MODELING AND ANALYSIS OF DISC ROTOR WING

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Abstract-Disc rotor configuration may be a conceptual design. the aim of the Project is to guage the merits of the DiscRotor concept that combine the features of a retractable rotor system for vertical take-off and landing (VTOL) with an integral, circular wing for high-speed flight. The primary objective of this project is to style such a configuration using the planning software Unigraphics and afterward analyzing the designed structure for its structural strength in analysis software ANSYS. This project deals with the all the required aerodynamic requirements of the rotor configuration. In today's world most the vtol/stol largely depends upon the thrust vectoring that needs huge amounts of fuel and separate devices like nozzles etc., whose production is extremely much tedious and dear. this is often an effort to use a rotor as within the case of helicopters for vtol/stol thus reducing the foremost of the value though weight would be considered as a hindrance to the project.

Keywords: Disc rotor wing**,** vertical take-off and landing (VTOL), UNIGRAPHICS, ANSYS software, Force, Coefficients, Wall and Wing.

I. INTRODUCTION

A circular wing, or disc, is that the primary lifting surface of the Disc Rotor aircraft during high-speed flight (approx. 400knots). During the high-speed flight, the disc are going to be fixed (i.e. not rotating) at some height above the fuselage. The disc may be a low-aspect-ratio wing, which is understood to be relatively inefficient lifting surfaces. There are multiple methods to enhance the performance of a circular wing like circulation control (Imber and Rogers). just one method to enhance performance is taken into account where "blades" are added to the ideas of the disc within the spanwise direction. This method was chosen based upon results from experiments on VTOL aircraft concepts with similar wing shapes.Blades are going to be almost like Reverse Velocity Rotors (RVRs). RVRs have symmetric airfoil shapes and thus have identical lifting characteristics when oriented at 0º or 180º to the free stream (Van Riper). Experimental models where blades are extended will have rounded leading and trailing edges.

The underlining purpose of those experiments was conducted to assist within the development of the DiscRotor concept. Much of the model's geometry and dimensions were based upon work performed in tangent with the Boeing Corporation. Requirements of the planning analysis included information about the aerodynamic forces generated by a circular-shaped wing, including the wake behind a circular wing when a fuselage and tail is present. The aim here isn't the planning of the particular aircraft, but rather to supply the specified information for the planning and analysis of the DiscRotor concept. The DiscRotor aircraft has been proposed to satisfy the wants for a complicated VTOL aircraft. Figure 1-4 is an inventive impression of the DiscRotor aircraft shown from the port side. this idea combines the payload-efficient features of rotor blades for vertical take-off and landing with an integral, circular, fixed-wing for high-speed flight.

EXISTING AIRCRAFT

Conventional fixed-wing aircraft, like a billboard jet, generate lift by forward movement of the whole aircraft. Wings fixed in reference to the fuselage generated the lifting force to realize flight. Commercial jets are characterized by high cruising speed and high efficiency on the wing. For this reason, fixed-wing aircraft remain the foremost widely used aircraft so far. Conventional rotary aircraft, like helicopters, generated lift by rotating multiple blades connected to a central shaft turned by an engine. because the rotational speed increases the blades generated lift to realize flight. Helicopters are considered the foremost efficient VTOL aircraft so far due to the relatively low disc loading.

Figure 1-1: VSTOL Wheel of Mis-Fortune

Figure 1-2: Photos of V-22 Osprey

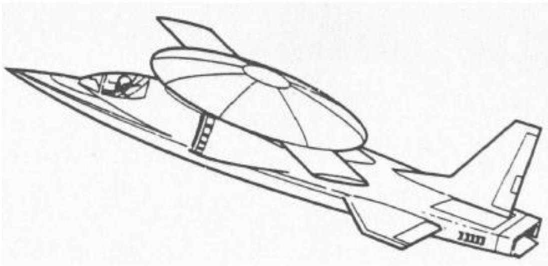
VSTOL aircraft concepts tested over the past 45 years. From left to right, during hover (Espinoza) and high-speed flight (Darcy).

Tilt Rotor: Osprey v-22

The V-22 Osprey has the power to take-off and land vertically with two rotors oriented vertically. As forward speed increases, the wing tip-mounted rotors are progressively titled to convert the aircraft into a configuration almost like a fixed-wing, turboprop airplane. Osprey combines the vertical takeoff, or hover, and landing capabilities of a helicopter with the forward speed of a hard and fast wing aircraft.

PROPOSED M-85 Concept AIRCRAFT

In the mid 1980s, there was a revival of interest in rotorcraft concepts that combine helicopter attributes with high cruise speed capabilities. This interest has driven investigations into multiple aircraft concepts over the years. within the mid 1980s, there was much interest to develop low downwash, high speed rotorcraft concepts (Talbot, Phillips and Totah). A relevant concept to the present study is that the stopped rotor design (M-85) and was the topic of studies performed at NASA Ames research facility.



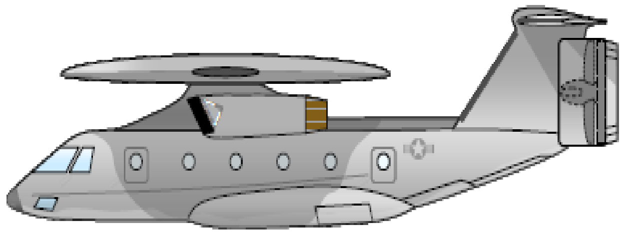


Figure 1-3: Stopped Rotor or M-85 Conceptual Drawing. Figure 1-4: Artistic Impression of DiscRotor configuration.

The concept is shown in Figure 1-3 and was derived as an approach to enable smooth, stable conversion between fixed-wing and hover-flight modes, while retaining the hover and low-speed flight characteristics of a coffee disk loading helicopter. The name, M-85, reflects the high-speed goal of 0.85 Mach number at high altitude. Emphasis has been placed on an efficient high-speed cruise then efficient hover. An initial analysis on the M-85 concept is reported in NASA Technical Memorandum 102871, Introduction of the M-85 High-Speed Rotorcraft Concept by Robert Stroub.

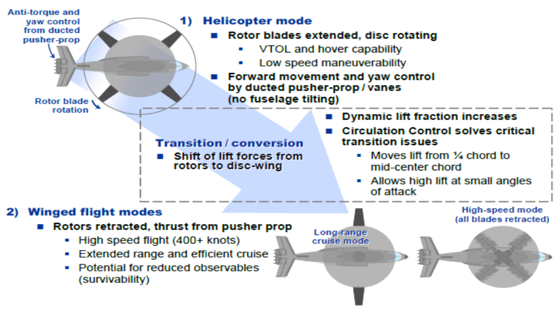
M-85 Fixed Wing Results

A low-speed structure test was completed by Swanson and Stroub in support of the planning study performed on the stopped rotor concept. the aim of this test was to guage the fixed-wing aerodynamics and compare three different cruise configurations. The results are presented in paper AIAA-1992-1067-859. the foremost efficient flight, i.e. highest L/D ratio, was achieved by extending two rotor blades from the stopped disc.

M-85 Hover Results

Hover characteristics are discussed within the NASA Technical Memorandum 102871 by Robert Stroub, Introduction to the M-85 High-Speed Rotorcraft Concept. It also discusses other technologies pertinent to the M-85 concept like passively controlling in-plane vibration during starting and stopping of the rotor system, aircraft system, and rotor drive technologies. As stated within the report, hover power is predicted to be no greater than 25% quite hover power for a standard rotor. This 25% power increment decided from small-scale model hover tests. The principal advantage of the DiscRotor is that the combination of low-speed VTOL and high-speed fixed-wing operation with the power to smoothly morph from helicopter flight to high-speed flight.

