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Static and Dynamic Analysis of a Circular Bulkheads

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Abstract: The bulkheads of the aircraft are the major components which will give shape and strength to the aircraft and shape can be elliptical and circular. In the present work, the circular bulk heads with different cross sections will be analyzed for both static and dynamic loads using ansys software including the cabin pressure in addition to external loads. Comparatively study will be done against different cross sections for a given diameter (total volume) based on strength to weight ratio.

I. INTRODUCTION

The basic functions of an aircraft's fuselage structure are to transmit and resist applied loads; to provide an aerodynamic shape and to protect passengers, payload, systems etc. from the environmental conditions encountered in flight. These requirements, in most aircraft, result in thin shell structures where the outer surface or skin of the shell is usually supported by longitudinal stiffening members and transverse frames to enable it to resist bending, compressive and tensional loads without buckling. Such structures are known as semi-monocoque, while thin shells which rely entirely on their skins for their capacity to resist loads are referred to as monocoquc'.

Fuselages, while of different shape to the aerodynamic surfaces, comprise members which perform similar functions to their counterparts in the wings and tail plane. However, there are differences in the generation of the various types of load. Aerodynamic forces on the fuselage skin are relatively low; on the other hand, the fuselage supports large concentrated loads such as wing reactions, tail plane reactions, undercarriage reactions and it carries payloads of varying size and weight, which may cause large inertia forces.

Furthermore, aircraft designed for high altitude flight must withstand internal pressure. The shape of the fuselage cross-section is determined by operational requirements. For example, the most efficient sectional shape for a pressurized fuselage is circular or a combination of circular elements. Irrespective of shape, the basic fuselage structure is essentially a single cell thin-walled tube comprising skin, transverse frames and stringers; transverse frames which extend completely across the fuselage are known as bulkheads.

A. History

Bulkhead partitions are considered to have been a feature of Chinese junks, a type of ship Song Dynasty author Zhu Yu (fl. 12th century) wrote in his book of 1119 that the hulls of Chinese ships had a bulkhead build.

The 5th-century book Garden of Strange Things by Liu Jiangsu mentioned that a ship could allow water to enter the bottom without sinking.

Archaeological evidence of bulkhead partitions has been found on a 24 m (78 ft) long Song Dynasty ship dredged from the waters off the southern coast of China in 1973, the hull of the ship divided into twelve walled compartmental sections built watertight, dated to about 1277.

B. Definition

A partition in a vessel, to separate apartments on the same deck or the bulkhead is a wall that separates the main cabin from the galley or sometimes different classes of seating.

The word bulki meant "cargo" in Old Norse. In the 15th century sailors and builders in Europe realized that walls within a vessel would prevent cargo from shifting during passage. In shipbuilding, any vertical panel was called a "head", So walls installed abeam (side-to-side) in a vessel's hull were called "bulkheads".

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C. Advantages and purpose of bulkhead

1) *Bulkheads in a ship serve several purposes:* ncrease the structural rigidity of the ves Divide functional areas into rooms create watertight compartments that can contain water in the case of aHull brea or other leak. some bulkheads and decks are fire-resistance rated to achieve Compartmentalisation, a passive fire protection measure.

D. Requirements of bulkheads

Fire stopped cable penetration in a bulkhead which is required to have a fire-resistance rating, on board a BC Ferries ship, British Columbia, Canada. The fire stop is made of purpose-designed putty on the outside and proprietary cementations fill on the inside.
Openings in fire-resistance rated bulkheads and decks must be fire stopped to restore the fire-resistance ratings that would otherwise be compromised, if the openings were left unsealed.
The authority having jurisdiction for such measures varies depending upon the flag of the ship. Merchant vessels are typically subject to the regulations and inspections of the Coast Guards of the flag country. Combat ships are subject to the regulations set out by the navy of the country that owns the ship.

E. Types of fuselage

There are mainly two types of fuselage
Monocoque Semi Monocoque

1) *Monocoque:* Monocoque fuselage design relies on the strength of the skin (also known as the shell or covering) to carry the various loads. True monocoque construction does not use formers, frame assemblies, or bulkheads to give shape to the fuselage. Instead, the skin carries all fuselage stresses. Since no bracing members are present, the skin must be strong enough to keep the fuselage rigid. Thus, the biggest challenge in monocoque design is maintaining enough strength while keeping the weight within allowable limits.
2) *Semi-monocoque:* This is the preferred method of constructing an all-aluminum fuselage. First, a series of frames in the shape of the fuselage cross sections are held in position on a rigid fixture, or *jig*. These frames are then joined with lightweight longitudinal elements called stringers. These are in turn covered with a skin of sheet aluminum, attached by riveting or by bonding with special adhesives. The fixture is then disassembled and removed from the completed fuselage shell, which is then fitted out with wiring, controls, and interior equipment such as seats and luggage bins. Most modern large aircraft are built using this technique, but use several large sections constructed in this fashion which are then joined with fasteners to form the complete fuselage.Both monocoque and semi-monocoque are referred to as "stressed skin" structures as all or a portion of the external load (i.e. from wings and empennage, and from discrete masses such as the engine) is taken by the surface covering. In addition, all the load from internal pressurization is carried by the external skin.

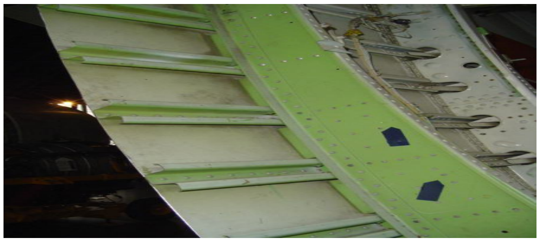

Figure:1.1 fuselage structure

The semi monocoque fuselage is constructed primarily of aluminium alloy; however, on newer aircraft graphite epoxy composite material is often used. Steel and titanium are found in areas subject to high temperatures. Primary bending loads are absorbed by the "longerons," which usually extend across several points of support. The longerons are supplemented by other longitudinal members, called "stringers." Stringers are lighter in weight and are used more extensively than longerons. The vertical structural members are referred to as "bulkheads, frames, and formers." These vertical members are grouped at intervals to carry concentrated loads and at points where fittings are used to attach other units, such as the wings, engines, and stabilizers.

The skin is attached to the longerons, bulkheads, and other structural members and carries part of the load. Skin thickness varies with the loads carried and the stresses supported.

There are many advantages in the use of the semimonocoque fuselage. The bulkheads, frames, stringers, and longerons aid in the construction of a streamlined fuselage. They also add to the strength and rigidity of the structure. The main advantage of this design is that it does not depend only on a few members for strength and rigidity. All structural members aid in the strength of the fuselage.

F. Structural Stress

The primary factors to consider in aircraft structures are strength, weight, and reliability. These factors determine the requirements to be met by any material used to construct or repair the aircraft.

Airframes must be strong and light in weight. An aircraft built so heavy that it couldn't support more than a few hundred pounds of additional weight would be useless. All materials used to construct an aircraft must be reliable. Reliability minimizes the possibility of dangerous and unexpected failures .Many forces and structural stresses act on an aircraft when it is flying and when it is static. When it is static, the force of gravity produces weight, which is supported by the landing gear. The landing gear absorbs the forces imposed on the aircraft fuselage during takeoffs and landings .During flight, any maneuver that causes acceleration or deceleration increases the forces and stresses on the wings and fuselage.

Stresses on the wings, fuselage, and landing gear of aircraft are tension, compression, shear, bending, and torsion. These stresses are absorbed by each component of the wing structure and transmitted to the fuselage structure. The empennage (tail section) absorbs the same stresses and transmits them to the fuselage. These stresses are known as loads, and the study of loads is called a stress analysis.

G. Types of Structural Stress

The five basic structural stresses to which aircraft are subject are:

Tension Compression

Torsion Shear Bending

While there are many other ways to describe the actual stresses which an aircraft undergoes in normal (or abnormal) operation, they are special arrangements of these basic ones.

Tension" is the stress acting against another force that is trying to pull something apart. For example, while in straight and level flight the engine power and propeller are pulling the airplane forward. The wings, tail section and fuselage, however, resist that movement because of the airflow around them. The result is a stretching effect on the airframe. Bracing wires in an aircraft are usually in tension.

