:	8/1/2023

APPROVAL

I hereby declare that I have reviewed this thesis and believe that it is adequate in scope and quality for the award for the Bachelor of Mechanical and Manufacturing Engineering Technology (BMMW) with Honours.

Signature :

Supervisor Name : TS. DR. OMAR BIN BAPOKUTTY

Date : 23/1/2023

DEDICATION

First and foremost, I would like to express my heartfelt gratitude to everyone who has assisted me with this project. To begin, I would like to express my heartfelt gratitude to my most respected supervisor, Ts. Dr. Omar bin Bapokutty, for his unwavering support of my Final Year Project, as well as his patience, motivation, enthusiasm, and vast knowledge. I could not have asked for a better project supervisor. Aside from my supervisor, I am grateful to my loving parents, Vejaya Kumar A/L Kunjiraman and Chandra A/L Subramaniam, for their words of encouragement and push for tenacity. My completion of this project would not have been possible without the help of my friends. I thank them for the stimulating discussions, the sleepless nights we spent working together before deadlines, and for lending me their hands until I finished my proposal completely. It is a pleasure to express gratitude to those who, directly or indirectly, made this proposal possible.

ABSTRACT

This study is to research the different on the properties of different material used in making fishing rods. The most common material used are bamboo, fibreglass, graphite, and carbon fiber.This material will be examine in terms of their stiffness and elasticity by using bending and. Bending tests are used to assess the behaviour of materials when subjected to simple beam loading. With some materials, it is also known as a transverse beam test. The test is used to determine a material's Young's modulus. From the experiment, we can get the result of elasticity and stiffness of the material.When the forces causing the deformation are removed, the ability of a deformed material body to return to its original shape and size is referred to as elasticity. A body that has this ability is said to be elastic. Meanwhile, stiffness are the extent to which an object resists deformation in response to an applied force..Material testing is important in manufacturing for a variety of reasons, including satisfying regulatory requirements, selecting acceptable materials and treatments for a given application, reviewing product design or enhancement parameters, and confirming a manufacturing process. As for this research, the result from this testing will help the anglers to get the better information on knowing the ability of the fishing and choosing which is the best rod.

ABSTRAK

Kajian ini adalah untuk mengkaji perbezaan sifat-sifat bahan yang berbeza digunakan dalam membuat pancing. Bahan yang paling biasa digunakan ialah buluh, gentian kaca, grafit, dan gentian karbon. Bahan ini akan dikaji dari segi kekukuhan dan keanjalannya dengan menggunakan ujian lenturan dan kilasan. Kaedah ujian lenturan mengukur kelakuan bahan yang tertakluk kepada beban rasuk mudah. Ia juga dipanggil ujian rasuk melintang dengan beberapa bahan. Ujian ini digunakan untuk mengukur modulus Young bagi sesuatu bahan. Ujian kilasan melibatkan pemisahan sampel di sepanjang paksi dan merupakan ujian yang berguna untuk memperoleh maklumat seperti tegasan ricih kilasan, tork maksimum, modulus ricih dan sudut pecah bahan atau antara muka antara dua bahan. Daripada kedua-dua eksperimen, kita boleh mendapatkan hasil keanjalan dan kekukuhan bahan. Keanjalan merujuk kepada keupayaan badan bahan yang cacat untuk kembali kepada bentuk dan saiz asalnya apabila daya yang menyebabkan ubah bentuk dikeluarkan. Badan yang mempunyai kebolehan ini dikatakan berkelakuan elastik. Sementara itu, kekakuan ialah sejauh mana objek menentang ubah bentuk sebagai tindak balas kepada daya yang dikenakan.. Pengujian bahan adalah penting dalam pembuatan untuk pelbagai sebab, termasuk memenuhi keperluan kawal selia, memilih bahan dan rawatan yang boleh diterima untuk aplikasi tertentu, menyemak reka bentuk produk. atau parameter peningkatan, dan mengesahkan proses pembuatan. Bagi kajian ini, hasil daripada ujian ini akan membantu pemancing untuk mendapatkan maklumat yang lebih baik untuk mengetahui keupayaan pancing dan memilih joran yang terbaik.

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Last but not least, I want to express my heartfelt thanks to my loving mother, Chandra a/p Subramaniam, who has been a rock of strength in all my attempts. My heartfelt gratitude also goes to my father, Vejaya Kumar a/l Kunjiraman, for his unwavering support and understanding. I'd also want to thank my dear parents for their unending love, support, and prayers. Finally, I'd want to express my gratitude to everyone who helped, supported, and inspired me to begin my studies.

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D,d	-	Diameter
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CHAPTER 1

INTRODUCTION

1.1 Background

Fishing poles

A fishing pole is a thin, long pole. that fishermen use to help catching fish with a fishing line with a hook attact at the end of the line. A fishing poles, in its most basic form, is a straight, stiff stick with one end linked to a line. However, contemporary fishing poles are generally bendble, with the line saved in a roll placed in a machine attached at the rod handle, which is manually hand rotated to controls the line retreval, as well as many line- confining rings that aid damping by distributing bending stress along the rod and help line trouncing and trapping. Baits are attacted on to one or more hooks tighted to the line to attract fish, and a bite index is used, some of which may be included into the rod itself.

Fishing poles principally functions as a substitute switch and allows the trawler to boost line movements while soliciting and pulling the fish. It also increases casting distance by adding the terminal tackles' launch speed as a longer swing compass corresponds to lesser bow speed at the tip with the same angular velocity. The length of fishing poles generally between 0.5 and4.5 m depends on the fashion of inclination, while the Guinness World Record is 22.45m.

Fishing poles are fashioned from a variety of materials, including metal and wood. Each material has unique properties and characteristics that it imparts to the rod and, as a result, to your fishing, such as sensitivity and precise casting. Bamboo, fibreglass, graphite, carbon fibre, and composite are the most common materials used to make fishing rods.

Bending

In applied mechanics, bend is a thin structural element's behaviour when exposed to an external stress applied perpendicular to the element's longitudinal axis. It is assumed that the structural element has at least one dimension that is a tiny fraction of the other two, frequently 1/10 or less. When the length of an element is significantly greater than its width and thickness, it is referred to as a beam. A sagging closet rod caused by the weight of clothes on hooks is an example of a bending beam.

1.2 Problem Statement

Fishing rod have many types and it is made of many materials. There is always a question on which is the best and how to choose a fishing rods among anglers. To explain about this, I had perform an experiment for bending and that will analyze the material properties of different type of material of fishing rod. From studies, we can differentiate the stiffness and elasticity of type of material used to making fishing rod and which is the best material.

1.3 Research Objective

The primary goal of this study is to:

a) To study the difference between the material used in making the fishing rod

b) To conduct bending test of the fishing rod in order to investigate the material's mechanical characteristics

c) To analyze bending test of the fishing rod in order to investigate the material's mechanical characteristics

1.4 Scope of Research

Scope of research is to investigate the mechanical characteristics of fishing rod which is stiffness and elasticity. These fishing rod comes in many types and made by many materials. Some types of fishing rod share the same materials, so the type of material have to be considered first before studying about the type of fishing rods. The test that will be performed on the material is bending test to study the stiffness and elasticity. This research focusing for different type of material used such as fiberglass, bamboo, graphite, carbon fiber and composite.

1.5 Significant of study

The goal of this study is to compare the mechanical properties of material used to make fishing rods through bending test. The comparison of the stiffness and elasticity on the material will determine which material is the best in making fishing rods. The knowledge and information on mechanical properties can be useful for the angles to choose fishing rods through this research.

1.6 Thesis outline

Overall, the study will be done over the course of two semesters. In general, the study in summarized into five chapters. For the first semester, chapter 1 until chapter 3 are covered.

- The first chapter provides a description of the research study, including the materials used, as well as the procedures or approaches used to determine material attributes. The issue statement, objectives, scope, and general technique are also included in this chapter.
- The mechanical qualities, types of fishing rods, and materials used to create fishing rods are all discussed in Chapter 2. The study's findings provided a broad notion and information for conducting the experiment and demonstrating the best strategy to employ in the project.
- The project's flow is discussed in Chapter 3. It also described the steps that must be followed in order to complete the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A fishing pole is a thin,long rod used by fishermen to help catching fish with a fishing line with a hook attact at the end of the line. A fishing rod, in its most basic form, is a straight stiff stick/pole with a line tied to one end. Contamprory rods, on the other hand, are usually elastic, with the line is kept in a reel attached to the rod handle, which is hand-rotated and regulates line retrieval, as well as several line-restricting rings that disperse bending stress throughout the rod and assist prevent line whipping and tangling. Baits or lures are dressed onto one or more hooks attached to the line to better tempt fish, and a bite indicator is employed, some of which may be included into the rod itself.. The angler while tempting and hauling the fish, use the fishing rod as an extended lever to increase line motions. . It also increases casting by raising the launch speed of the final tackles, as well as a larger swing radius equates to a faster arc speed at the tip when the angular velocity is increased which is kept constant. Depending on the type of angling, fishing rods are normally between 0.5 and 4.5 m (2 and 15 feet) long.

Weight and action, power, stiffness, shape, number of parts, balance, length, and strength are all characteristics of fishing rods. The stiffness and durability of fishing rods made of various materials are the main subject of this research.

Stiffness

Stiffness is the degree to which an object resists deformation in response to an applied force. Flexibility, also known as pliability, is a related concept whereas the more flexible something is, the less stiff it is.

Elasticity

Elasticity refers to the ability of a distorted material body to return to its original shape and size after the forces that caused the deformation are removed. A body with elastic behaviour is one that has this ability.

2.2 Mechanical properties

Mechanical properties are physical properties that a material exhibits when forces are applied to it.There are many types of mechanical behaviour but as for the research the main concerned properties are

I. Elasticity

II. Ductility

III. Stiffness

2.2.1 Elasticity

Elasticity refers to the ability of a distorted material body to return to its original shape and size after the forces that caused the deformation are removed. A body with elastic behaviour is one that has this ability.