Hover flight and fixed-wing flight are the 2 main flight configurations for the DiscRotor.



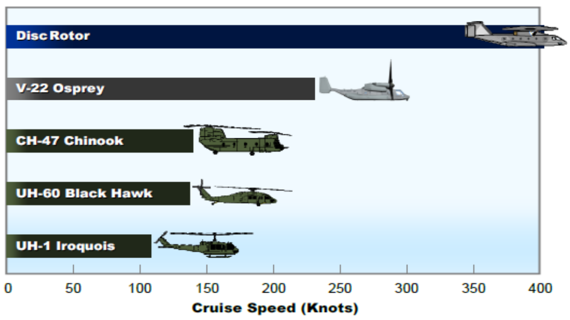


Figure 1-5: Diagram of the Disc Rotor's Flight Modes. Figure 1-6: DiscRotor Speed Capability Compared to Other Rotorcraft.

Transition during flight

The Disc Rotor will experience a period transition from hover to fixed-wing flight. This transition is critical to the Disc Rotor's success, though it accounts for a comparatively short period of flight time. Hover and high-speed flight will compose the bulk of the flight time, and thus, focus of this study. Transition between modes are going to be re-examined in following efforts by the Boeing-VA Tech Team.

Benefits of concept

As mentioned, the principal advantage of the configuration comes from the mixture of VTOL and high-speed operability while having the ability to smoothly morph from hover to high-speed flight. The concept embodies the simplest attributes of the lifting efficiency of helicopters with the high-speed, high-altitude capability of a fixed-wing aircraft. The Disc Rotor provides significant improvements in capability compared to current rotorcraft technology.

Figure 1-6 compares the estimated cruise speed capability of this new concept aircraft thereupon of existing VTOL-capable platforms. it's estimated that the Disc Rotor will cruise at speeds in more than 400 knots, nearly 3 times as fast because the UH-60 when loaded with a complement of personnel and equipment, and almost twice as fast because the V-22 Osprey.

Initial Sizing

As a start line for analysis and style, an initial sizing study was conducted by partners from the Boeing Corporation. the choices were guided by engineering principles, past research, existing aircraft and knowledge. The sizing study is summarized in Figure 1-7. These results were utilized in defining and fabricating generic models utilized in experimentation and numerical study.

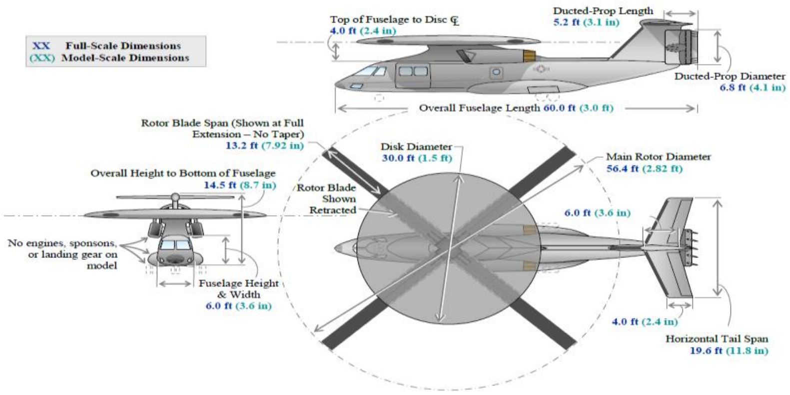


Figure 1-7: Results of Initial sizing by Boeing Model dimensions are for a 1:20 scaled model.

GEOMETRIC MODELING

it's a branch of applied math and computational geometry that studies methods and algorithms for the mathematical description of shapes. The shapes studied in geometric modeling are mostly two- or three-dimensional, although many of its tools and principles are often applied to sets of any finite dimension. Two-dimensional models are important in computer typography and technical drawing. Three-dimensional models are central to CAD and manufacturing (CAD/CAM),and widely utilized in many applied technical fields like civil and engineering, architecture, geology and medical image processing.

Geometric models are usually distinguished from procedural and object-oriented models, which define the form implicitly by an opaque algorithm that generates its appearance. they're also contrasted with digital images and volumetric models which represent the form as a subset of a fine regular partition of space; and with fractal models that give an infinitely definition of the form.

ROTARY WING PROFILE

As already mentioned, the wing profile is within the sort of delta wing and therefore the rotor system has three blade rotors of NACA 0012 profile. The delta wing profile is NACA 0016 which is that the symmetrical airfoil shape. the necessity for symmetrical profile is again associated with the installation of the rotor system at the center of the wing component and performs all the operational maneuvers. The rotor twist plays a crucial role within the operational VTOL and lift generation. The profile would be in such a fashion that the fluid encountering to the wing gets twisted by the rotor.System at the located point and spins about the rotor axis which allowing to go away the rotor configuration and thus; following the remaining wing path and again gets into the atmosphere.

II LITERATURE SURVEY

The Fairey Gyro force unit, this sort of craft later evolved into the a lot of larger twin-engine Fairey Roto force unit, that used tip jets to power the rotor on take-off and landing however that then used 2 antelope turboprops driving typical propellers mounted on substantial wings to supply propulsion, the wings serving to unload the rotor throughout horizontal flight. The Rotodyne was developed to mix the potency of a fixed-wing craft at cruise with the VTOL capability of a whirlybird to supply short haul airplane service from town centers to airports. The concept of victimization constant engine for vertical and horizontal flight by fixing the trail of the thrust diode to the city Siddeley Pegasus engine that used rotating ducts to direct thrust over a spread of angles. electrical engineer proprietary a vertical take-off and landing vehicle thought in 1928. AN early purposeful contribution to VTOL was Rolls-Royce's Thrust mensuration Rig ("flying bedstead") of 1953. This diode to the primary VTOL engines as employed in the primary British VTOL craft, the Short SC.1 (1957) that used four vertical elevate engines with a horizontal one for forward thrust. Another British VTOL project was the gyro force unit, wherever a rotor is hopped-up throughout take-off and landing however that then freewheels throughout flight, with separate propulsion engines providing forward thrust. In 1954, within the chair of "The construction {and style|and style} of helicopters national capital Aviation Institute organized a design team to develop craft-jet transport (aircraft with vertical take-off and landing). The project is being enforced underneath the steering of Academician BN Yuryeva and informatics Bratuhina conjunction with the All-Union Electro technical Institute, wherever the director at that point was academician Iosifyants atomic number 47. For the chosen landing force installation of 4 theatre NK-12MV capability of 12000 bhp, that were used for Tu-95 bomber. Planned that may be the engine to propel homocentric aerial screws diameter of six meters.

This was developed aspect by aspect with AN framing, the Hawker P.1127, that became later the Kestrel so entered production because the Hawker Siddeley Harrier, tho' the supersonic Hawker Siddeley P.1154 was canceled in 1965. The French in competition with the P.1154 had developed a version of the Dassault Mirage III capable of accomplishing Mach one. The Dassault Mirage IIIV achieved transition from vertical to horizontal flight in March 1966, reaching Mach one.3 in level flight a brief time later. The Harrier is usually flown in STOVL mode that permits it to hold a better fuel or weapon load over a given distance. the British Royal Navy service, the Navy operates SeaHarriers principally from its combat ship INS Viraat. the most recent version of the Harrier, the BAE Harrier II is operated by the British Royal Air Force and Royal Navy.