"Compression" is a squeezing or crushing force that tries to make parts smaller. Anti-compression design resists an inward or crushing force applied to a piece or assembly. Aircraft wings are subjected to compression stresses. The ability of a material to meet compression requirements is measured in pounds per square inch (psi).

"Torsion" is a twisting force. Because aluminum is used almost exclusively for the outside, and, to a large extent, inside fabrication of parts and covering, its tensile strength (capability of being stretched) under torsion is very important. Tensile strength refers to the measure of strength in pounds per square inch (psi) of the metal. Torque (also a twisting force) works against torsion. The torsion strength of a material is its ability to resist torque. While in flight, the engine power and propeller twist the forward fuselage. The force, however, is resisted by the assemblies of the fuselage. The airframe is subjected to variable tensional stresses during turns and other maneuvers.

"Shear" stress tends to slide one piece of material over another. Consider the aircraft fuselage. The aluminum skin panels are riveted to one another. Shear forces try to make the rivets fail under flight loads; therefore, selection of rivets with adequate shear resistance is critical. Bolts and other fasteners are often loaded in shear, an example being bolts that fasten the wing to the spar or carry-through structure. Although other forces may also be present, shear forces try to rip the bolt in two. Generally, shear strength is less than tensile or compressive strength in a particular material.

"Bending" is a combination of two forces, compression and tension. During bending stress, the material on the inside of the bend is compressed and the outside

Material is stretched in tension. An example of this is the G-loading an airplane structure experiences during maneuvering. During an abrupt pull-up, the airplane's wing spars, wing skin and fuselage undergo positive loading and the upper surfaces are subject to compression, while the lower wing skin experiences tension loads.

An airplane structure in flight is subjected to many and varying stresses due to the varying loads that may be imposed. The

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designer's problem is trying to anticipate the possible stresses that the structure will have to endure, and to build it sufficiently strong to withstand these. The problem is complicated by the fact that an airplane structure must be light as well as strong. The manufacturer states upon certification that the design meets or exceeds all FAR requirements for the category of aircraft being produced.

owever, hard landings, gust loads caused by extreme turbulence, performing aerobatic maneuvers in a non-aerobatic airplane, etc.can affect the airworthiness of one or more major airframe assemblies to the extent that the airplane is no longer airworthy. This reiterates the necessity of operating the aircraft within the limitations outlined by the manufacturer. Every flight imposes loads and stresses on the aircraft. How carefully it is flown, therefore, will have an effect on the service life of its assemblies.

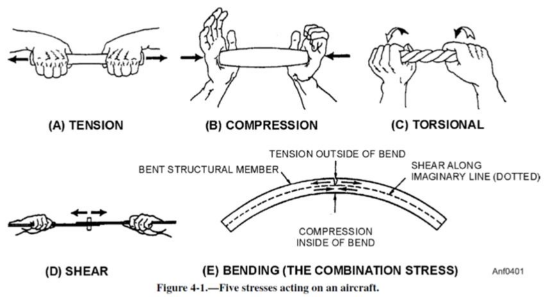

FIG 1.2 Stress acting

H. Specification of stresses

The fuselage of an aircraft is subject the five types of stress—torsion, bending, tension, shear, and compression. Torsional stress in a fuselage is created in several ways. For example, torsional stress is encountered in engine torque on turboprop aircraft. Engine torque tends to rotate the aircraft in the direction opposite to the direction the propeller is turning. This force creates a torsional stress in the fuselage. Figure 4-2 shows the effect of the rotating propellers. Also, torsional stress on the fuselage is created by the action of the ailerons when the aircraft is maneuvered.

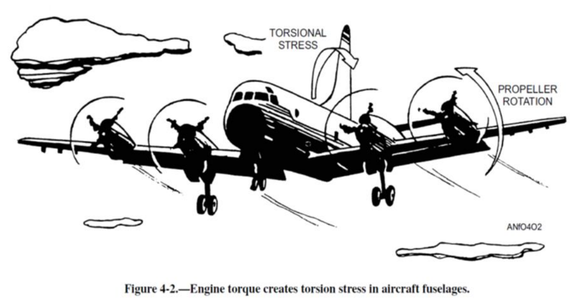

Fig 1.3 engine torque created torsions

When an aircraft is on the ground, there is a bending force on the fuselage. This force occurs because of the weight of the aircraft. Bending increases when the aircraft makes a carrier landing. This bending action creates a tension stress on the lower skin of the fuselage and a compression stress on the top skin. Bending action is shown in figure 4-3. These stresses are transmitted to the fuselage when the aircraft is in flight. Bending occurs because of the reaction of the airflow against the wings and empennage. When the aircraft is in flight, lift forces act upward against the wings, tending to bend them upward. The wings are prevented from folding over the fuselage by the resisting strength of the wing structure.

I. Construction materials

Fuselages must be constructed of materials that are both light and strong. Early aircraft were made of wood. Lightweight metal alloys with strength greater than wood were developed and used on later aircraft .Materials currently used in fuselage construction are metallic materials.

J. Metallic Materials

The most common metals used in aircraft fuselage construction are aluminum, steel and their alloys.

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K. Alloys

An alloy is composed of two or more metals. The metal present in the alloy in the largest amount is called the base metal. All other metals added to the base metal are called alloying elements. Adding the alloying elements may result in a change in the properties of the base metal. For example, pure aluminum is relatively soft and weak. However, adding small amounts of copper, manganese, and magnesium will increase aluminum's strength many times. Heat treatment can increase or decrease an alloy's strength and hardness. Alloys are important to the aircraft industry.

1) *Aluminum:* Aluminum alloys are widely used in aircraft fuselage construction. Aluminum alloys are valuable because they have a high strength-to-weight ratio. Aluminum alloys are corrosion resistant and comparatively easy to fabricate. The outstanding characteristic of aluminum is its lightweight. Aluminum alloys are mainly used for bulkhead constructions.
2) *Steel Alloys:* Alloy steels used in fuselage construction have greater strength, more so than other fields of engineering would require. These materials must withstand the forces that occur on today's modern aircraft. These steels contain small percentages of carbon, nickel, chromium, vanadium, and molybdenum. High tensile steels withstand stress of 50 to 150 tons per square inch without failing. Such steels are made into tubes, rods, and wires, commonly these are made to use in longerons. Another type of steel used extensively is stainless steel. Stainless steel resists corrosion and is particularly valuable. for use in or near water.

L. Nonmetallic materials

In addition to metals, various types of plastic materials are found in aircraft construction. Some of these plastics include transparent plastic, reinforced plastic, composite, and carbon-fiber materials.

M. Transparent Plastic

Transparent plastic is used in canopies, windshields, and other transparent enclosures. You need to handle transparent plastic surfaces carefully because they are relatively soft and scratch easily. At approximately 225°F, transparent plastic becomes soft and pliable.

N. Reinforced Plastic

Reinforced plastic is used in the construction foredooms, wingtips, stabilizer tips, antenna covers, and flight controls. Reinforced plastic has a high strength-to-weight ratio and is resistant to mildew and rot. Because it is easy to fabricate, it is equally suitable for other parts of the aircraft. Reinforced plastic is a sandwich-type material. It is made up of two outer facings and a center layer.

II. LITERATURE REVIEW OF BULKHEADS

A. Bulkhead

Basically, the purpose of aircraft structure is to transmit and resists all loads applied to it. The fuselage structures of general aviation aircraft today can usually be divided into the truss, monocoque, or the semi-monocoque types. Truss or framework types of construction have wood, steel tube, aluminum tube, or other cross sectional shapes which may be bolted, welded, bonded, pinned, or riveted into a rigid assembly.

The use of new materials in the construction of civil aircraft is now becoming common place. To continues this trend composite materials will be used for wing skins, control surfaces, bulkheads and access panels. Advanced metallic materials will be used in high load areas (landing gear, flap mechanisms, engine and wing attachment structures).As proposed in the VT study, micro-perforated titanium, wing-leading-edge skins will be used for the boundary layer suction structure. A conventional, aluminum alloy, fuselage pressure shell will be proposed as this is well proven and adds confidence to the aircraft structural framework. Filament wound composite structures may offer mass reductions for the pressure cabin but this technology is still unproven in airliner manufacture, so it will not be used on our aircraft.