Most solid materials exhibit elastic behaviour to some degree, but the quantity of the force and the extent to which elastic recovery is possible for any given material as a result of the resulting deformation is limited. This limit, known as the elastic limit, is the maximum stress or force per unit area that a solid material can withstand before permanent deformation occurs. Stresses that exceed a material's elastic limit cause it to yield or flow. The elastic limit denotes the transition from elastic to plastic behaviour in such materials. In most brittle materials, stresses that exceed the elastic limit result in fracture with little or no plastic deformation.

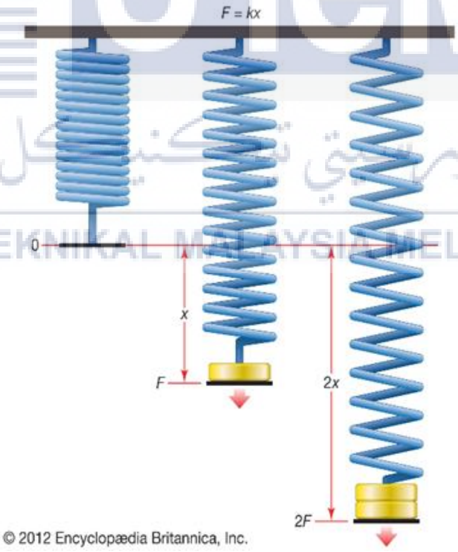


Figure 1 Elasticity

2.2.2 Ductility

Ductility is the physical characteristic of a substance that allows it to be hammered thin or stretched into wire without breaking. A ductile material may be drawn into a wire.

Most metals, including gold, silver, copper, erbium, terbium, and samarium, are examples of ductile materials. Tungsten and high-carbon steel are two examples of non-ductile metals. Nonmetals in general are not ductile.

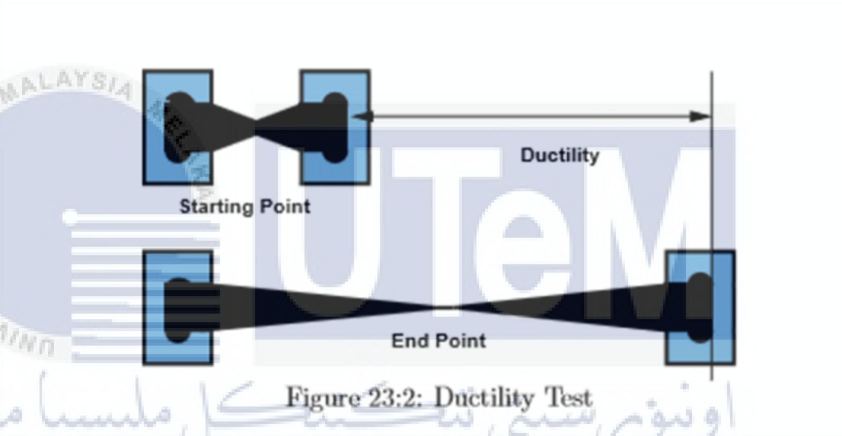


Figure 2 Ductility Test

2.2.3 Stiffness

The stiffness of an item is the degree to which it resists deformation in response to an applied force. Flexibility or pliability is a complimentary concept: the more flexible a thing is, the less stiff it is.

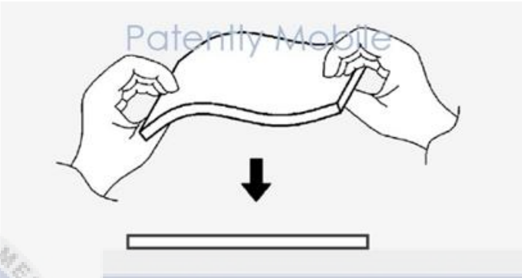


Figure 3 simple explain image

The stiffness, k, of a body is a measure of the resistance to deformation provided by an elastic body. For a single-degree-of-freedom elastic body.

$$k = \frac{F}{\delta}$$

where,

F is the force on the body

Delta is the displacement produced by the force along the same degree of freedom (for instance, the change in length of a stretched spring)

In the International System of Units, stiffness is typically measured in newtons per meter (N/m)

Rotational stiffness

A body may also have a rotational stiffness, kα

$$k = \frac{M}{\theta}$$

Where,

- M is the applied moment
- Ө is the rotation
- In the SI system, rotational stiffness is typically measured in newton-metres per radian.
- Further measures of stiffness are derived on a similar basis, including:
    - shear stiffness - the ratio of applied shear force to shear deformation
    - torsional stiffness - the ratio of applied torsion moment to the angle of twist

2.3 Different Between Stiffness And Elasticity

The stiffness, K of an object is the degree to which it resists deformation in response to an applied force. Elastic Modulus, E is a quantity that measures an object's or substance's resistance to being elastically deformed when stressed. The slope of the tangent line to the stress-strain (elastic) curve is defined as the elastic modulus. It is a material-specific quantity that indicates the stiffness of a material by measuring its resistance to being deformed elastically when stressed. Spring constant, or member stiffness factor, on the other hand, is a constant defined by the geometric terms of a single member/element - A, "L", "I", the material property "E", and the loads "P" and "M". It calculates the force needed to create a unit displacement/rotation and provides its relative strength to other components. It also demonstrates the capability of a structural joint to share the force applied to the joint through proportionality.

Another way to distinguish Elasticity and Stiffness is that they work on different scales and orders of magnitude, whereas E defines the link between stress and strain (essentially, how individual atoms move under load), whereas K represents the relationship between force and deflection (how a beam or structure behaves under load).

When a force is applied to an elastic object or body, its stiffness is measured. It is a broad property because it depends on how much matter is required to cause an object to contort. A rubber ball, for example, is stiffer than dough because it requires more mass to deform. The stiffness of a rubber ball is measured by force independent of the object. Elasticity differs from stiffness in that it measures an object's ability to resist deformation. A rubber ball is also more elastic than dough because it is more likely to return to its original shape after being pressed. Elasticity is an intensive property because it is independent of force and depends on what makes up the object. Rubber, for example, is more elastic than steel. It makes no difference whether or not force has yet impacted the material. The materials used are important.

Stiffness K is a structural property that includes geometric and material effects. Young' s Modulus E, on the other hand, is a material property. Another things is, Stiffness measures quantitatively, and elastic measures qualitatively.

2.4 Three Point Bending Test

The three-point bending flexural test determines the modulus of elasticity in bending, flexural stress, flexural strain, and flexural stress-strain response of the material. This test is performed using a universal testing machine (tensile tester or tensile testing machine) equipped with a three- or four-point bend fixture. The simplicity with which the specimen may be prepared and examined is the major advantage of a three-point flexural test. However, this method has some drawbacks: the testing method's results are sensitive to specimen and loading geometry, as well as strain rate. The test method usually entails using a specific test fixture on a universal testing machine. Test preparation, conditioning, and performance all have an impact on the results. The sample is supported by two pins that are spaced apart.

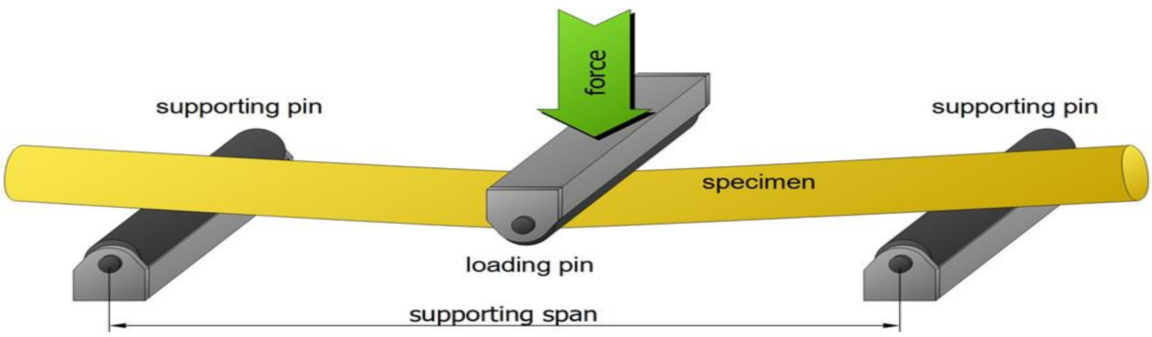


Figure 4 Three Point Bending Test

2.5 Fishing Rod

A fishing poles is a thin, long rod that fisherman use to assist them in capturing by manipulate a line that terminates in a hook to catch fish. A fishing rod is a straight, stiff stick/pole with a line connected to one end in the form of a hook with lines are the most basic form. However, contemporary poles contemporary fishing poles are generally bendble, with the line saved in a roll placed in a machine attached at the rod handle, which is manually hand rotated to controls the line retreval, as well as many line- confining rings that aid damping by distributing bending stress along the rod and help line trouncing and trapping. Baits are attacted on to one or more hooks tighted to the line to attract fish, and a bite index is used, some of which may be included into the rod itself.

The angler can use the fishing rod as a long lever to increase line motions while tempting and hauling the fish. Moreover, it also improves casting distance by increasing the terminal tackles' launch speed, as a longer swing radius correlates to a faster arc speed at the tip at the same angular velocity. Depending on the type of angling, fishing rods are normally between 0.5 and 4.5 m (2 and 15 feet) long. Typical fishing poles are composed of a single piece of hardwood or bamboo, whereas modern rods are usually made of alloys or, more commonly, high-tensile synthetic composites, and may be multi-piece or telescoping in design to make them more portable and storage-friendly. The majority of fishing rods taper towards the tip to lessen the gravitational leverage an angler must resist when lifting the rod. Many current rods are made from hollow blanks to boost the design's specific strength while reducing total weight.