Search and Rescue Missions

The look for and rescue of personnel in hostile territory, i.e. the Combat Search and Rescue mission (CSAR) may be a vital military air mission. This mission requires rapid deployment, vertical takeoff and landing (VTOL) capability, long range, extended loiter and high maneuverability. Speed is crucial to the survival of the wounded and to undetected passage through enemy territory. The success of those CSAR missions depends upon the capabilities of aircraft. the present CSAR platform, the UH-60 Blackhawk, features a mission cruise speed but 150 knots (UH-60A Blackhawk). Mission speed could also be increased and acoustic detectability reduced by configuring a complicated CSAR as a tiltrotor, just like the V-22, which cruises at about 230 knots, thanks to the more efficient propulsion afforded by its tilting proprotors (Boeing V-22 Osprey Backgrounder). However, the two disc-loading of the tiltrotor is nearly double that of a helicopter, reducing hover efficiency and leading to increased downwash velocities that subtract from personnel rescue operations. during a future CSAR aircraft, where speed is crucial to the survival of wounded personnel.

Emergency Response Applications

Both civilian and military rescue missions require rapid response to achieve success. Aircraft used for rescue applications require VTOL capability to succeed in remote areas because landing strips aren't available. Helicopters are the sole current suitable aircraft for such operations, but are unable to succeed in high speeds. An aircraft with the power to succeed in speeds twice as high as helicopters would scale back the reaction time of EMS personnel. a couple of minutes in reaction time can determine the difference between life and death during a stroke or attack. a typical take off time for an EMS response helicopter, like the Dauphin N2, is seven minutes which doesn't include the transit time during flight. The cruising or maximum flight speed is typically between 120 and 160 knots. In rural areas, far more distance must be covered to succeed in patients and therefore the reaction time depends more upon the aircraft's maximum speed. to extend the reaction time, the in-transit or flight time would need to be decreased by increasing aircraft speed.

III DESIGN METHODOLOGY

Hover Flight – DiscRotor Model

An idea for a completely unique high-speed,VTOL aircraft has been proposed and mentioned because the DiscRotor. See chapter one for an in depth description of this idea. The concept will emphasize higher-speeds and increased mission radii compared to existing VTOL aircraft. during this section, the aerodynamic forces and wake structure are examined for a completely unique rotor design. The rotor consists of a rotating disc with blades extended from its periphery.

Tests were conducted to get basic aerodynamic characteristics of this novel rotor in hover. Because no such rotor exists, the validity of this as a lifting system was a critical design requirement. Small scale tests were conducted on a 3ft diameter rotor without the presence of a fuselage. A "hover rig" was constructed capable of rotating the model at accelerates to three,500 RPM to succeed in tip speeds of 500fps. We consider a way to enhance the circular wing's performance within the previous chapter by simply leaving two blades extended within the spanwise direction, however, one among the blades are going to be improperly aligned, presenting a pointy vanguard. Reverse Velocity Rotors (RVRs) have symmetric airfoil shapes and thus have identical lifting characteristics when oriented at 0º or 180º to the free stream (Van Riper). The blades for this experiment model will have rounded leading and trailing edges to mimic RVRs.

ROTOR STYLE

It is a kind of fan that's accustomed generate each the lift force that supports the burden of the whirlybird and thrust that counteracts mechanics sweep up forward flight. Before the event of hopped-up helicopters within the middle twentieth century, machine gyro pioneer Juan American state la Cierva researched and developed several of the basics of the rotor.

Figure 3-1 Swash plate of a rotor

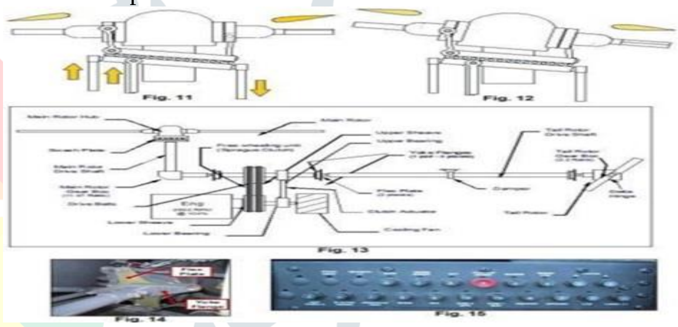


Figure 3-2. operating of a swash plate

SWASH PLATE

The pitch of rotor blades will be varied cyclically throughout its rotation so as to manage the direction of rotor thrust vector (the a part of the rotor disc wherever the most thrust are developed, front, rear, right side, etc.). Collective pitch is employed to vary the magnitude of rotor thrust (increasing or decreasing thrust over the entire rotor disc at constant time). The overwhelming majority of helicopters maintain a continuing rotor speed (RPM) throughout flight, exploit solely the angle of attack of the blades because the sole means that of adjusting thrust from the rotor.The swash plate is 2 coaxial disks or plates; one plate rotates with the mast, connected by idle links, whereas the opposite doesn't rotate. The rotating plate is additionally connected to the individual blades through pitch links and pitch horns. The non-rotating plate is connected to links that ar manipulated by pilot controls, specifically, the collective and cyclic controls. The swash plate will shift vertically and tilt.

ROTOR CONFIGURATION VARIETIES

Figure 3-3 Aerospatiale/Westland catamount.

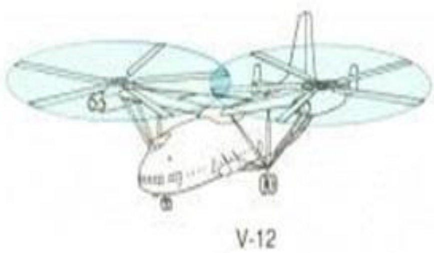


Figure 3-4 The Mil Mi-12 (V-12)

Figure 3-5 The Kaman HH-4

Figure3-6 tandem bicycle rotors (fore and aft)

Fig 3.7 A homocentric rotor is found on the Kamov Ka-25.

BLADE STYLE

For a whirlybird, the rotor is that the lift-producing device. The blades of the rotor ar airfoil-shaped and ar long and slender (large facet ratio). the amount of blades varies with the look. Generally, for heavier helicopters, a lot of blades ar accustomed cut back the load that every should carry..

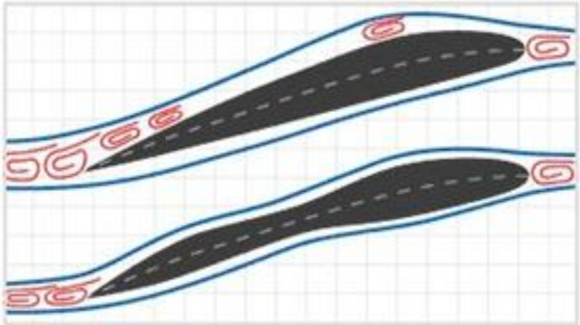


Figure 3-8 blade profiles

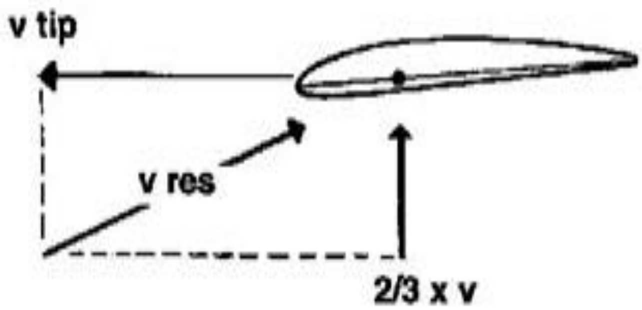


Figure 3-9 rate profile

3.4.1 VELOCITIES WITHIN THE ROTOR PLANE

The wind speed "V" is stalled within the rotor plane. Energy is extracted. The wind speed once the rotor is apex. 1/3 x V (max. efficiency).The blade doesn't "see" the wind from the direction; it truly comes as a result of the blade rotates through the air with a tip speed "V tip". This creates the ensuing wind speed "V res" therefore you'll be able to construct "V res".