Both the monocoque and semi-monocoque fuselage structures use their covering or skin as an integral structural or load carrying member. Monocoque (single shell) structure is a thin walled tube or shell which may have rings, bulkheads or formers installed within. It can carry loads effectively, particularly when the tubes are of small diameter. The stresses in the monocoque fuselage are transmitted primarily by the strength of the skin. As its diameter increases to form the internal cavity necessary for a fuselage, the weight-to-strength ratio becomes more efficient, and longitudinal stiffeners or stringers are added to it.

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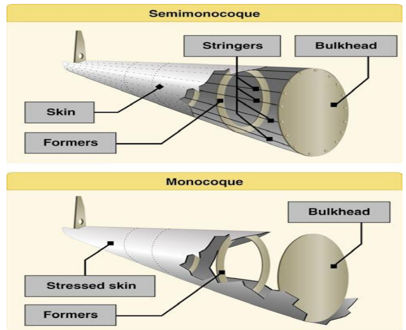
B. Fuselage parts



2.1 Fuselage parts

III. METHODOLOGY

A. static analyses
Preprocessor

B. bulkhead dimensions
Bulkhead diameter: 0.3 meters

Skin thickness: 1.2 mm or 0.0012 meters

Cross sectional area: 20mm

C. Material properties
Young's modulus: $70*10^4$ n/m^2

Poisons ratio: 0.3

Density: 2700 kg/mt^3

D. Load
1000N
To give material properties go pre processor→ material properties→ material models, select structural → linear→ elastic→ isotropic give EX=7 e^4, PRXY=0.3 , go to density DENS=2700. Click ok → exit.

E. Modeling
select modeling→create→ key points→ inact cs→ all 12 key points are given→create lines→join all the lines→now create area by using the lines →select area→pick all the lines→apply→ok

now next step is to extrude this area into 360 degrees process to create→ operate→extrude→ pick area→rotate it into 360 degrees→by using Booleans command we can add all the areas for the free mesh.

F. Meshing
Next step is to mesh the volumes now select the meshing→ mesh→volumes→free→pick all volumes→apply→ok

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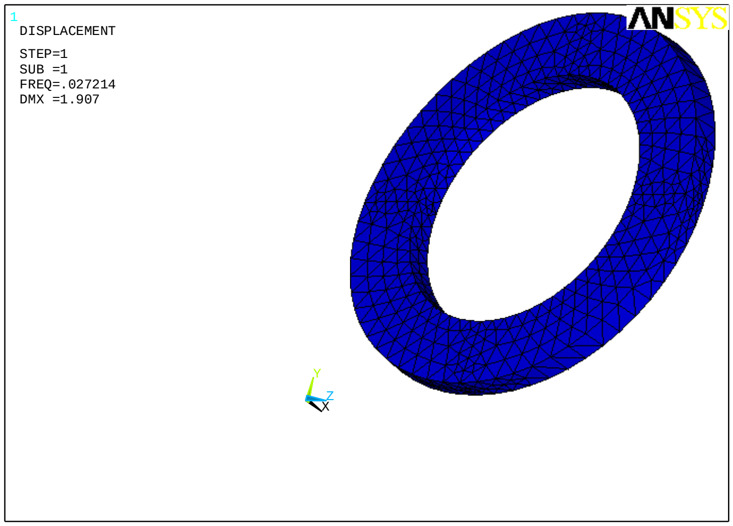
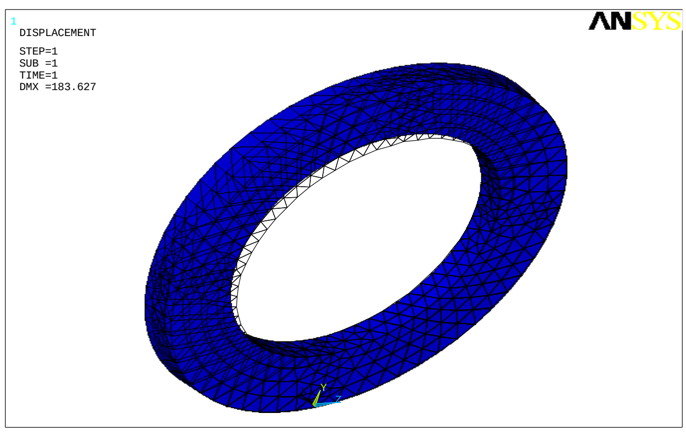


F. boundary conditions

After completing the meshing we have to apply boundary conditions. To fix the surface go to loads→ apply→ structural→ displacement→ on lines select first side circle lines click ok select all dof, click ok. Then again go to loads→ apply→ structural→ displacement→ on areas select first side stringers circles click ok select all dof, click ok. The model after applying the boundary conditions the figure is shown in figure3.3

Now select the modal analysis. To select modal analysis go to pre processor→loads→analysis type→ select modal analysis→click ok, analysis options→ and give value 10 in no. o f modes to extract ,no. of modes to expand.



G. Solution

After applying loads and boundary conditions, solution should be done. To solve the problem go to solution> solve> current LS >click ok >click yes. Solution will be done, Then plot the deformation.

H. Post processor

To select the set of mode to read results go to general post processor> read results> first set To plot deformation go to general post processor> plot results> deform shape> select deform shape click ok. It will show the deform shape and of fuselage model and displacement value also. Then go to post processor> plot results>counter plot> nodal solution click dof solution> x-component of displacement click apply. it will show the x-component of displacement. If we select y or sum of displacement it will show that displacement.

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IV. RESULTS AND DISCUSSIONS

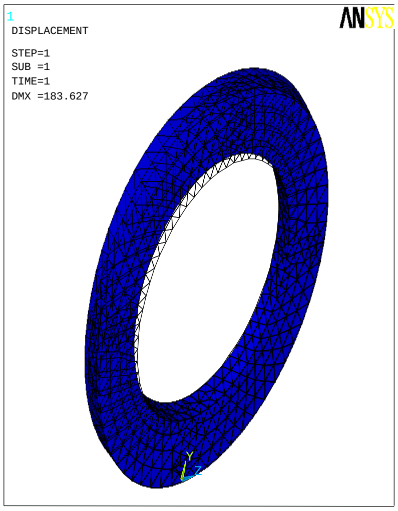
A. Static analysis results

Here we have done static analysis on a single circular bulkhead and also we have measured the original dimensions. Now by using the ansys we have done static and dynamic analysis on original bulkhead. By taking it as a reference of original values, we increased and decreased the dimensions and both analysis by using ansys software.

Now by changing the thickness we are going to performer static analysis.

B. Orginal values

By using this thickness we are going to performer a static analysis on a circular bulkhead. Here we are going to find out the deformed shape and deformation of bulkheads in xyz directions.



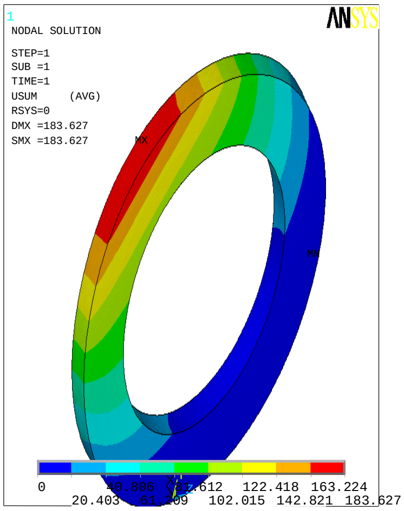
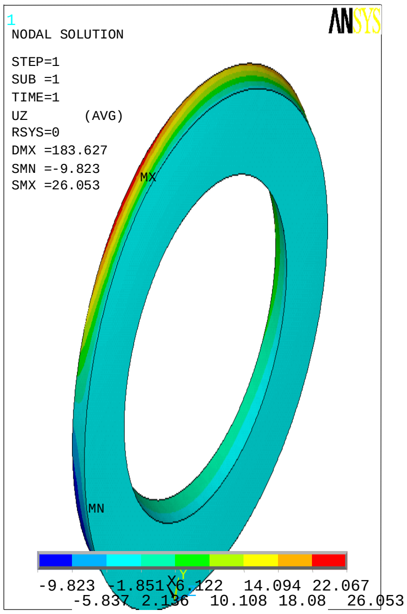
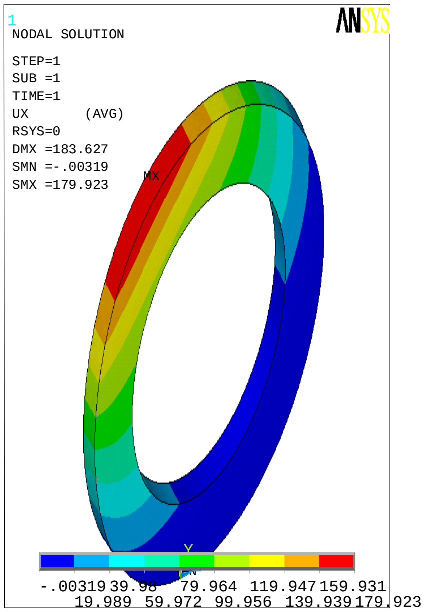