Fishing rods come in a variety of sizes, actions, hardness, and combinations, depending on whether they'll be used for small, medium, or large fish, or in freshwater or saltwater. Weight and action, power, stiffness, shape, number of parts, balance, length, and strength are all characteristics of fishing rods. The stiffness and durability of fishing rods made of various materials are the main subject of this research. Various sorts of fishing rods are developed for certain subtypes of angling, such as spin fishing rods, which are lighter and have a faster action and are optimised for frequent, repetitive casting. Fly rods are made to sling heavy lines and ultralight artificial flies more effectively. Ice fishing rods are usually very short and made to fish through little drilled holes in ice covered lakes, whereas trolling rods are used to move heavy bait or lures through water when boat fishing, and normally have larger ultimate tensile strength due to the big proportions of the target fish.

2.5.1 Type of fishing rod

A wide variety of materials can be used to make fishing rods. Fiberglass, graphite, or a next generation composite, often known as carbon fiber, are the most common materials used. Carbon fiber and graphite are frequently combined in the rod-making process.

Fly rods

Fly rods are thin, flexible fishing poles with hook strung with fur, feathers, foam, or another light substance and meant to cast an artificial fly. Synthetic materials are also used to tie modern flies. The majority of modern fly rods are built of man-made composite materials like fiberglass, carbon/graphite, or graphite/boron composites, and were constructed of yew, green heart, and subsequently split bamboo. Split bamboo rods are often regarded the most elegant, the most "traditional," and the most fragile of the designs, requiring a great lot of care to endure a long time. A fly rod casts using the weight of the fly line rather than a weighted lure, thus lightweight rods may cast the tiniest and lightest of flies. On one end, a monofilament piece known as a "leader" is tied to the fly line, and on the other end, the fly.

Tenkara rods

Tenkara rods are fly rods that are used for tenkara fishing in Japan. Carbon rods, fly rods, and telescopic rods are all combined into one rod. These telescopic rods are extremely light and portable. Their expanded length is usually between 11 and 13 feet (3.5 to 4 meters), and their motion is exceedingly gentle. Tenkara rod motion has been standardized as a ratio of how many stiffer portions to how many bends more easily tip parts. 5:5, 6:4, 7:3, and 8:2 are the usual actions, with 5:5 being a softer/slower rod and 8:2 being a stiffer rod. Western fly-rods are similar. Tenkara rods can also feature cork or even wooden handles, with wooden handles being more coveted because to their heightened sensitivity to fish attacks and the heavier feel that aids with rod balance. Tenkara rods are not equipped with guides. Tenkara is a type of fixed-line fishing technique in which the line is attached directly to the tip of the rod rather than using a reel.

Spin casting rods

Spin casting rods are rods that are used to hold a spinning reel and are usually located above the handle. Small eyes and a forefinger grip trigger are common features of spin casting rods. They are so similar to bait casting rods that they can be used with either type of reel. While rods were once designated as "spin casting" or "bait casting" rods, this is no longer the case, as the rod design is suitable for any fishing style, and they are now simply referred to as "casting rods," with no differentiation made as to which style they are better suited for actual usage.

Baitcasting rods

While beginning fishermen frequently utilise easy-to-use spin casting rods, baitcasting rods and reels are generally more difficult to handle. Professional fishermen, on the other hand, prefer baitcasting rod and reel combinations because baitcasting reels allow for more precise casting. Casting rods are generally seen to be more powerful than spinning rods because they can use heavier line and handle more cover. Baitcasting rods include a low-profile design and a super-quiet 7.0:1line retrieve.

Spinning rods

Spinning rods are usually between 5 and 8.5 feet (1.5 and 2.5 meters) in length and are made of graphite or fiberglass with a cork or PVC foam handle. To help control the line, spinning rods often feature 5–8 guides positioned down the underside of the rod. From the handle to the tip, the eyes get smaller, with the one closest to the handle usually being considerably larger than the others to reduce friction when the coiled line comes off the reel and to gather the very huge loops of line that come off the spool of a spinning reel. The spinning reel, unlike baitcasting and spin casting reels, hangs behind the rod rather than on top, and is held in place by a sliding or locking reel seat. The weight of the reel hangs beneath the rod, and the fisherman's second and third fingers straddle the "leg" of the reel where it is joined to the reel seat on the rod, making for a more comfortable manner to fish for extended durations.

Ultra-light rods

These rods are intended to catch smaller fish, give greater excitement when fishing with larger fish, or allow fishing with lighter line and smaller lures. Though the term is most often associated with spinning or spin-casting rods and tackle, fly rods with smaller line weights (size #0–#3) have long been used for ultra-light fishing, as well as to protect the thin-diameter, lightweight end section of the leader, or tippet, used in this type of angling.

Ultra-light spinning and casting rods are often shorter (four to eight feet or 1.2 to 2.4 meters), lighter, and more limber than standard rods. Depending on the intended usage, tip actions range from slow to quick. Fishing line of 1 to 6 pounds-force (0.5 to 2.5 kg (4.5 to 26.5 N) is generally carried on these rods. Small spinners, wet flies, crappie jigs, tubes, or bait like trout worms can all be cast with ultra-light rods weighing as little as 164 of an ounce (0.44 g).

Ice rods

Modern ice rods are usually relatively small spinning rods, ranging in length from 24 to 36 inches (61 to 91 cm). Traditional ice rods are basically stiff rod-like pieces of wood with a carved wooden handle, a couple of line guides, and two opposing hooks mounted ahead of the handle to wind the line around by hand. Ice rods are used to fish through gaps in frozen lakes and ponds' blanket ice.

Sea rods

Sea rods are made for catching fish in the ocean. They are long (on average around 13 feet or 4 meters), incredibly thick, and have massive and hefty tips, eyes, and handles. Sport fishing vessels require the largest of sea rods. Some of these are specialist rods for use with very heavy equipment, such as shark and marlin rods.

Surf rods

Surf casting is the most popular use for sea rods. Surf casting rods are two-handed casting rods that look like giant spinning or bait casting rods with long grip handles. Surf casting rods are usually between 10 and 14 feet (3 and 4 meters) long to allow the operator to cast the lure or bait beyond the breaking surf, where fish tend to cluster, and durable enough to cast heavy-weighted lures or bait needed to hold the bottom in rough water. They're virtually always employed for shore fishing (sea fishing from the beach, rocks, or other shore features).

Trolling rods

Trolling is a fishing technique that involves casting a lure or bait to the side or behind a moving boat and having the boat's motion propel the bait through the water. Trolling can theoretically be done with any casting or spinning rod (with the exception of ultralight rods) for light and medium freshwater game fishing. Most manufacturers have produced a whole line of generally long, robustly constructed rods marketed as "Trolling Rods" and aimed mostly at ocean anglers and Great Lakes salmon and steelhead fishermen in the last 30 years. A trolling rod should have a rapid action (quite stiff) because a highly "whippy" slow action rod is exceedingly irritating to troll with, and a fast action (fairly stiff) rod is often much simpler to work with when fishing this way.

<u>Telescopic rods</u>

Telescopic fishing rods are made to collapse to a small size and then expand to a long length. Rods as long as 20 or 30 feet (6 or 9 meters) can close to as little as one and a half feet (45 cm). This makes it simple to transfer the rods to remote locations or on buses, compact vehicles, public buses, and subways. Telescopic fishing rods are constructed from the same materials as multi-piece fishing rods. Graphite, carbon, and occasionally fiberglass, or combinations of these materials, are designed to open and close by slipping into each other. The eyes on spinning rods are usually, but not always, a unique design that helps to strengthen the end of each piece. Telescopic fishing rods come with a variety of grade eyes similar to those seen on conventional rods. This type also includes the eyeless Tenkara rods, which are commonly constructed of carbon and/or graphite.

2.5.2 Material used to make rods

Bamboo

Bamboo was the first material utilized by rod producers in 1910, and it is being used until today. Bamboo is perhaps the greatest natural fishing rod material for rod manufacture. Bamboo is a flexible material, which is why it was chosen in the first place, and it forms a robust, bendy, but hefty rod.

Fiberglass

Fiberglass is the closest material to bamboo for fishing rods and was first utilized by rod manufacturers in the 1940s. It is still utilized in many various sorts of rods today. As a material, fiberglass is just as bendy as bamboo, if not more so, and it's far lighter, more durable, and less expensive. When you pull a weight at the end of the line, the fiberglass rod flexes in a parabolic arc, bending the entire rod from tip to butt. However, it is heavier and less responsive than the other fishing rod materials on the list. Fiberglass rods bend from the butt portion and have a slower motion.

Graphite

It because the material is lighter and stronger than bamboo and fiberglass, they may be robust while utilizing less material. This produced thinner, longer graphite rods that were lighter and weighted far less than the earlier bamboo and fiberglass rods. Because of their stronger construction, they have far more sensitivity in the rod tip. This, along with their lightweight durability, results in some of the greatest steelhead fly rods.

Graphite fishing rod blanks are made using graphite sheets. These graphite sheets are created with layers of graphite fibers, glass fibers (for flexibility), other specialized materials, etc. These materials come in different strength and rigidity. All of these are held together with a resin; creating the graphite sheet which is called pre-preg. The graphite sheet or pre-reg is then cut into shape. The shape cut creates a wider section of what will be the rod butt, and tapers down all the way to a narrower section of which is the tip. Certain sections or areas of the sheet are strengthened with additional materials. All of these are done before the graphite sheet or pre-reg is rolled into a tube. A thicker wall does not mean that the rod blank will be stiffer. Stiffness depends on the materials used to build the graphite sheet or pre-reg used. For example, a graphite sheet built using more carbon or graphite fibers and lesser glass fibers will result in a stiffer sheet. It will certainly push the cost up but the benefits are a lighter, thinner, stiffer, and more sensitive rod blank. A softer or lower action rod will require lesser layers of the said sheet.