AIRFOIL, ELEVATE & DRAG

Probably the one most vital rotor style parameter is its Lift/Drag quantitative relation, that ought to be as high as doable. M This quantitative relation depends on the look of the surface. this can be the thickness of the device as a proportion of the chord length. A blade with a decent L/D performance encompasses a fineness quantitative relation of regarding V-day, with its most chamber being 1 / 4 of the method back from the vanguard. A typical L/D worth for a whirlybird blade is 30:1.

The types of surface used with a airfoil dissent.

BLADE TWIST &TAPER

When a blade rotates, every purpose thereon travels at a unique speed that is removed from the foundation, the upper the rate. this implies that the contribution to elevate and drag of each purpose on the blade differs, with every facet obtaining larger once moving nearer to the rotor tip. The elevate distribution over the blade isn't constant, that isn't the fascinating scenario as a result of the contribution diminishes once obtaining nearer to the foundation. to vary this distribution, blades ar twisted and, sometimes, additionally tapered. The twist is specified the angle of attack will increase once traveling towards the foundation, manufacturing a lot of elevate. Tapering the blade additionally contributes to achieving a a lot of equally spaced elevate distribution. With blade tapering, the blade's surface gets larger once traveling towards its root. each tapering and twisting will be determined once wanting rigorously at rotor blades at rest

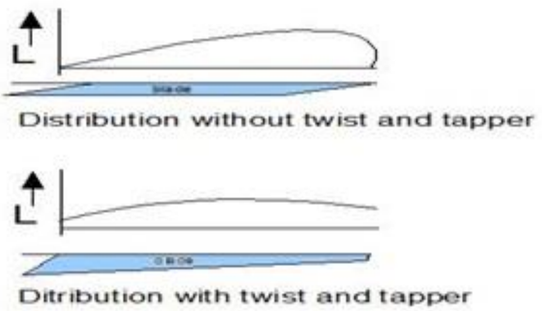


Figure 3-10 Graphs for elevate and taper distribution

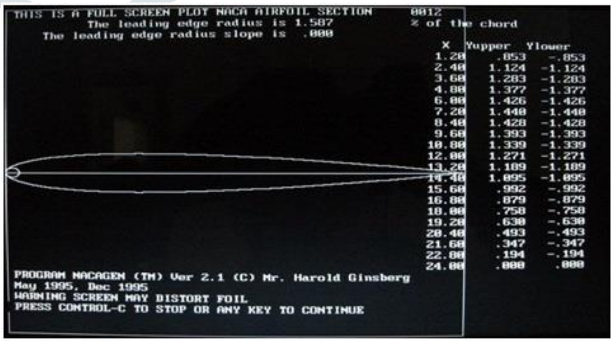


Figure 3-11 Blade Profile NACA 0012

BLADE ROOT CUT OUT

Blade twist and taper ends up in giant angle of attack and huge blade surfaces at the foundation. However, near to the foundation, the blade is traveling over the hull, therefore the generated downwash doesn't contribute to whirlybird thrust. For this reason, rotor blades ar usually cut out close to the foundation. another excuse for airfoil cut out is to scale back the results of potential reverse flow once flying at high speeds

TWISTING MOMENTS

Rotor blades ar perpetually strained by moments that try and twist them. This twisting has its origins within the moments that exist between the centre of pressure (due to the mechanics forces) and therefore the mass center of mass over the chord line. The mass center of mass is found earlier than the centre of pressure for all blade angles (in its operational range). during this method, elevate tends to lower the angle of attack: a stable condition.

BLADE TIP SPEED & NOISE REDUCTION

When the blades ar terribly long or the whirlybird is meant with a high rotor revolutions per minute, the blade tip speed will become very high. once the tip speed reaches the sound of speed, pressure waves inherit existence, that causes rotor drag. A high tip speed is additionally the one most vital style parameter influencing generated noise levels. It is, therefore, logical to expect a lot of styles with lower revolutions per minute and really economical (larger L/D ratio) performance blades. during this method, blade potency is listed off for noise reduction rather than higher flight performance.

IMPACT OF FIXING WIND SPEED

Changing the Wind Speed Changes Wind Direction Relative to the airfoil

In this next image we've taken one airfoil from its hub, and that we look from the hub towards the tip, at the rear aspect (the lee side) of the airfoil. The wind within the landscape blows between, say eight m/s and sixteen m/s (from rock bottom of the picture), whereas the tip of the blade rotates towards the left aspect of the image.

The angle of attack of the wind changes way more dramatically at the foundation of the blade (yellow line) than at the tip of the blade (red line) because the wind changes. If the wind becomes powerful enough to create the blade stall, it'll begin stall at the foundation of the blade.

ELEVATE DIRECTION

Let us cut the airfoil at the purpose with the yellow line. within the next image the gray arrow shows the direction of the elevate at this time. The elevate is perpendicular to the direction of the wind. As elevate pulls the blade part within the direction we would like, i.e. to the left therefore it additionally bends the airfoil somewhat.

AIRFOIL PROFILES (CROSS SECTIONS)

The turbine rotor blades look tons just like the wings of AN craft. In fact, airfoil designers usually use classical craft wing profiles as cross sections within the outmost a part of the blade.

The thick profiles within the innermost a part of the blade ar typically designed specifically for wind turbines. selecting profiles for rotor blades involves variety of compromises together with reliable elevate and stall characteristics and therefore the profile's ability to perform well even though there's some dirt on the surface.

3.4.10 AIRFOIL MATERIALS

Most modern rotor blades on giant wind turbines ar fabricated from glass fibre bolstered plastics, (GRP), i.e. glass fibre bolstered polyester or epoxy. victimization carbon fiber or aramid (Kevlar) as reinforcing material is another chance, however typically such blades ar wasteful for giant turbines. Wood, wood-epoxy, or wood-fiber-epoxy composites haven't penetrated the marketplace for rotor blades, though there's still development happening during this space. Steel and Al alloys have issues of weight and metal fatigue severally. they're presently solely used for terribly tiny wind turbines.

BLADE PROFILE

The rotor system has 3 blade rotors of NACA 0012 profile that is that the symmetrical device form. The rotor twist plays a crucial role within the operational VTOL and elevate generation.

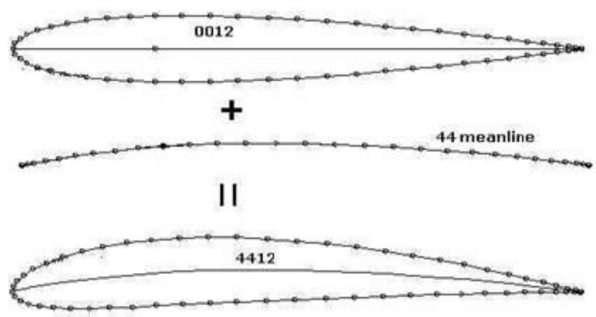


Fig. 2

Figure 3-12 airfoil profiles

Figure 3-13 Drag polar of NACA 0012

The profile would be in such a fashion that the fluid encountering to the wing gets twisted by the rotor system at the settled purpose and spins regarding the rotor axis that permitting to depart the rotor configuration and thus; following the remaining wing path and once more gets into the atmosphere. The profile chosen rotor configuration encompasses a sensible L/D quantitative relation and with alittle angle of attack the elevate generation can be done terribly simply.