Fig 4.1 deformed shape

Fig 4.2 total displacements





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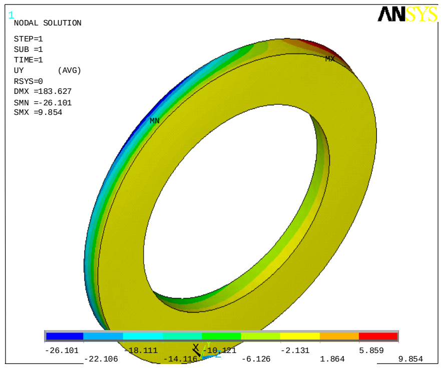
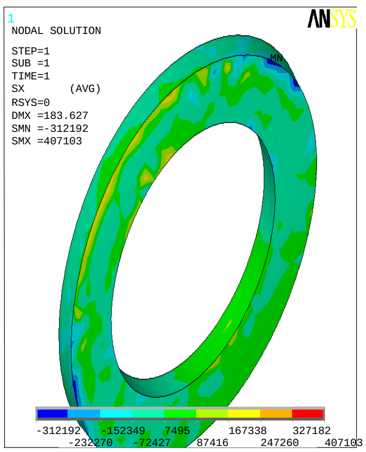
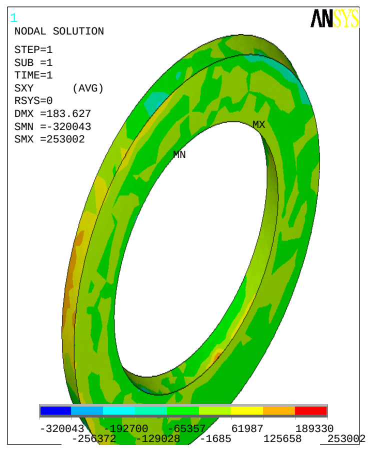


B. Stress Analysis





CALCULATIONS:

WEIGHT w = V* ρ

VOLUME v = L*A

AREA OF BULKHEAD A= 0.1*0.0376*0.02*0.02*0.0376

= 0.0000000565

LENGTH L = 2πr

L= 2*22.7*300

= 13620

Where as

V= 13620*0.0000000565

= 0.00077

Deflection δ = 183.627

Were as we have got deflection from ansys

Density ρ= 2700

W= 0.00077*2700

= 2.07

WEIGHT w= 2.07kgs

Weight ratio=total weight of bulkhead to deflection

$$\frac{\delta}{w} = \frac{183.627}{2.07}$$

= 88.70

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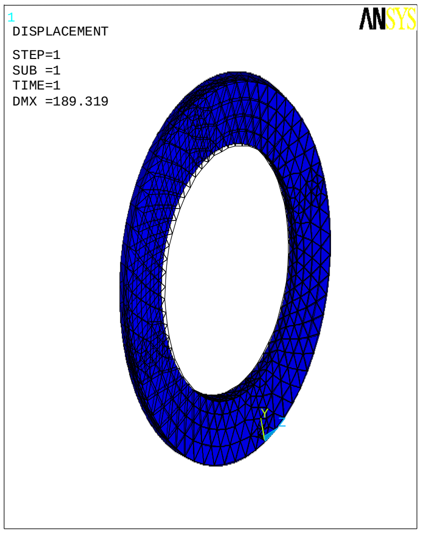
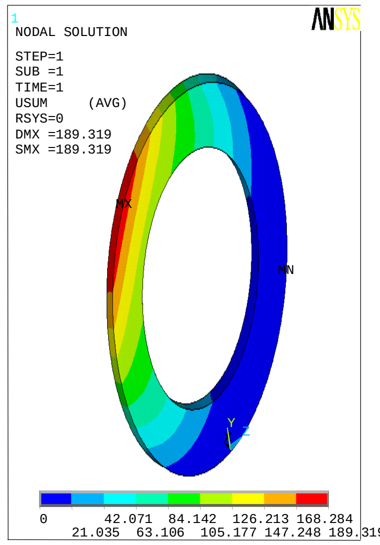
C. Thickness t=1.0

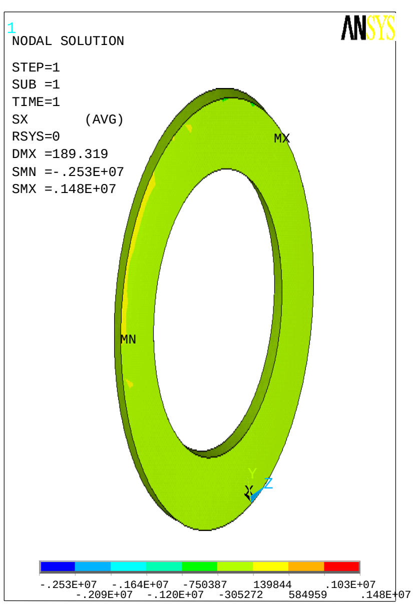
By using this thickness we are going to performer a static analysis on a circular bulkhead. Here we are going to find out the deformed shape and deformation of bulkheads in xyz directions.

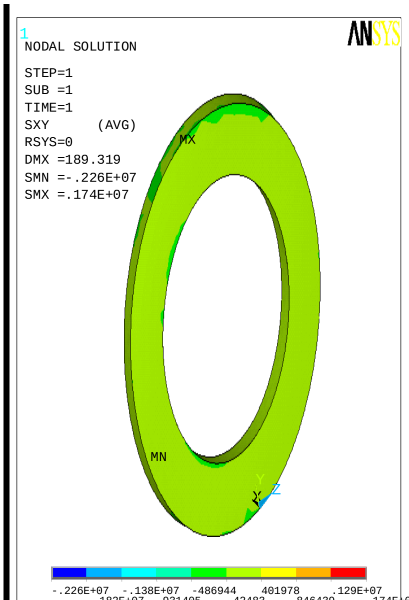




Deformed shape displacement in xyz

Stress analysis:





In x direction In xyz direction

CALCULATIONS

WEIGHT w = V* ρ

VOLUME v = L*A

AREA OF BULKHEAD A = 0.1*0.038*0.02*0.02*0.038

= 0.00000005776

LENGTH L = 2πr

L= 2*22.7*300

= 13620

where as

V= 13620*0.00000005776

= 0.0007866

Deflection δ = 189.319

Were as we have got deflection from ansys

Density ρ= 2700

W= 0.0007866*2700

= 2.12

WEIGHT w= 2.12kgs

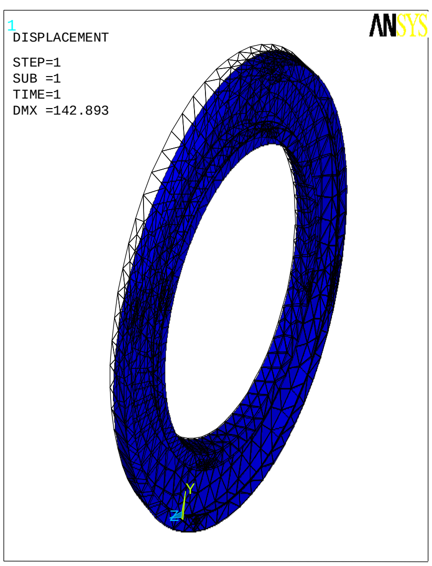
Weight ratio=total weight of bulkhead to deflection

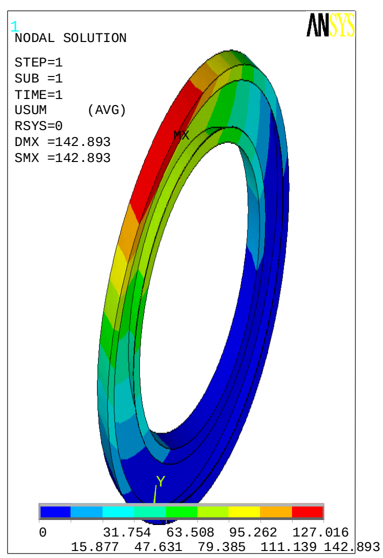
$$\frac{\delta}{w} = \frac{189.319}{2.12}$$

= 89.3**0**

D. Thickness t=1.5

By using this thickness we are going to performer a static analysis on a circular bulkhead. Here we are going to find out the deformed shape and deformation of bulkheads in xyz directions.