Carbon Fiber

A carbon fiber rod is not always superior to a glass fiber rod. The qualities of the two fibers differ, and each has its own set of tradeoffs. When compared to glass fiber, carbon fiber is less flexible (stiffer), brittle, and easily fractured. when overused, yet it enables for longer and quicker rods. Carbon fiber also provides for a smaller diameter, more sensitive rod than glass fiber. Carbon fiber rods are also significantly lighter than glass fiber rods, allowing you to fish for longer periods of time. Each has a role in the fishing industry, and when the blanks are used correctly, they both increase an angler's chances of success. When it comes to fishing rods, carbon fiber and graphite are technically the same material and have the same properties. As a result, when someone refers to a graphite or carbon fiber rod, they are referring to the same item. Instead of going over all of the advantages and disadvantages of a carbon fiber rod, which are the same as those of graphite, I'll just go over the pros and negatives of graphite.

Composite

Composite fishing rods are built of a composite material that combines graphite and fiberglass. As a result, fiberglass Graphite composite rods have both graphite and fiberglass properties, but not to the extremes; composite rods sit in the medium. Composite rods move quicker than fiberglass but are slower than graphite. They are not, however, sluggish action, and the rods are often medium action.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The processes or strategies used to find, select, process, and analyse information on a topic are referred to as research methodology. The methodology portion of a research paper helps the reader to objectively examine the overall validity and reliability of the study. The methodology section answers two major questions whereas how the data was obtained or created, and how it was examined. This chapter discuss on the method used on how to study the problem. This section begin with what material use in the project. The research flow that consist flow chart are also included in this chapter

3.2 Material Specification and preparation

The materials that used in this research are based on the research and finding. To start with material selection, two catagory of fishing rod are separated which is hollow and solid. Another two category are separated each from hollow and solid which is raw and composite material. In this research a total of 8 type of material are used. The main material are graphite, carbon fiber, fiberglass because this are the material that had been used currently by most of the manufacturer. Fiberglass was separated with 2 type of material which is hollow and solid. Moreover, other materials are choosed based on classic and modern era. Rotan are classical material that had been used long time ago while HDPE polyethylene and aluminium are modern material that has been choosed to test their potential in developing new fishing rods.

3.3 Type of material used

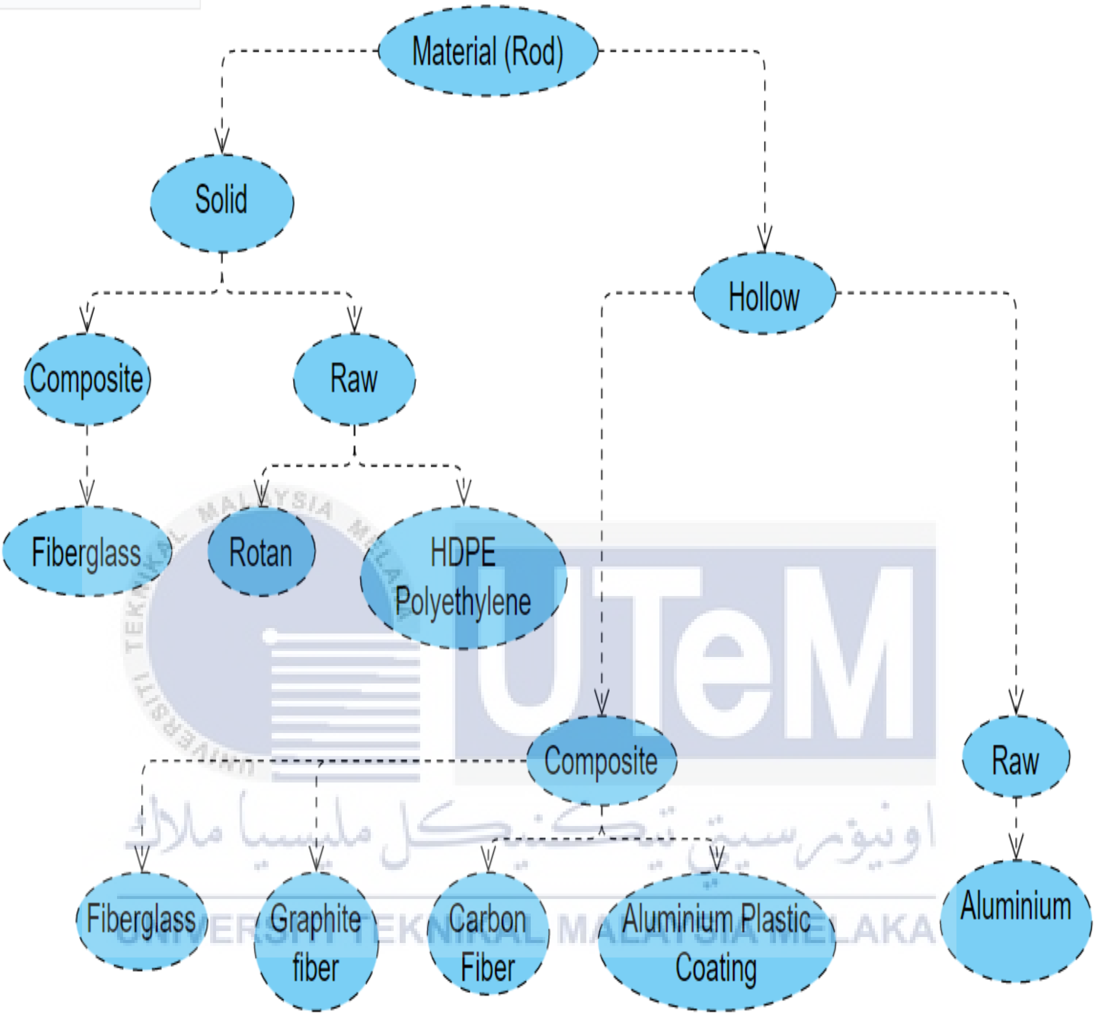


Figure 5 Material chart

3.4 Proposed Methodology

The proposed method that is choosed for this research are bending test to experiment the stiffness and elasticity of the selected 3 material. Bending testing is bending a material rather than pushing or dragging it in order to evaluate the connection between bending stress and deflection. Bending tests are frequently performed on brittle materials such as ceramics, stone, masonry, and glassware. It may also be used to investigate the behaviour of materials designed to bend during their useful life, such as wire insulation and other elastomeric goods. For this research, the three point bending test will be used. The bending test yields results for the modulus of elasticity in bending, flexural stress, flexural strain, and the material's flexural stress-strain response. The major benefit of a three point flexural test is the simplicity of specimen preparation and testing.

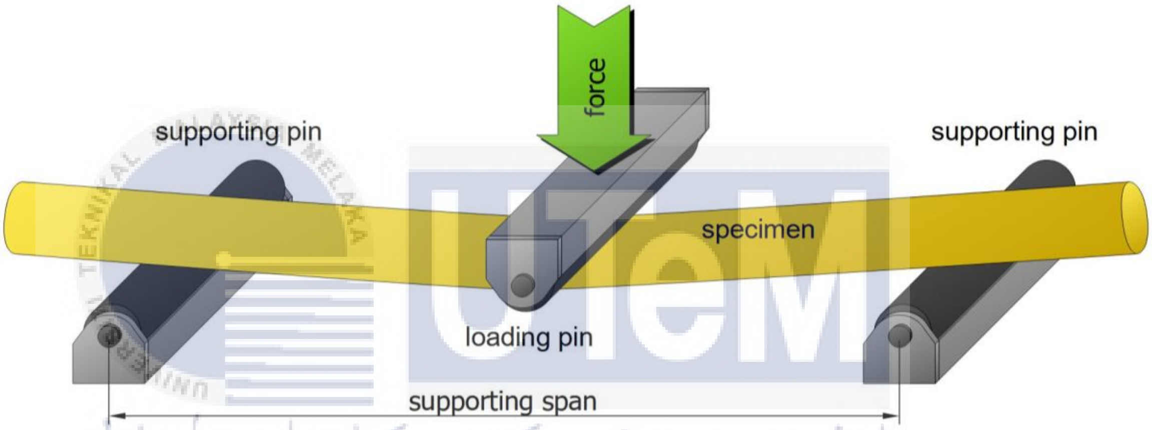
3.4.1 Experimental Setup

<u>Bending test</u>

For the bending test, 3 point bending test will be used to conduct the experiment. This method is specifically used for brittle materials such as concrete, wood, and composite material

3.4.1.1 Parameters

Specimen parameter for bending test



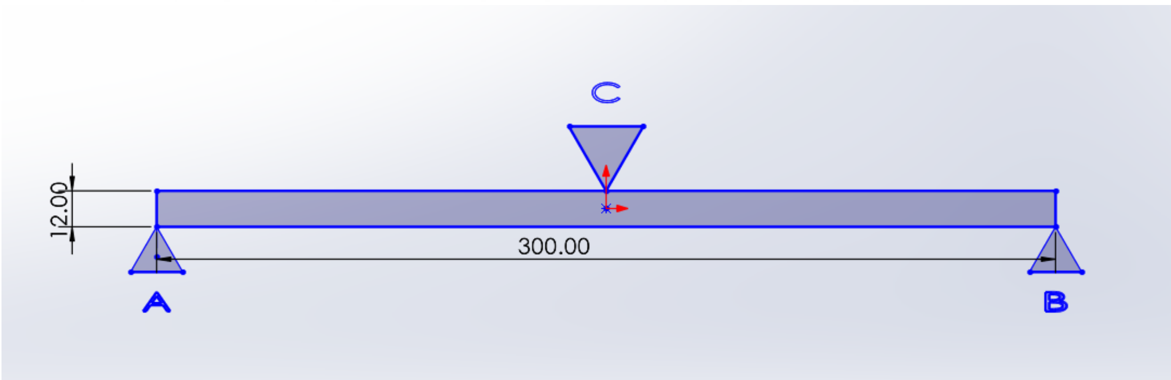
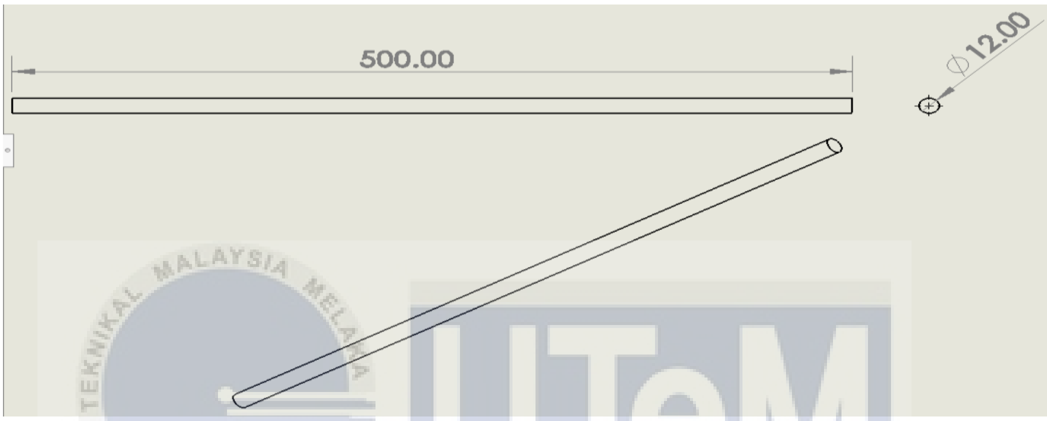