3.5.1 NACA 0012

As AN in mucilaginous and incompressible fluid flows, the full head remains unchanged,‖ thus aforesaid Bernoulli in adapting the conservation of energy law to fluid flow. That means, in plain English, that while not friction, energy of a fluid stream is preserved. the tip purpose of all airfoils is to vary the direction, or a lot of expressly, the momentum of a moving atmosphere with a minimum of friction loss. Momentum is that the product of mass and velocity; it's a vector amount, which means that it's direction. To AN heavier-than-air craft, the airstream has horizontal momentum and to supply the reaction we tend to decision elevate, a number of the oncoming atmosphere should run a downward momentum. elevate is that the same quite development because the recoil of a piece.

The ensuing basic section is that the NACA 0012 which may be outlined mathematically and might simply be scaled to ANy thickness by ever-changing the constants in an equation. the results of thickness and camber were therefore separated and a scientific cataloging system can be applied; style of a Dewey decimal number system for airfoils. the primary number indicates {the most|the utmost|the most} camber of the mean line in p.c of chord and therefore the second the placement of maximum camber from the vanguard in tenths of chord. The last 2 integers indicate the thickness in p.c of chord. The mean lines used with NACA four digit airfoils are mathematically outlined.

Highly cambered airfoils that employment well for mechanical device blades would be calamitous if used for a rotor wing bearing on the forty four mean line, the form resembles a Venetian blind slat. From the revealed device coefficients the twisting force will be calculated:
Lift against angle of attack for the NACA 0012 surface at numerous Reynolds numbers between two hundred,000 and 1,000,000 and at numerous angles of attack between -20 and twenty.
Lift against drag for the NACA 0012 surface at numerous Reynolds numbers between two hundred,000 and 1,000,000 and at numerous angles of attack between -20 and twenty degrees.

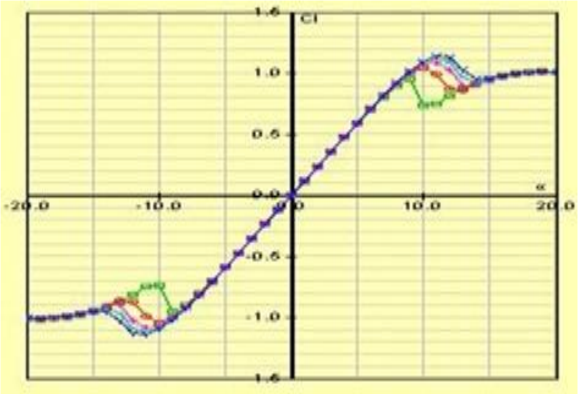


Figure 3-14 elevate of NACA 0012

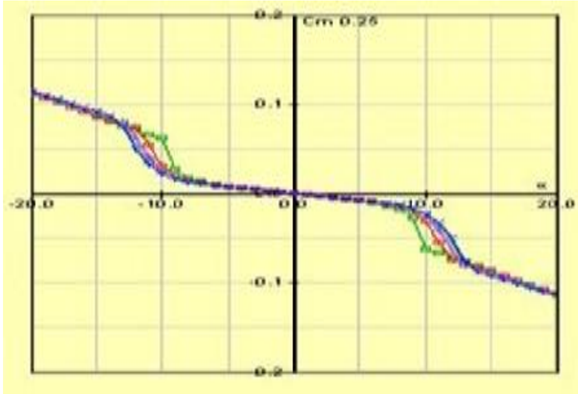


Figure 3-15 Moment co economical of NACA 0012

3.6 VTOL (VERTICAL INITIATE & LANDING)

It includes fixed-wing craft which will hover, initiate and land vertically yet as helicopters and alternative craft with hopped-up rotors, like tilt rotors. The word for artificial satellite and rockets is VTVL (vertical takeoff with vertical landing). Some VTOL craft will operate in alternative modes yet, like CTOL (conventional take-off and landing), STOL (short take-off and landing), and/or STOVL (short take-off and vertical landing). Others, like some helicopters, will solely operate by VTOL, because of the craft lacking undercarriage which will handle horizontal motion. VTOL could be a set of V/STOL (vertical and/or short take-off and landing).

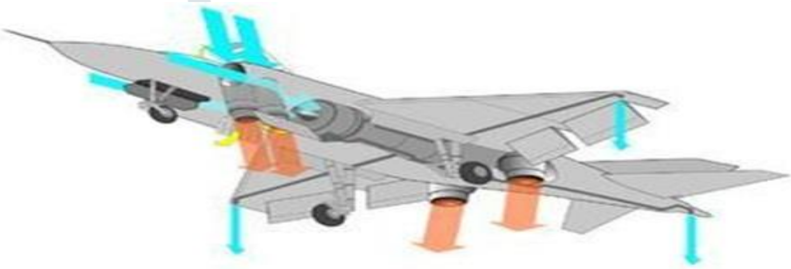


Figure 3-16 Thrust vectoring

The first operational VTOL jet craft was the British Royal Air Force Harrier; its jet engines ar mounted horizontally, with their blast deflected downward to impact vertical thrust for takeoff. It achieved high subsonic speeds in level flight VTOL and STOL craft have the distinct advantage of having the ability to require off and land "on a dime". They didn't need a runway like ancient craft. The VTOL may initiate and land just about anyplace together with rooftops and ship decks aside from craft carriers. STOL solely needed a brief runway. There has invariably been AN interest in developing these forms of airships for strategic and sensible reasons. However. There ar size constraints. the biggest whirlybird is that the Russian Sikorsky which may elevate full ocean instrumentality crates. the biggest and quickest VTOL is that the Harrier "Jump" jet, used extensively to the current day by the British and Indian Air Force. There aren't any industrial sized VTOL or STOL craft. there's a revival of interest in Zeppelins, originally popularized by the Nazis, taking them successive step additional, wherever thousands of individuals will be transported.

MODELING OF DISC ROTOR BY UNIGRAPHICS

Engineering drawings are in use for quite 2000 years. However, the utilization of orthographic projections was formally introduced by the French mathematician Gaspard Monge within the eighteenth century. Since visual objects transcend languages, engineering drawings have evolved and become popular over the years. While earlier engineering drawings were handmade, studies have shown that engineering designs are quite complicated. an answer to several engineering problems requires a mixture of organization, analysis, problem solving principles and a graphical representation of the matter. Computers are getting used increasingly for both design and detailing of engineering components within the drawing office CAD (CAD) is defined because the application of computers and graphics Software to assist or enhance the merchandise design from conceptualization to documentation. CAD Is most ordinarily related to the utilization of an interactive special effects system, mentioned as a CAD system. CAD systems are powerful tools and within the mechanical design and geometric modeling of products and components. There are several good reasons for employing a CAD system to support the engineering design

UNIGRAPHICS

NX is one among the world's most advanced and tightly integrated CAD/CAM/CAE development solutions. Spanning the whole range of development, NX delivers immense value to enterprises of all sizes. It simplifies complex product designs, thus speeding up the method of introducing products to the market. The NX software integrates knowledge based principles, industrial design, geometric modeling, advanced analysis, graphic simulation, and concurrent engineering. The software has powerful hybrid modeling capabilities by integrating constraint based feature modeling and explicit geometric modeling.
NX design tools are superior in power, versatility and productivity. you'll work faster and more efficiently within the full range of design tasks, from 2D layout through 3D modeling, assembly design, drafting and documentation. Work Seamlessly with Data from Other CAD Systems • With synchronous technology, NX allows you to directly use models created with other CAD

systems. you'll import and modify CAD geometry from any source with speed, ease and efficiency. NX is that the solution of choice for multi-CAD, collaborative design.