Deformed shape displacement in xyz

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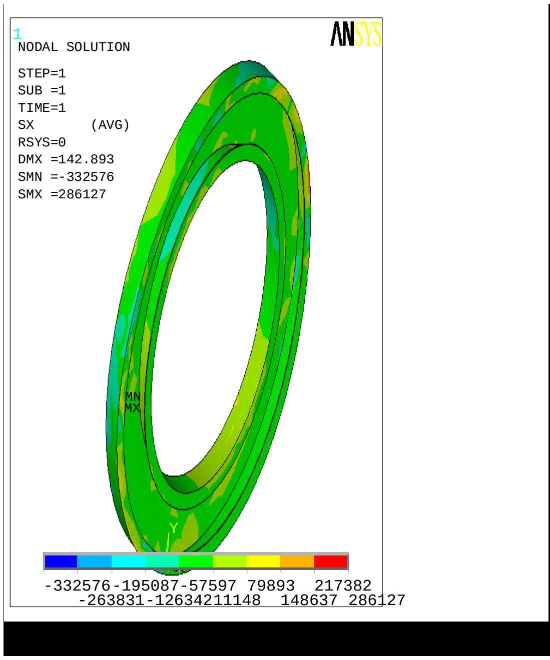
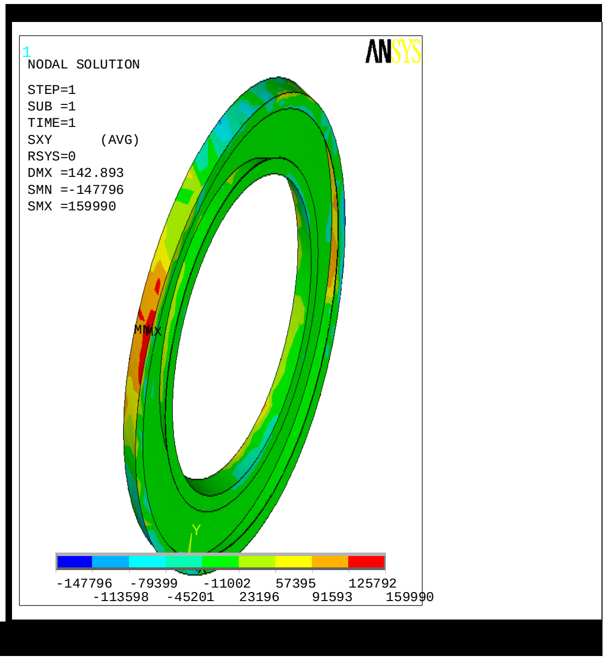
E. Stress analysis





In x direction In xyz direction

WEIGHT w = V* ρ

VOLUME v = L*A

AREA OF BULKHEAD A= 0.1*0.037*0.02*0.02*0.037

= 0.00000005476

LENGTH L = 2πr

L= 2*22.7*300

= 13620

where as

V= 13620*0.00000005476

= 0.0007458

Deflection δ = 142.89

Were as we have got deflection from ansys

Density ρ= 2700

W= 0.0007458*2700

= 2.013

WEIGHT w= 2.013kgs

Weight ratio=total weight of bulkhead to deflection

$$\frac{\delta}{w} = \frac{142.89}{2.013}$$

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= 70.98

Static analysis comparisons:

THICKNESS	WEIGHT	DEFLECTION	WEIGHT RATIO
1.0	2.07	183.627	88.70
1.2	2.12	189.89	89.30
1.5	2.013	142.89	70.98

Table 4.1 Weight Ratios

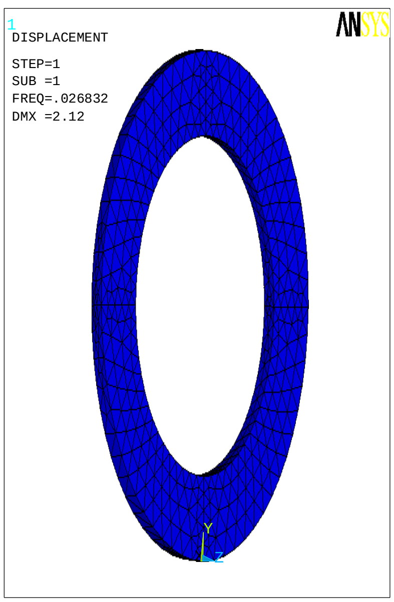
Static analysis of a bulkhead with different thickness is performed.
Here we can observe that while decreasing the thickness deflection are is going to be increased.
Where as we can observe that while increasing the thickness deflections are going to be decreased.
Here weight also plays a major role in aircraft design.
From the above results we can conclude that thickness of 1.5 is the better one to prefer for the aircraft deigns.

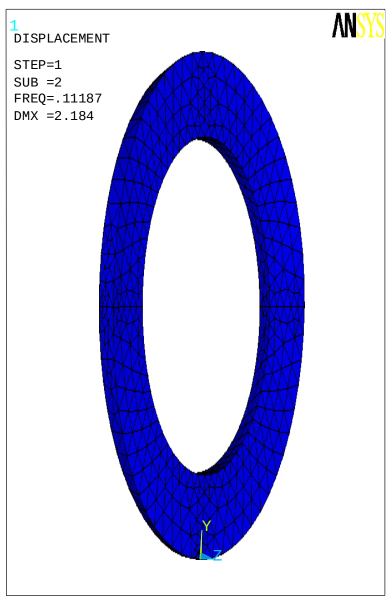
F. dynamic analysis results

Here we have done dynamic analysis on a single circular bulkhead and also we have measured the original dimensions. Now by using the ansys we have done static and dynamic analysis on original bulkhead. By taking it as a reference of original values, we increased and decreased the dimensions and both analysis by using ansys software.
Now by changing the thickness, we are going to performer dynamic analysis.

G. Orginal values

By using this thickness we are going to performer a dynamic analysis on a circular bulkhead. Here we are going to find out the deformed shape and deformation of bulkheads in xyz directions.