Figure 6 Material Diameters

3.4.1.2 Procedures

Material preparations

- Various type of material was prepared for the experiment. Most of the material are commonly used for making fishing rods
- Prepare the specimen as ASTM D7264 standard. The material was cut into cylinder rod with 500mm length and 12mm diameter.



- The weight of the prepared material was measured and recorded(Different material have different weight)

Bending test

- Roller support were assemble on to the bending machine for 3 point bending test
- The distance between the roller was set to 300mm for the test
- The specimen was placed horizontaly across the two rollers
- The loading pin was dragged down until it touchs at the middle of the specimens
- Start button was pressed to start the loading pin from pressing down the specimen
- Force is applied in the middle of the specimen that is supported between the two support until the the specimen is fractures and the result is recorded.
- The ste was followed for other types of material until all the materials are tested
- Carbon Fiber Reinforced Polymer

3.5 Flow Chart

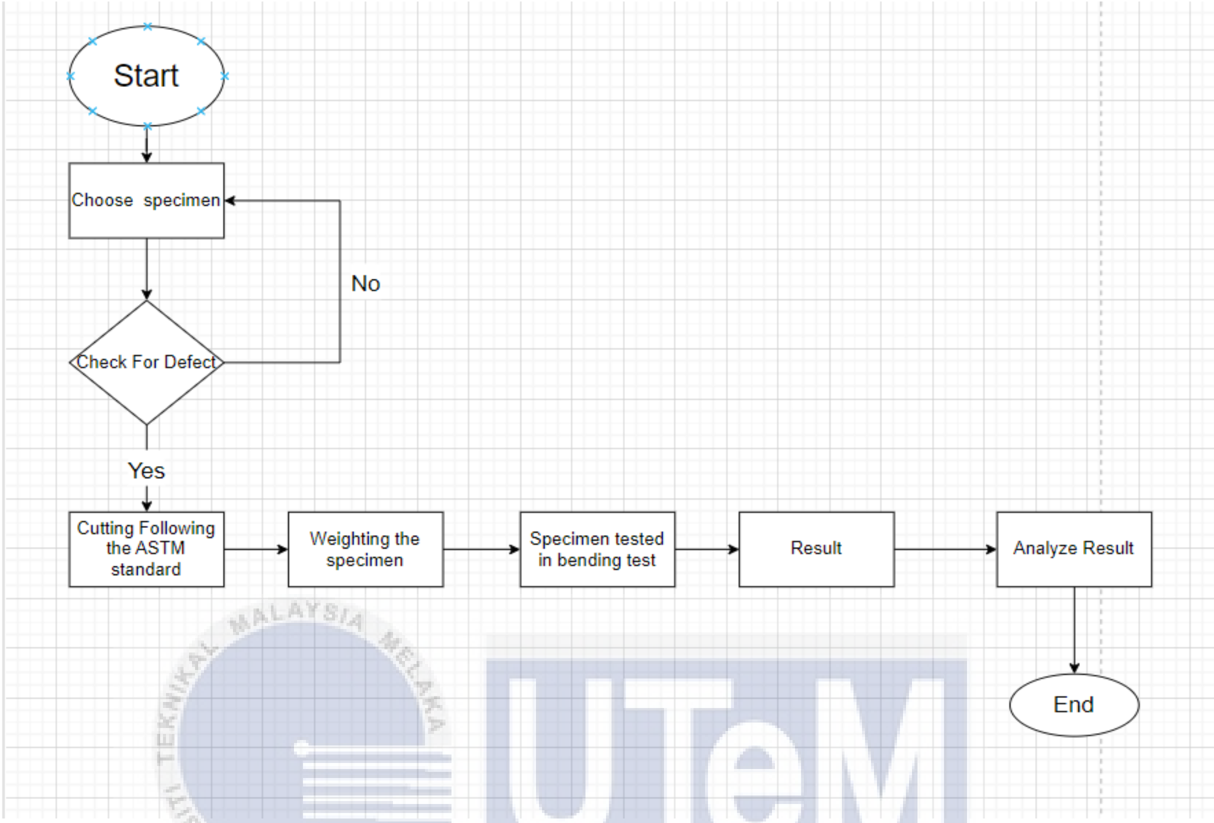


Figure 7 flow chart

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Expected Result

As stated from product review and description about fishing rod, fishing rod made from grapihite are the most best. It because of it material properties which is strong, light weighted, high stiffness, and high elasticity. As from this research, the expected result should be that the material grapihte will have high stiffness and elasticity.Comparing to the other material, the graphite should have high Modulus of elasticity.

4.2 Introduction

This chapter lists all the project findings and discusses them in detail. This section analyzes and describes all the techniques and results produced in each phase. In addition, the architecture and equipment used are addressed and defined. This chapter is intended to clarify and evaluate the project outcomes following the implementation process. In addition, this section defines the functionality of the project

4.3 Analyze the Different Between The Weight Of The Materials

As from the studies, although the specimen are all in the sama parameters they have have different weight because of different type of material were used.

Material	Length	Diameter	Weight
	Solid Rod		
Fiberglass	500mm	12mm	109.70g
Rotan	500mm	12mm	22.855g
HDPE Polyethylene rod	500mm	12mm	87.248g
	Hollow rod		
Carbonfiber	500mm	12mm	39.640g
Graphite fiber	500mm	12mm	26.240g
Fiberglass	500mm	12mm	19.605g
Aluminium	500mm	12mm	34.354g
Aluminium Plastic coating	500mm	12mm	38.167g

Table 1 Weight of Material

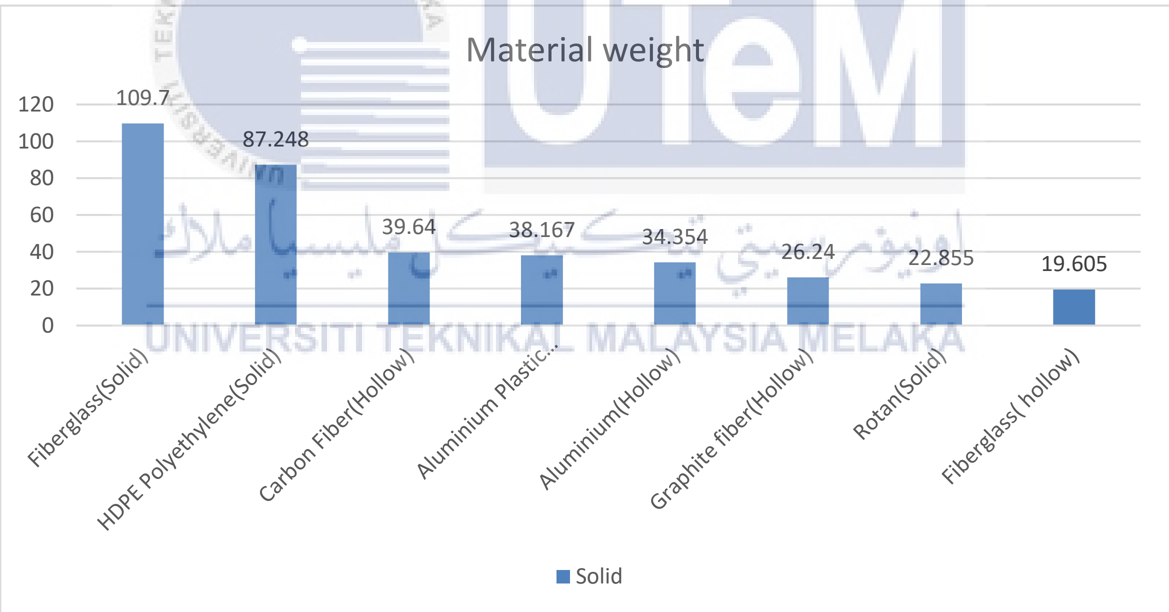


Figure 8 Graph of Material Weight

4.4 Analyze the Different Between The Stiffness and Electicity of different material

Material	Force, kN	Displacement, mm	Stiffness, kN/mm	Elasticity, Mpa
Graphite fiber	0.328573	4.553854	0.072153	40101.3
Carbon fiber	0.659593	6.470521	0.101938	59023.5
Fiberglass	2.167114	26.41719	0.082034	45969.2
Rotan	0.15807	97.02221	0.001629	1432.01
HDPE Polyethylene rod	0.41204	95.30765	0.004323	1946.10
Aluminium	0.26479	8.738854	0.030300	30071.9
Aluminium plastic coating	0.15869	7.92225	0.020030	15985.0
Fiberglass (hollow)	0.14512	9.156417	0.015849	9504.43

Table 2 Stiffness and Elasticity value

The table shows the result of stiffness and elasticity after the bending test has done. From the result, Carbon fiber shows the highest stiffness and elasticity value.