MODELLING OF DISC ROTOR

The following steps or images shows the procedure or process how the disc rotor shoud be modeled in Unigraphics software modeled in Unigraphics software

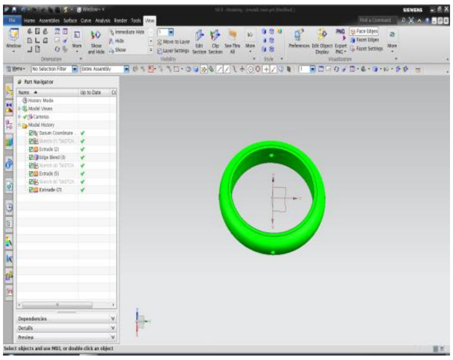


Figure 4-1: Rotor pheripare

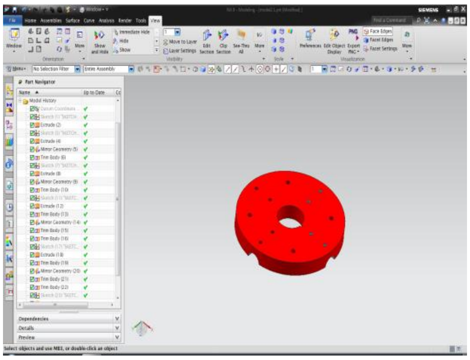


Figure 4-2: Drilled rotor disc

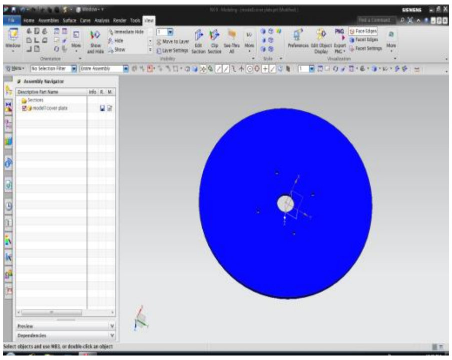


Figure 4-3: Disc Plate

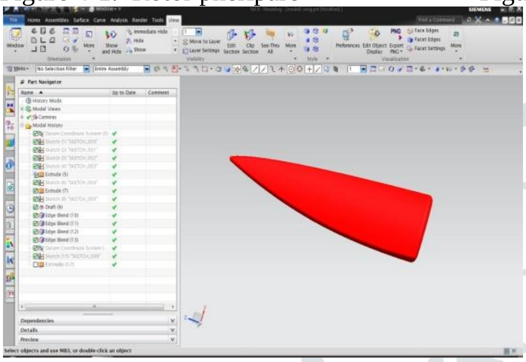


Figure 4-4: Rotor Wing

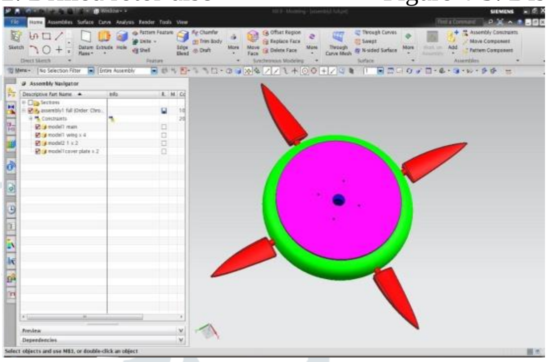


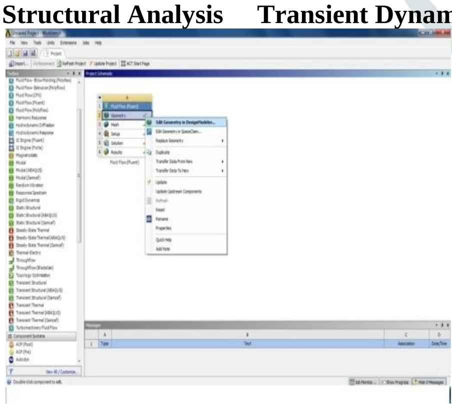
Figure 4-5: Assembly of disc rotor

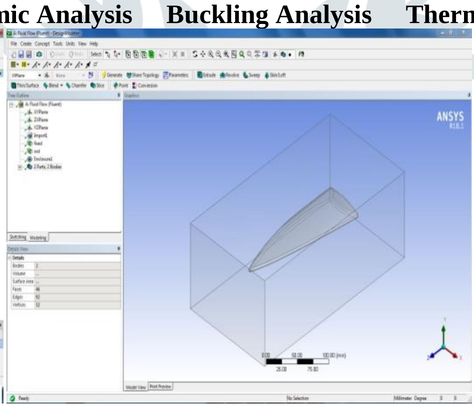
DISC ROTOR BLADE ANALYSIS

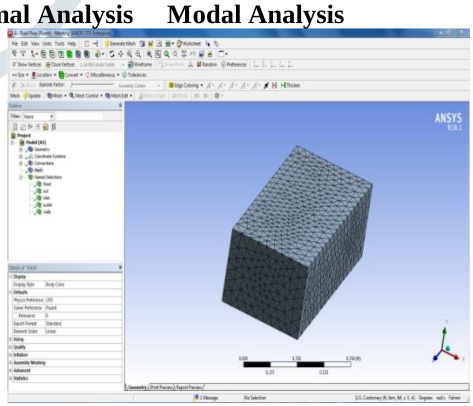
Today technology helps solving most complex problems. it's effectively used not just for structural analysis but also for a good range of phenomenon like static (structural, creep, fatigue, fracture), dynamic (linear and non-linear), vibration and noise, heat transfer, fluid flow; additionally to manufacturing processes like injection molding and metal forming..As CAD/CAM/CAE technology is far advanced, ANSYS, evolved because the hottest and complete CAE package with its highly powerful capabilities to assist us understand the important world functionality of a design. ANSYS Mechanical provides solutions for several sorts of analyses including structural, thermal, modal, linear buckling and shape optimization studies. ANSYS Mechanical is an intuitive mechanical analysis tool that permits geometry to be imported from variety of various CAD systems. It are often wont to verify product performance and integrity from the concept phase through the varied product design and development phases.

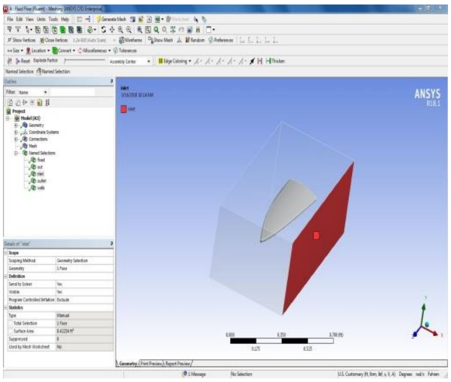
Specific Capabilities of ANSYS:

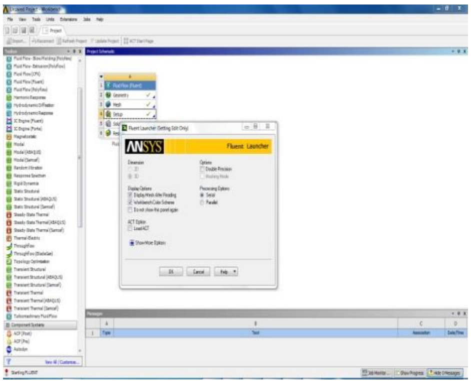
Structural Analysis Transient Dynamic Analysis Buckling Analysis Thermal Analysis Modal Analysis