Mode-1

Mode-2

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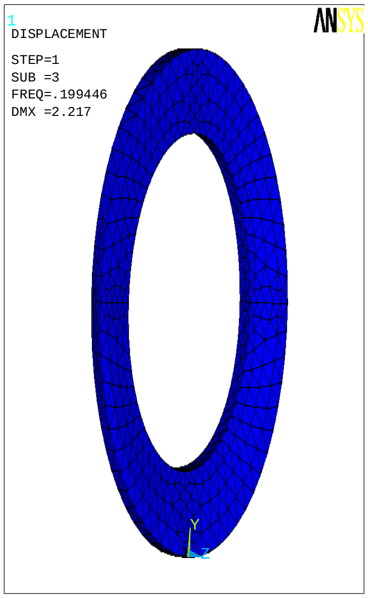

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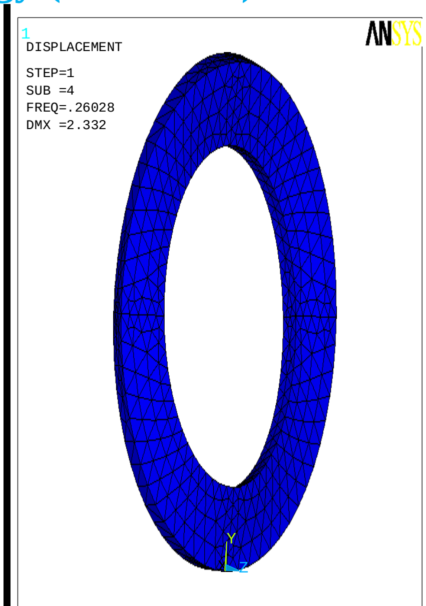

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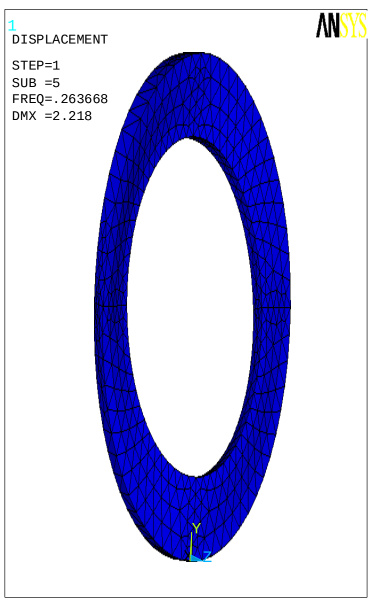

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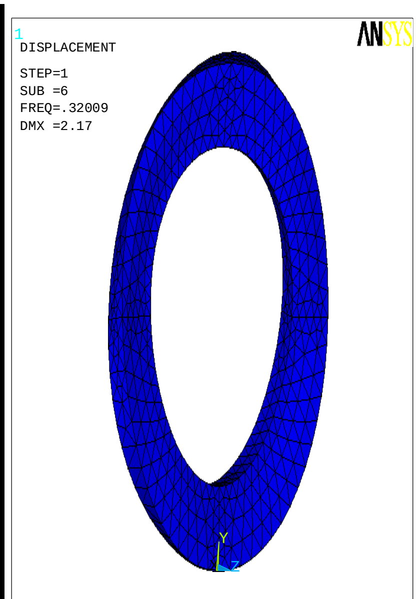

Mode-6

Here from figure we can observe that different model analysis are performed.

Mode	Frequency
1	0.0268
2	0.1187
3	0.1994
4	0.2600
5	0.2636

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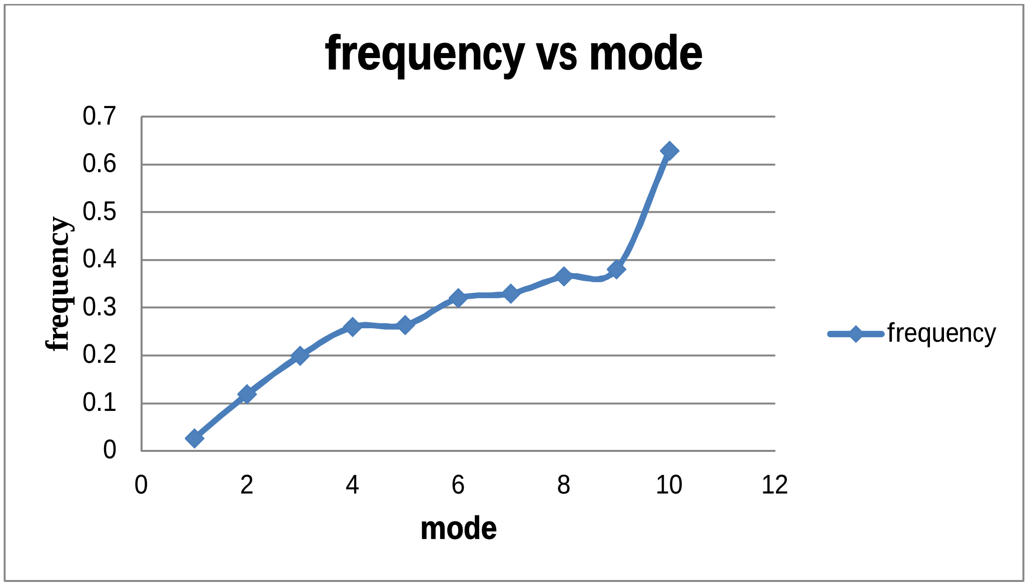
6	0.3200
7	0.3300
8	0.3659
9	0.3810
10	0.6288

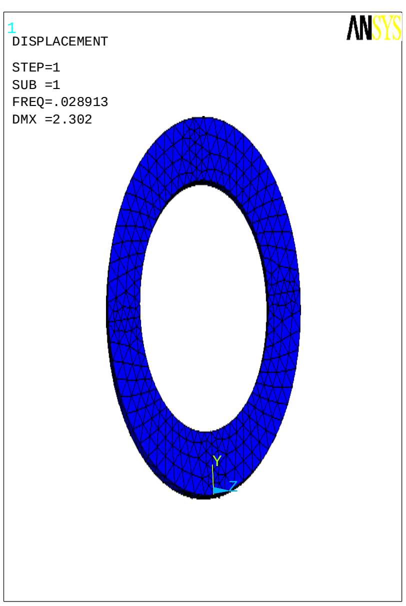
Table 4.2 Modes and frequency

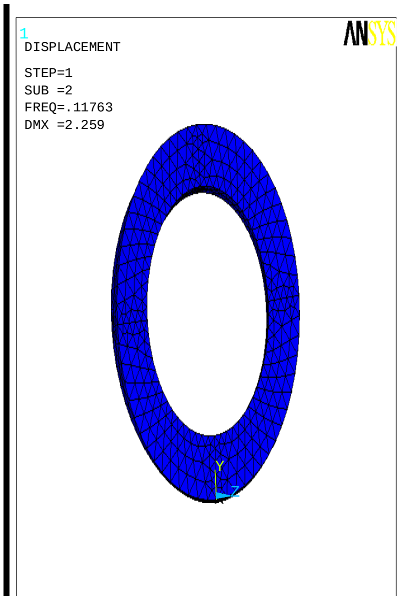


Frequency vs mode

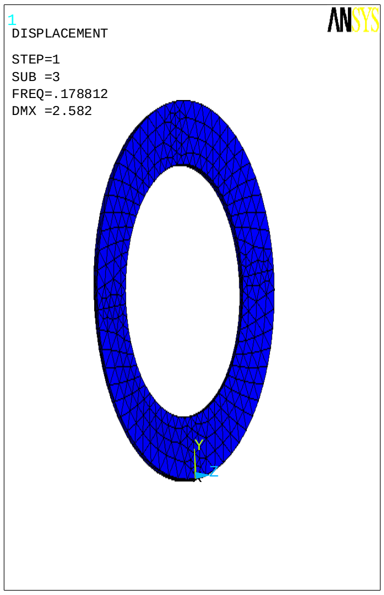
H. Thickness t=1.0

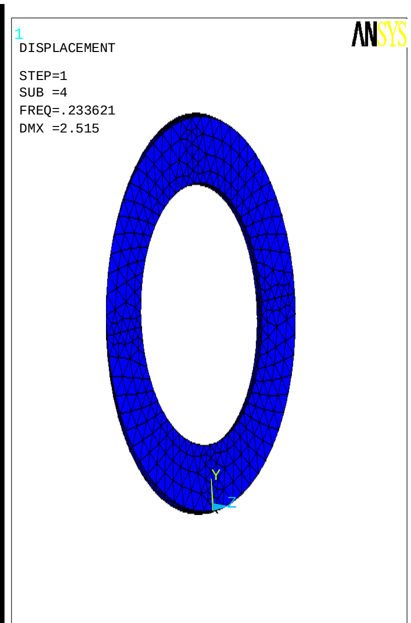
By using this thickness we are going to performer a dynamic analysis on a circular bulkhead. Here we are going to find out the deformed shape and deformation of bulkheads in xyz directions.