4.5 Graph of Bending test of materials

Graphite Bending Test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.3 kN
Unit	kN	N/mm2	MPa
sample 1	0.32857	145.261	40101.3

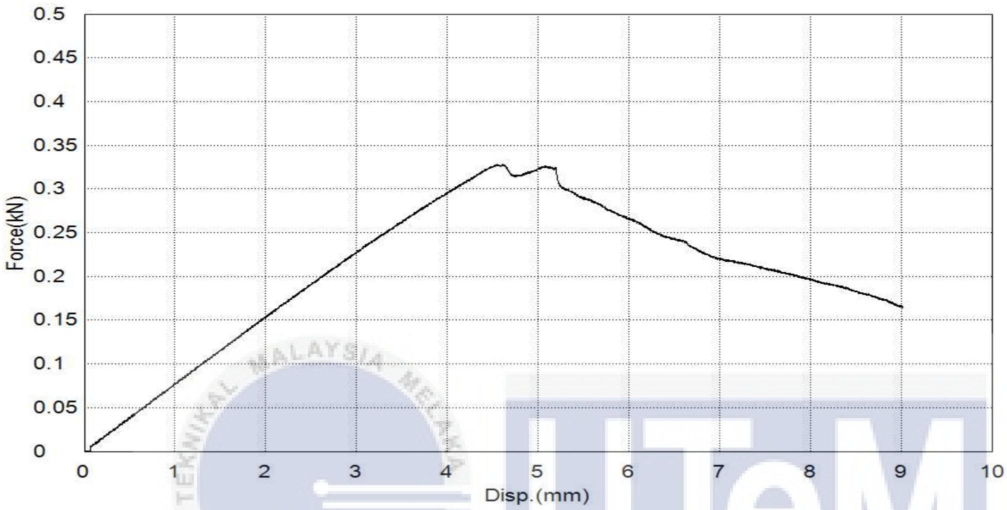


Table 3 Result of Graphite test

Figure 9 Fracture Graphite Material

This is the result of graphite fiber under bending test. It needed 0.32857 kN of maximum force to reach the maximum stiffness and elasticity. Throughout this process the material had fracture and from the diagram the we can see the fracture start at the point where the loading pin is touching the material and the crack are not surrounding the whole rod

Carbon Fiber Bending Test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.3 kN
Unit	kN	N/mm2	MPa
sample 1	0.65959	291.604	59023.5

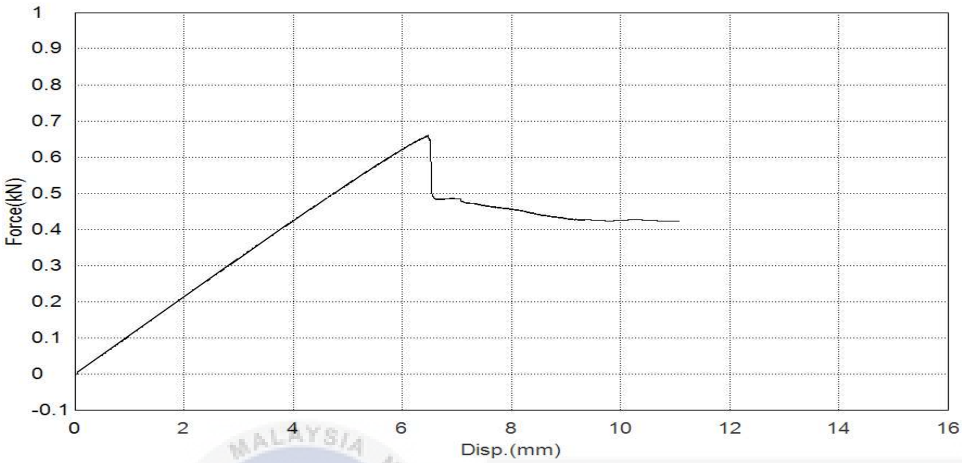


Table 4 Result of Carbon Fiber

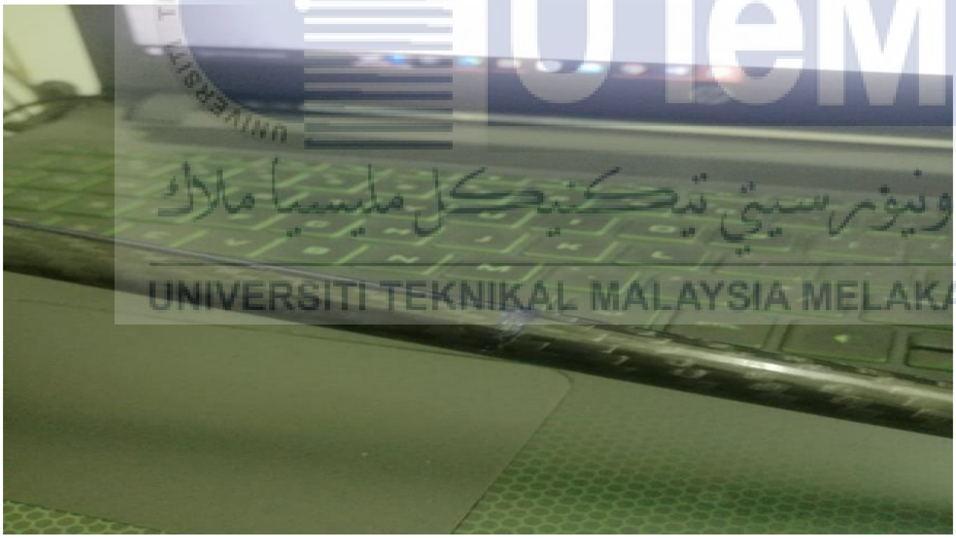


Figure 10 Fracture Carbon Fiber Material

This is the result of carbon fiber under bending test. It needed 0.65959 kN of maximum force to reach the maximum stiffness and elasticity. Throughout this process the material had fracture and from the diagram the we can see the fracture start at the point where the loading pin is touching the material same as the fracture occur on graphite fiber

Fiberglass Bending Test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.3 kN
Unit	kN	N/mm2	MPa
sample 1	2.16711	958.075	45969.2

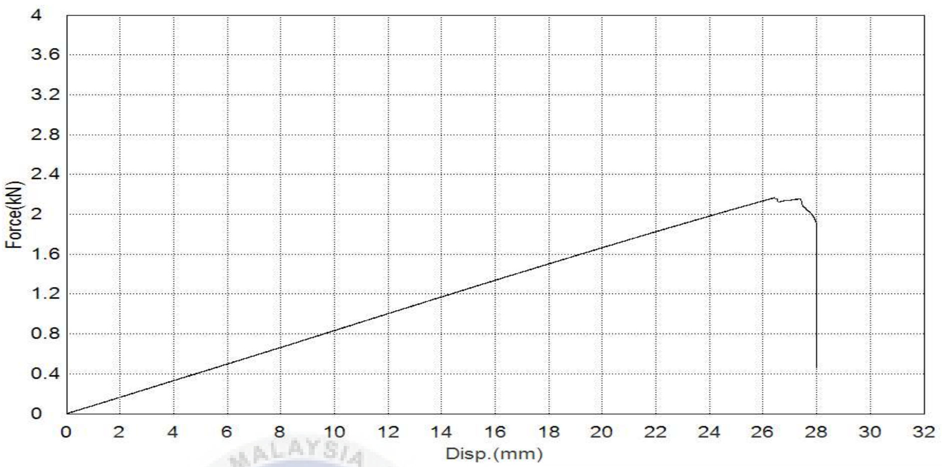


Table 5 Result of Fiberglass

Figure 11 Fracture Fiberglass

This is the result of fiberglass under bending test. It needed 2.16711 kN of maximum force to reach the maximum stiffness and elasticity and it is the highest force recorded. Throughout this process the material had fracture and from the diagram the we can see the fracture start at the point where the loading pin is touching the material but the crack occur all around the rod and from the naked eyes it looks like a cracked glass.

Fiberglass (Hollow) Bending test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.3 kN
Unit	kN	N/mm2	MPa
sample 1	0.14512	64.1560	9504.43

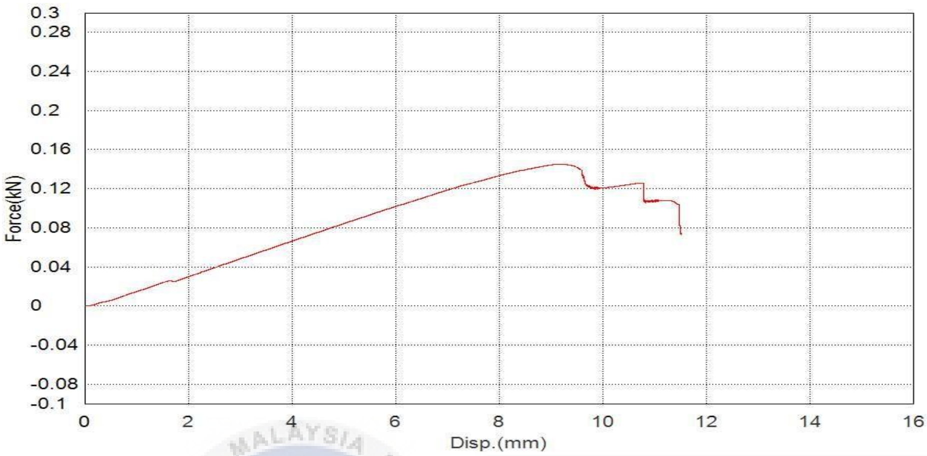


Table 6 Result of Hollow Fiberglass

Figure 12 Fracture Hollow Fiberglass

This is the result of hollow fiberglass under bending test. It needed 0.14512kN of maximum force to reach the maximum stiffness and elasticity. Throughout this process the material had fracture and from the diagram that we can see the fracture start at the point where the loading pin is touching the material but the crack occur all around the rod and from the naked eyes it can be seen clearly.