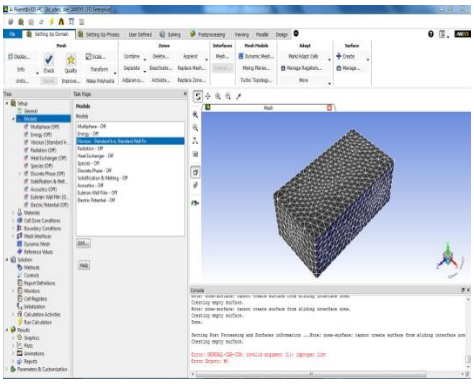


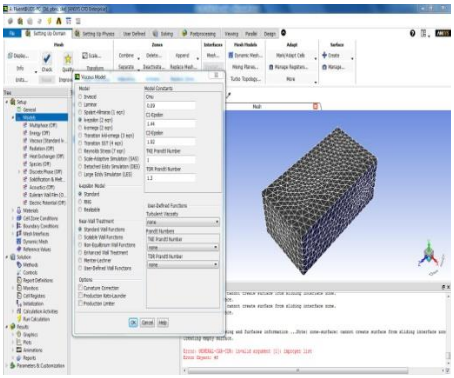


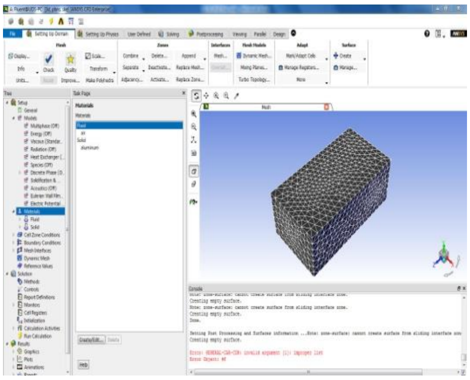


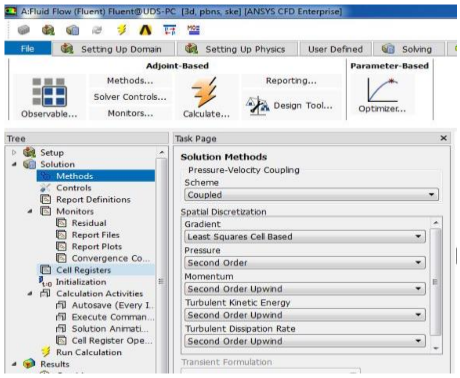


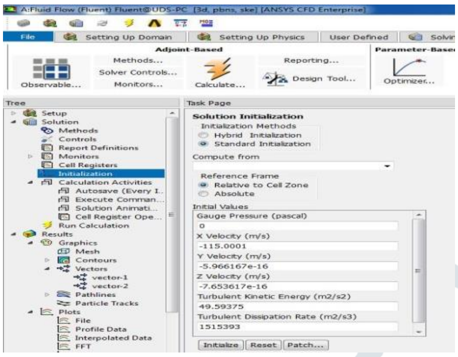


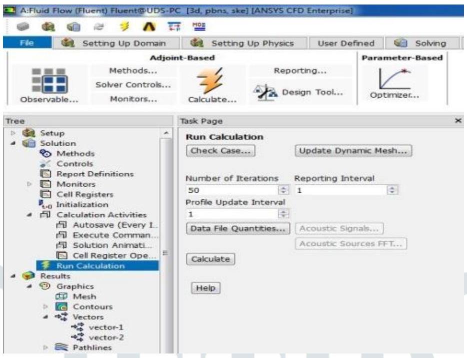


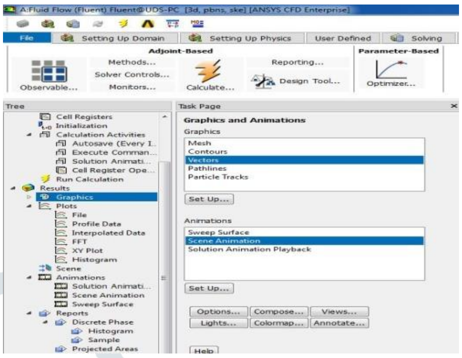


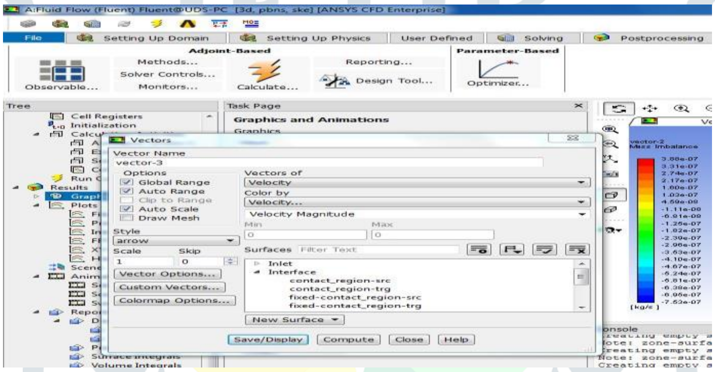






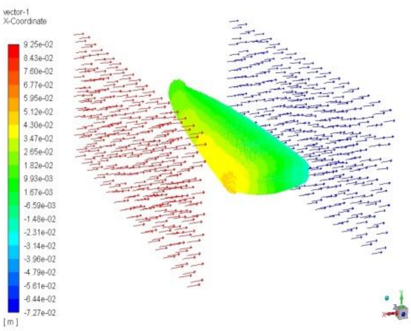


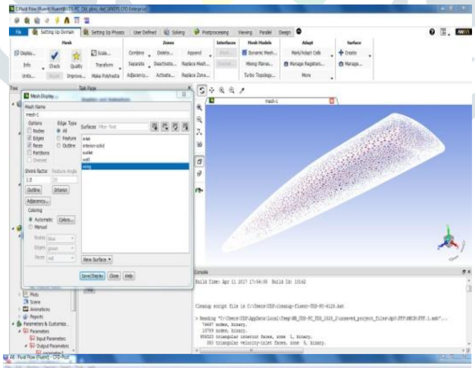


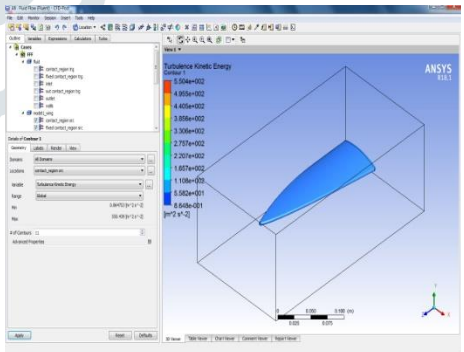


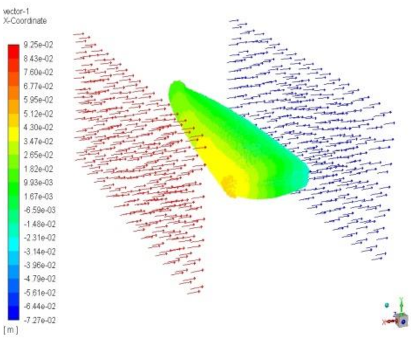
To Calculate the results we've to line some iterations..