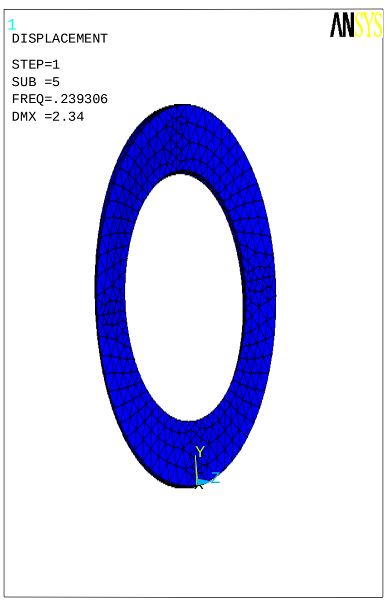


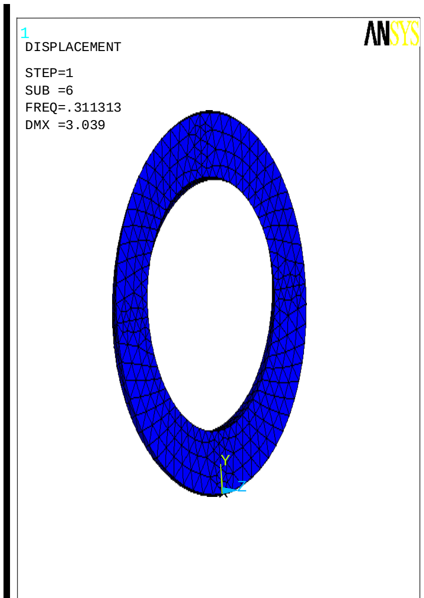
Mode-1 Mode-2





Mode-3 Mode-4





Mode-5 Mode-6

Mode	Frequency
1	0.0289
2	0.1176

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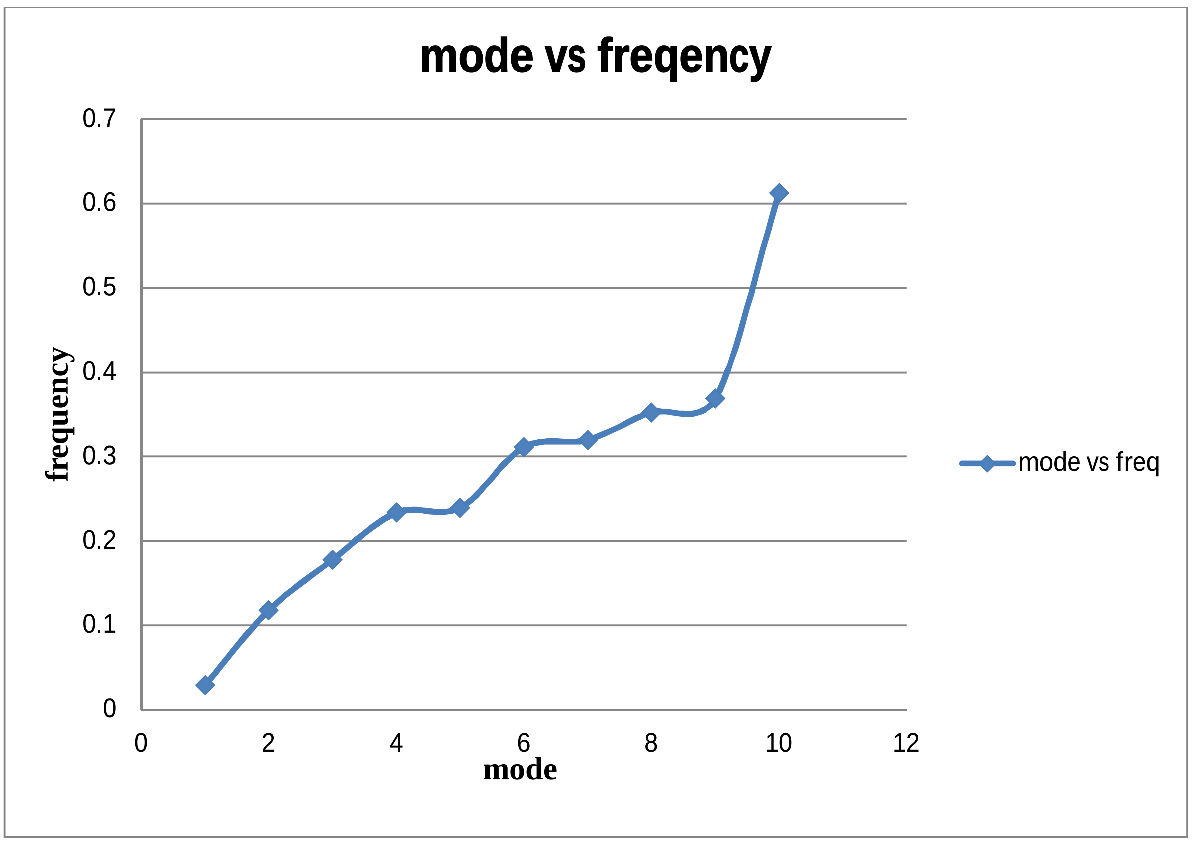
3	0.1788
4	0.2336
5	0.2393
6	0.3113
7	0.3200
8	0.3526
9	0.3692
10	0.6127

Table 4.3 Modes and frequency



Frequency vs mode

I. Thickness t=1.5

By using this thickness we are going to performer a dynamic analysis on a circular bulkhead. Here we are going to find out the deformed shape and deformation of bulkheads in xyz directions.

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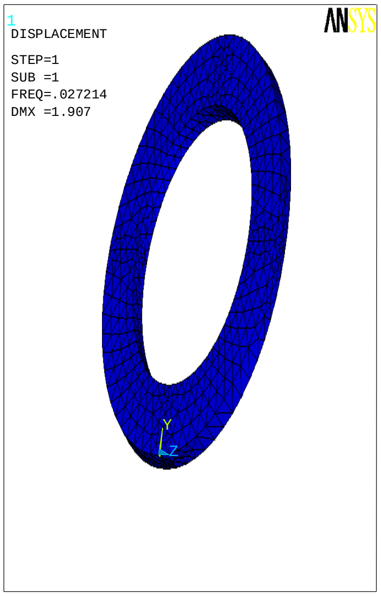
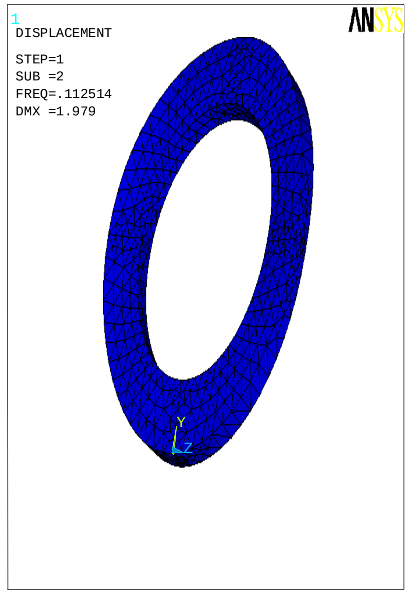
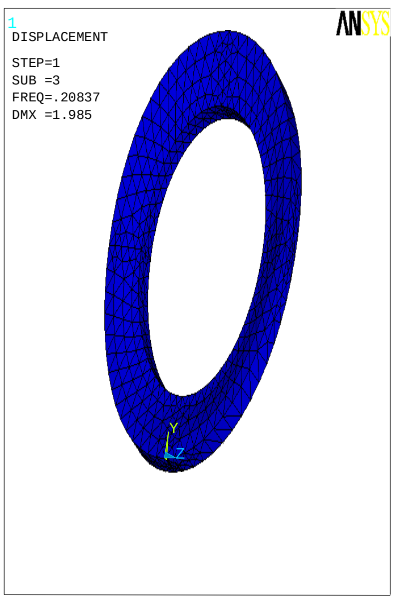