Aluminium rod Bending test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.3 kN
Unit	kN	N/mm2	MPa
sample 1	0.26479	117.062	30071.9

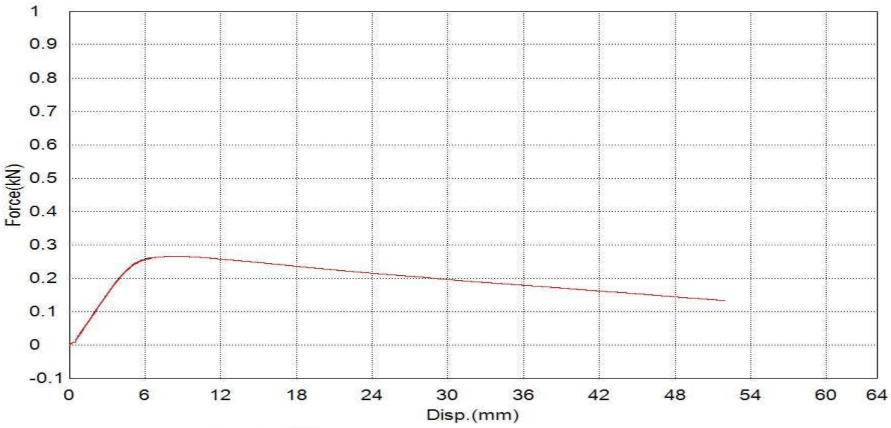


Table 7 Result of Aluminium

Figure 13 Deformed Aluminium

This is the result of aluminium under bending test. It needed 0.26479kN of maximum force to reach the maximum stiffness and elasticity. Throughout this process the material had fracture and from the diagram that we can see the rod did not crack but dent at the point where the loading pin is touching the material. Usually this kind of fracture can be seen on metal rod that is hollow when it under go deformation due to bending force.

Aluminium Plastic Coating BendingTest

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.14 kN
Unit	kN	N/mm2	MPa
sample 1	0.15869	70.1570	15985.0

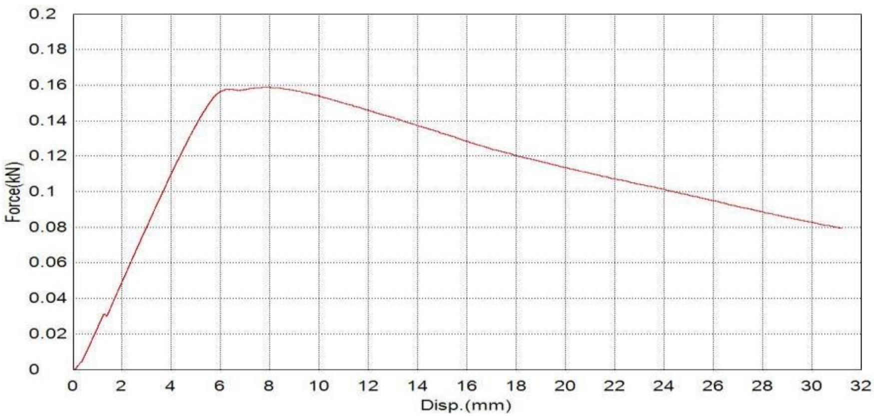


Table 8 Result of Aluminium Plastic Coating

Figure 14 Deformed Aluminium Plastic Coating

This is the result of aluminium plastic coating under bending test. It needed 0.15869kN of maximum force to reach the maximum stiffness and elasticity which is lower then the aluminium. Throughout this process the material had fracture and from the diagram that we can see the rod did not crack but dent at the point where the loading pin is touching the material same as the aluminium material. Usually this kind of fracture can be seen on metal rod that is hollow when it undergo deformation due to bending force.

Rotan Bending test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.5 kN
Unit	kN	N/mm2	MPa
sample 1	0.15807	69.8830	1432.01

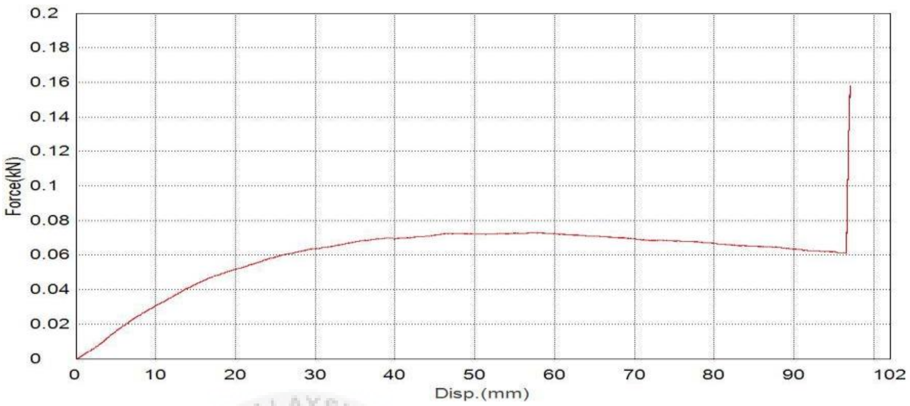


Table 9 Result of Rotan

Figure 15 Deformed Rotan

This is the result of rotan under bending test. It needed 0.15807kN of maximum force to reach the maximum stiffness and elasticity. The result is inaccurate because when the material was tested, the material did not fracture and the machine had reach the limit of it bending. Throughout this process the material had not fracture and from the diagram that we can see the rod has slightly dent at the point where the loading pin is touching the material. The rotan also under go slightly deformation after the testing.

HDPE Polyethylene rod Bending Test

Name	Maximum Force	Maximum Stress	Elasticity
Parameters	Calculate on Entire areas	Calculate on Entire areas	Force 0.1 - 0.2 kN
Unit	kN	N/mm2	MPa
sample 1	0.41204	182.160	1946.10

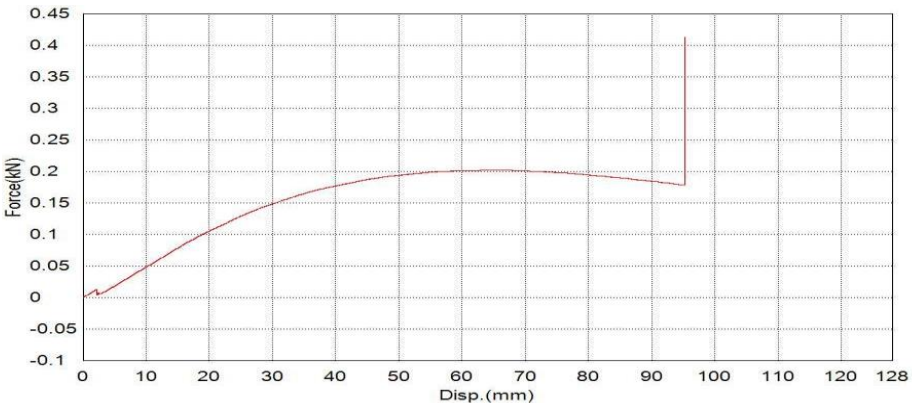


Table 10 Result of HDPE

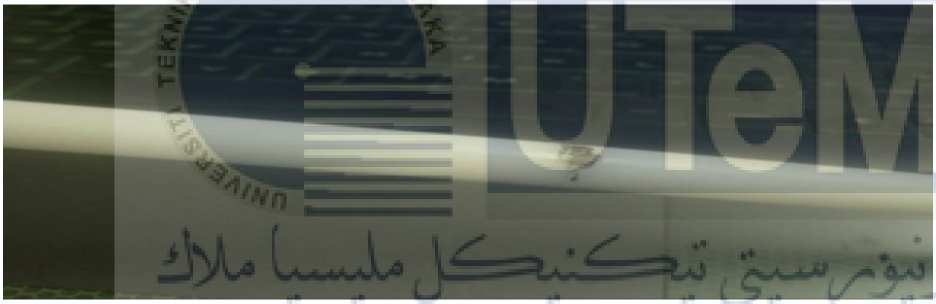


Figure 16 HDPE after Bending Test

This is the result of HDPE Polyethylene under bending test. It needed 0.41204kN of maximum force to reach the maximum stiffness and elasticity. The result is inaccurate because when the material was tested, the material did not fracture and the machine had reached the limit of it bending same as the rotan. Throughout this process the material had not fracture and from the diagram that we can see the rod has no significant change on the shape and size of the material. The HDPE Polyethylene also under go slightly deformation after the testing but the deformation is not significant as the rotan.