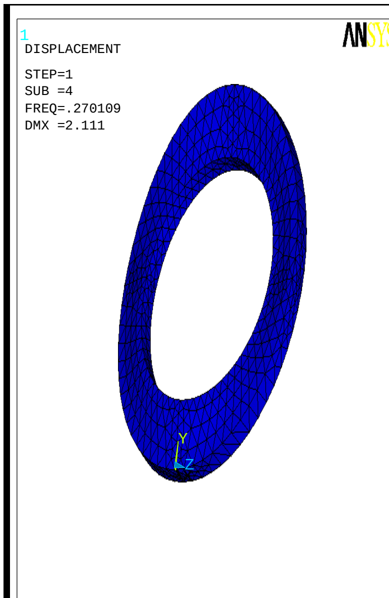
Mode-1



Mode-2



Mode-3



Mode-4

Mode	Frequency
1	0.2721
2	0.1125
3	0.2083

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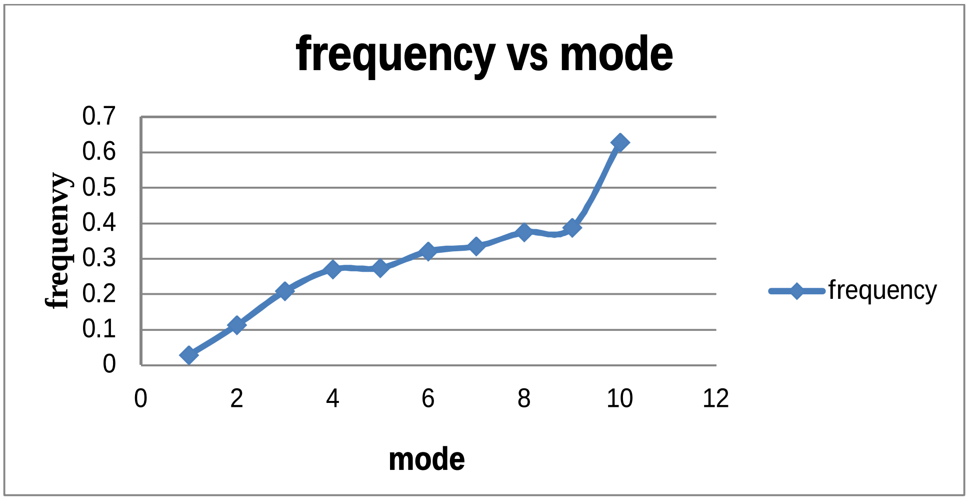
4	0.2700
5	0.2740
6	0.3211
7	0.3350
8	0.3750
9	0.3880
10	0.6285

Table 4.4 Modes and frequency

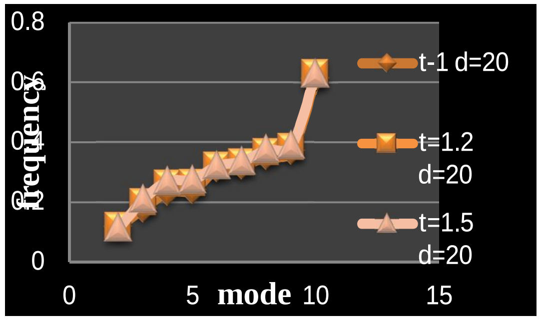


Frequency vs mode

Mode	THICKNESST=1.0	THICKNESST=1.2	THICKNESST=1.5
1	0.0289	0.0268	0.2721
2	0.1176	0.1187	0.1125
3	0.1788	0.1994	0.2083
4	0.2336	0.2600	0.2700
5	0.2393	0.2636	0.2740
6	0.3113	0.3200	0.3211
7	0.3200	0.3300	0.3350

8	0.3526	0.3659	0.3750
9	0.3692	0.3810	0.3880
10	0.6127	0.6288	0.6285

4.5 Modes and frequency



Frequency vs mode

From the above figures and values we have got an result that while increasing the thickness, frequency is going to increase.n this particular thickness of 1.5 frequency is better when compared with remaining thickness.

V. CONCLUSION

Static analyses of bulkhead with different thickness are performed by using the ansys software. A 10 mode solid 183 is used for present study. In the present work, a model of airbus 320 bulkhead is created and optimized the geometry is meshed.

A. Static analysis

static analysis of a bulkhead with different thickness is performed.
Here we can observe that while decreasing the thickness deflection are is going to be increased.
Where as we can observe that while increasing the thickness deflections are going to be decreased.
Here weight also plays a major role in aircraft design.
From the above results we can conclude that thickness of 1.5 is the better one to prefer for the aircraft deigns

B. Dynamic analysis

From the above figures and values we have got an result that while increasing the thickness, frequency is going to increase.
In this particular thickness of 1.5 frequency is better when compared with remaining thickness.

C. Future scope of present work

During the course of research work, various problems have been found interesting in this area. Only a very few issues are attempted in the present work. As we have found that by increasing small amount of thickness there is a scope for the future use, but whereas weight will be major issue for aircraft design.
Present work can be extended to fatigue analysis.

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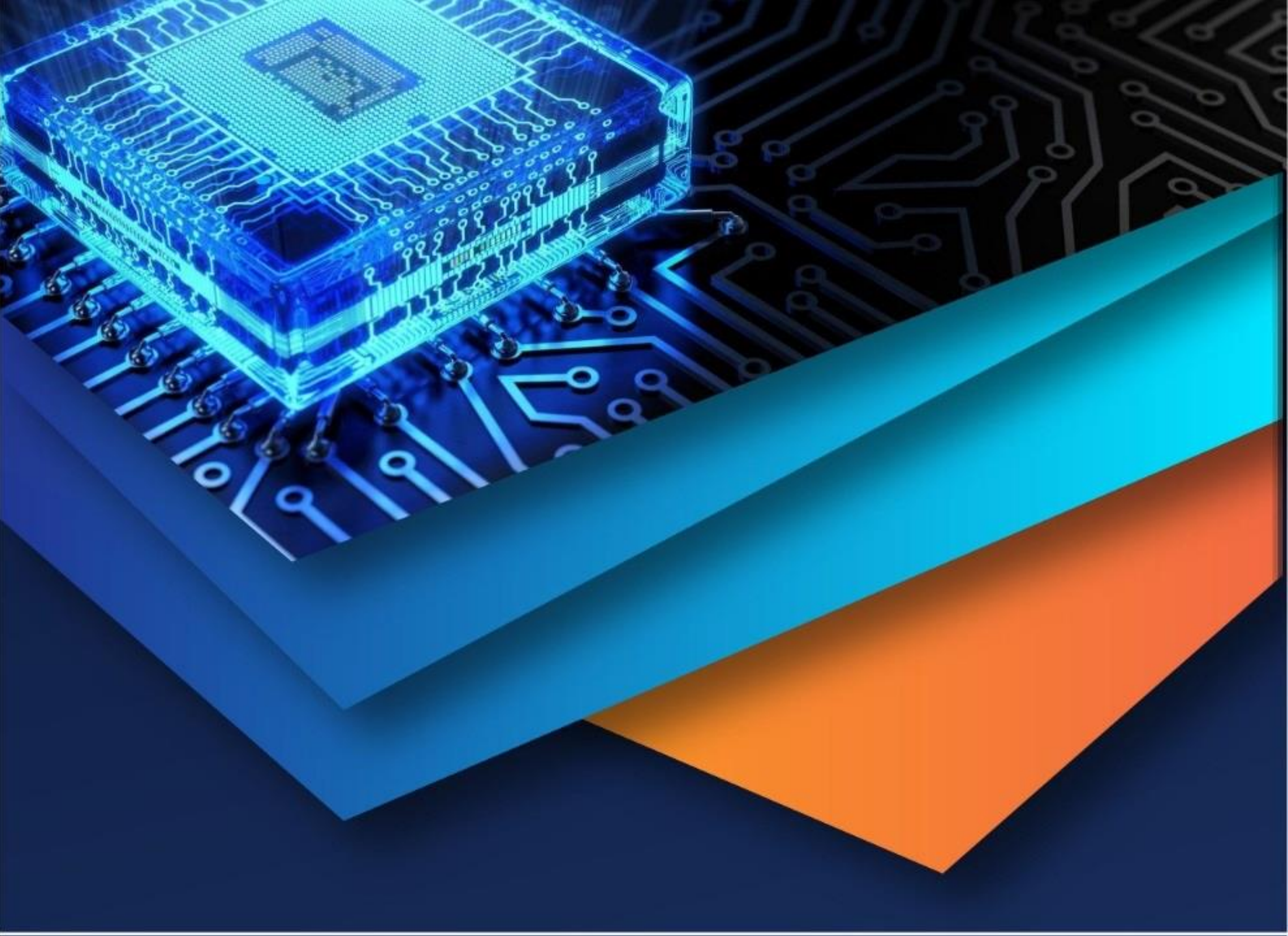

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