4.6 Graph of Stiffness and Elasticity of Material Tested

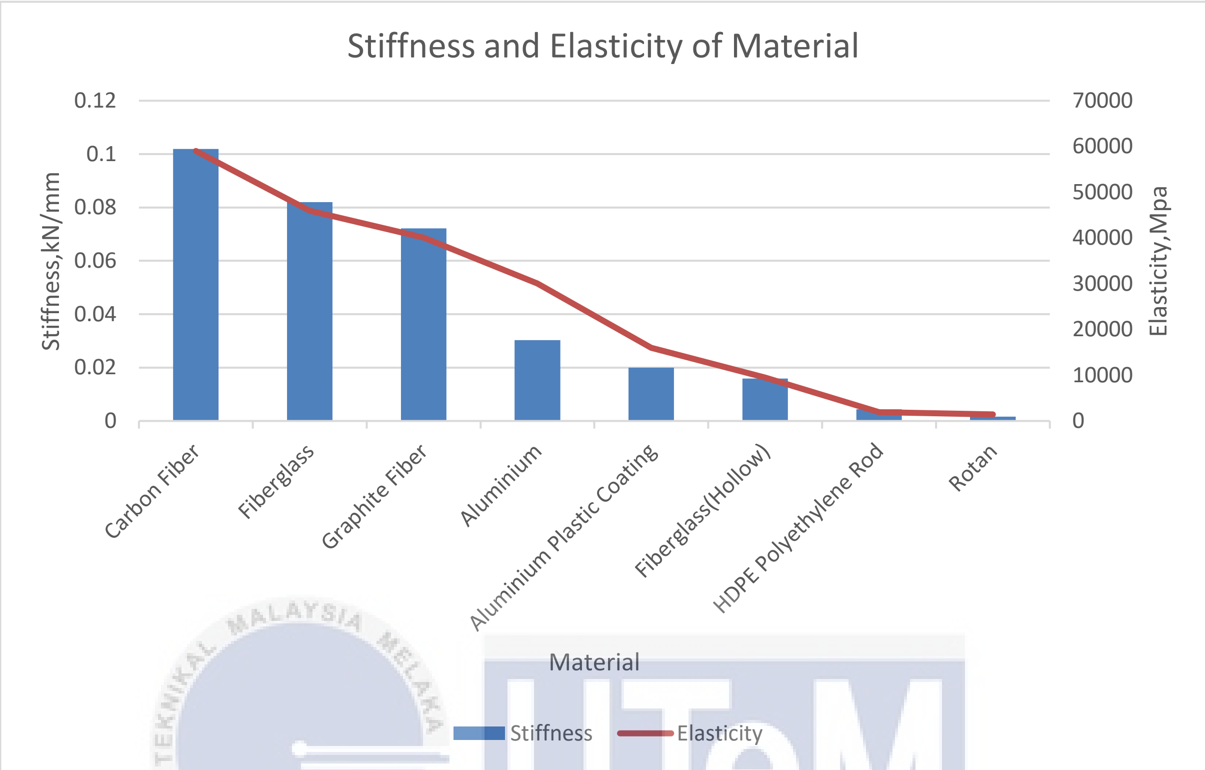


Figure 17 Graph of Stiffness and Elasticity of Material

As from the result obtain from the bending test, Graph of stiffness and elasticity are plotted. From the graph, we can see clearly that the material with high stiffness and elasticity are the carbon fiber with the stiffness value of 0.101938kN/mm and elasticity of 59023.5 Mpa. Although the Rotan was very flexible and did not fracture from the test, it still has the lowest stiffness(0.001629kN/mm) and elasticity(1432.01Mpa) compared to the other materials. Comparing with carbon fibre and fiberglass, although the fiberglass needed the highest amount of force to be bend, still the stiffness and elasticity of the rod is below the level of carbon fibre with the value of 0.082034kN/mm and 45969Mpa for stiffness and elasticity. As from the expected result, the result of this material test should be expected that the graphite rod has the highest stiffness and elasticity, but after the experiment we can analyse that the carbon fibre is much better than graphite fibre.

4.7 Analysis and Discussion of Result

Why is Carbon Fiber is stronger than Graphite fiber

The confusion of which material is the best between carbon fiber and graphite is complicated by the fact that a number of rod manufacturers employ materials manufactured by businesses other than Hexcel while labelling their rods as IM6, IM7, and IM8, which implies nothing in and of itself. It because IM6, IM7 and IM8 that labelled in graphite fishing rod product are Hexcel Corp's trade numbers are used to identify their products and are not industry quality or material standards. What an angler needs to know is how the term "modulus" applies to graphite rods. Many people assume that modulus is a thread count. Modulus is synonymous with rigidity. The greater the modulus, the stiffer the material by weight, implying that less material is required to obtain the stiffness of lower-modulus materials. As a result, the product is lighter.

The term that graphite fishing rod that has been used are very loosely but nearly all the rods and blanks that are called graphite are actually the technically terms of carbon fiber. It because when making using the original graphite rod materials, and as the modulus of elasticity rate increase the strain rate would be decrease resulting into more brittle rod that will more prone to failure. However, with all the advancement of material, technology and composites proces throughout the years many manufacturer came up with design of rod that are made of composite material which is infused with graphite. For example, carbon graphite rod, graphite fiberglass rod and many other materials.

This will explain the result of the material testing where the carbon fiber is more stronger then graphite fiber. From the result we can see that the carbon fiber is more stiff and elastic then graphite, but if we compare with the weight of the rod the graphite fiber rod is lighter then the carbon fiber. This means the material quantity in carbon fiber rod is higher then the graphite rods. Moreover in angling activities, weight is the deterrence to performance while stiffness is equates to responsiveness of fishing rods that is the ability to store and release energy.

This is why most of the product review and description about fishing rod, fishing rod made from graphite are the most best because although the carbon fiber is stiffer when it comes to performance it will be less perform because of it heavier weight. On the other hand, graphite is less stiffer than carbon fiber but in performance hand it is more easy to handle because of light weight, but has been stated before that graphite is just a technical terms of carbon fiber.

Most of the manufacturer and expert point of reviews state that because the product of graphite fishing rods are not the original graphite material but the mix of other material in composite process to produce one. As for this studies, the graphite rod that has been choosen are rod that has made of composite of 30% carbon fiber, 20% of graphite and the rest are epoxy. However, still the rod are called graphite rod because it to differ between the original carbon fiber and carbon fiber with the combination of graphite. Therefore, this is why carbon fiber is stronger than graphite because of the difference of quantity of material in the both rods.

The Difference Between Fiberglass and Fiberglass(Hollow)

The stiffness and elasticity of fiberglass is depend on the quantity of material on the rods. As from the research, to compare the weight of the both fiberglass the hollow fiberglass is lighter then the solid fiberglass. It obiviously can be understand it because of the material quantities in the rod. The solid rod is heavier due to solid form and more material while the hollow fiberglass is lighter because it in tube form that less material into it.

From the bending test, the stiffness and elasticity of fiberglass also related to the material quantities. The solid fiberglass is more stiffer than hollow fiberglass. It because the quantity of material in solid fiberglass is higher which needed higher force to bend it to its maximum stiffness while the opposite goes to the hollow fiberglass.

Potential Of New Research

Throughout the research with many other material that can be develop into fishing rod, the rotan is one of the interesting material because of the result. First of all, the weight of the material. Comparing with the material that had been widely used as fishing rod like the graphite, carbon fiber and fiberglass the rotan is much more lighter then others although all of them are in same dimension. Meanwhile, te rotan is in solid form and still lighter than graphite rod which is in hollow tube form.

Secondly, in bending test the rotan poor in his ability because it have a vey low stiffnes and elasticity(but the result are inaccurate because of the bending limit of the machine) comparing to other composite material. The force used to bend the rotan also compered to be smaller then any other material tha has been tested. This means, the rotan need less force to be bend compare to other materials. But the interesting part of the rotan is throughout the bending process, the material did not fracture and just deformed.

Reconsider on the ability and the flexibility of the rotan, maybe the material can be research more and can be used in composite process to create a new different fishing rods.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

In this chapter summarizes the research, discusses of finding and limitation of the project. The chapter is divided into two section which is summary of research and the future work that can be done.

5.1 Conclusion

This research is conducted study the difference between the material used in making the fishing rod. There are three main material that are been used to make fishing rod nowdays which is graphite, carbon fiber and fiberglass. In addition some of material also been tested due to the potential of the material and because the material was been used long tome ago. Bending test had been done because the experiment is more suitable to measure the stiffness and elasticity of the material. In bending test, the 3 point bending method is used because the method is suitable for composite material and to be known most of the fishing rods are made of composite material. Throughout the testing, the dimesion of material are prepared even to make it as the constant for the research.

Before the bending test, the weight of the material is recorded and compared. All of the material have different weight which prove that although the dimension of the material are constant, the quantities of material are difference from others. After the bending test, the result also proves that different material have different stiffness and elasticity. Form the test also gives us the answer why most of the fishing rod manufacturers are makes rod out of carbon fiber and graphite fiber.

From the result and research that had been done, it can be said the objective are successfully achieved.In addition, the research also gives the answers about the difference between carbon fiber and graphite fishing rods. This research able to identify which of the material shows the higest stiffness and elasticity and also which material can be potential to be developed into fishing rods. Furthemore, just by bending test do not prove which material is the best of all, because when it comes to fishing many circumtance had to be considered and have to be tested.

5.2 Recommendations

When it comes to fishing rod, just with bending test will not prove which material is the best of all. During this research and study are conduct, some of the work progress or procedure especially while conducting experiments can be improve in the future. The recommendations are listed below:

1. Possibly to do other test such as torsion, strength, durability and many others that can be related to fishing rods.

2. Increase the number of specimens during the material testing to gain various result in order to get the average result which is more accurate.

3. Testing the material in the exact shape and design of fishing rods which may gives a different results

4. Examine the composite material for defect before the testing to get the fair results.

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APPENDICES

APPENDIX 1 GANTT CHART PSM 1

No	Project Activities	Plan Vs Actual Plan	MARCH			APRIL				MAY				JUNE			
		Week	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1.	PSM Briefing	Plan								M							
		Actual								I							
2.	Chapter 2 Literature Review	Plan								D							
		Actual															
3.	PSM Workshop	Plan								T							
		Actual								E							
4.	Chapter 1 Introduction	Plan								R							
		Actual								M							
5.	Chapter 3 Methodology	Plan															
		Actual								B							
6.	Chapter: 4 Expected result	Plan								R							
		Actual								E							
7.	Formatting and Grammar Improvement	Plan								A K							
		Actual															
8.	Slide Preparation	Plan															
		Actual															
9.	Final Improvement	Plan															
		Actual															
10.	Final Presentation	Plan															
		Actual															
11.	Report Submission	Plan															
		Actual															

APPENDIX 2 GANTT CHART PSM 2

ACTIVITIES	STATUS	WEEK														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PSM 2 Briefing	Plan															
	Actual															
Chapter 4 Results & Discussion	Plan															
	Actual															
Chapter 5 Conclusion	Plan															
	Actual															
Formatting and Grammar Improvement	Plan															
	Actual															
Slide Preparation	Plan															
	Actual															
Final Improvement	Plan															
	Actual															
Report Submission	Plan															
	Actual															
Thesis Summary	Plan															
	Actual															
Final Presentation	Plan															
	Actual															