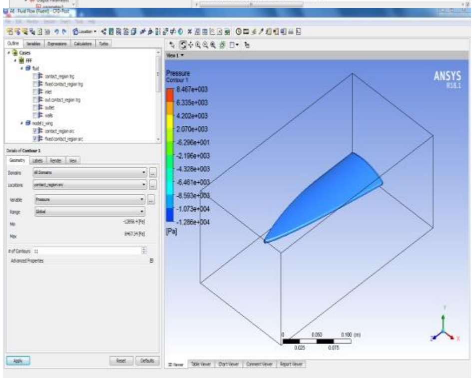
ANALYSIS RESULTS ROTOR BLADE

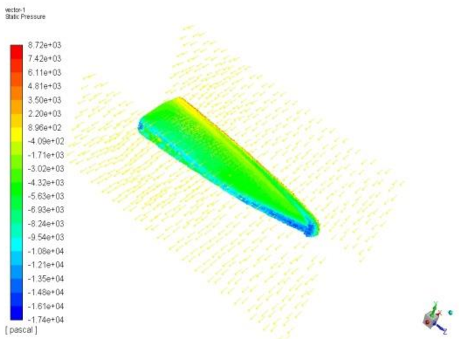


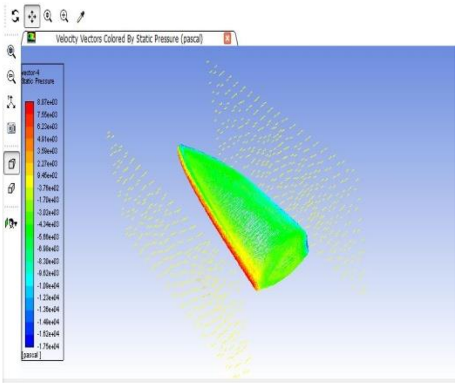


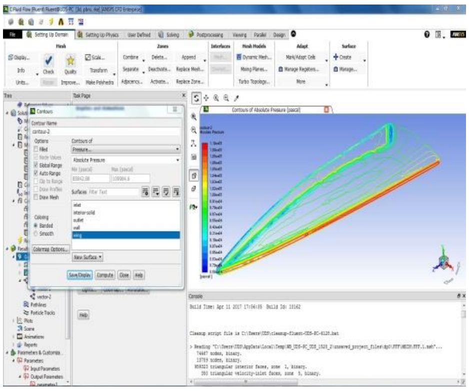


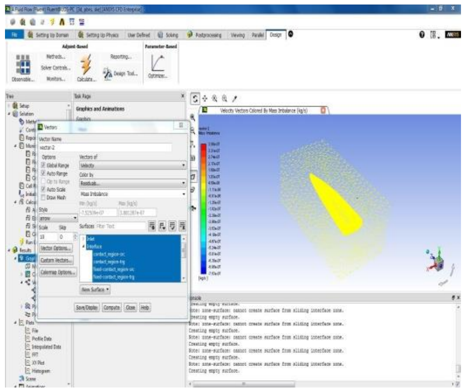


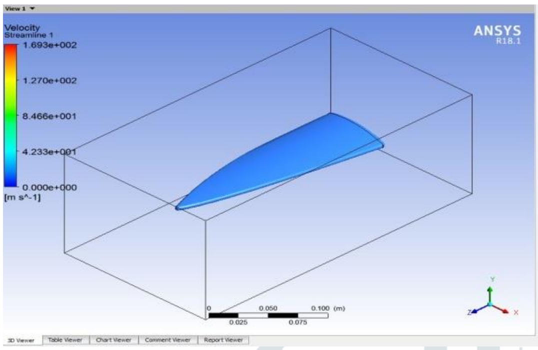


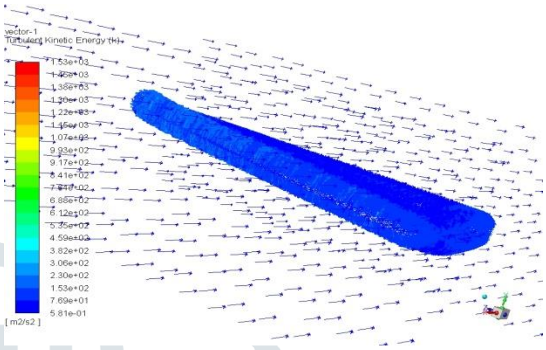


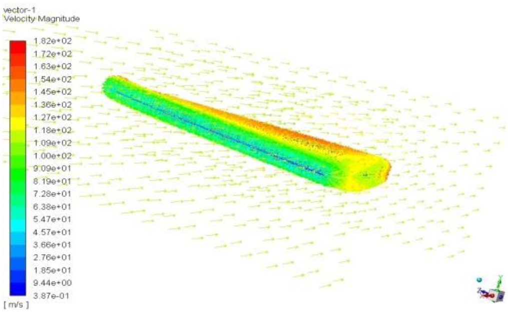


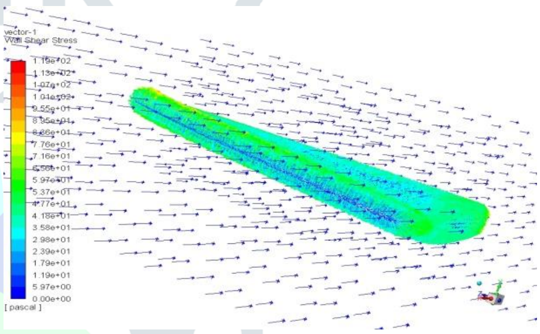




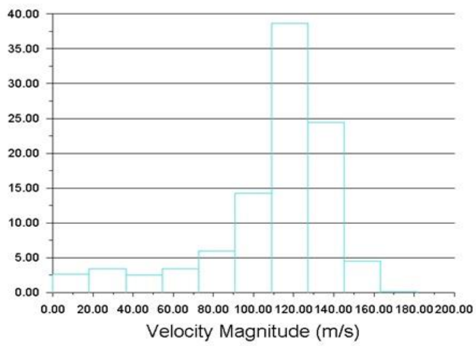




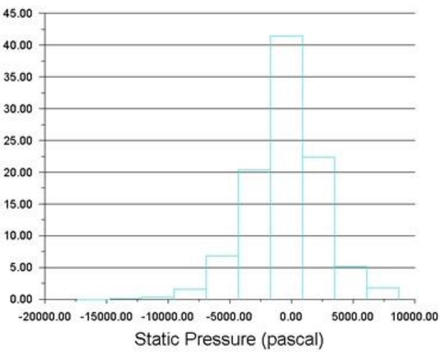




GRAPHS



Graph: 1



Graph: 2

RESULTS AND DISCUSSION

Forces - Direction Vector (1 0 0)

Zone		Forces (n)			Coefficients		
		Pressure	Viscous	Total	Pressure	Viscous	Total
Iteration 1	wall	4.9017644e-17	- 2.7047527	-2.7047527	6.0513284e-21	-0.00033390725	-0.00033390725
	wing	-3.7729387	-0.88418114	-4.6571199	-0.000465777	-0.00010915397	-0.00057493097
		----------	----------	---------	---------	----------	----------
	Net	- 3 7729387	-3.5889338	-7.3618726	-0.000465777	-0.00044306122	-0.00090883822
Iteration 2	wall	-5.2432156	0.0015065818	-5.241709	-0.000647285	1.859906e-07	-0.00064709969
	wing	5.126626	-0.001938871	5.1246871	0.00063289246	-2.3935767e-07	0.00063265311
		-----------	-----------	-----------	----------	-----------	----------
	Net	-0.11658955	0.0004322899	-0.11702184	-1.4393218e-05	-5.3367072e-08	-1.4446585e-05

Iteration 3	**wall**	**5.8412189**	**-0.009226338**	**5.8319926**	**0.00072111042**	**-1.1390104e-06**	**0.00071997141**
	wing	**-0.60157192**	**-0.003643047**	**-0.60521496**	**-7.4265283e-05**	**- 4.4974161e-07**	**-7.4715025e-05**
		-------------	----------	---------	-----------	-----------	-----------
	Net	**5.239647**	**-0.012869386**	**5.2267776**	**0.00064684514**	**-1.588752e-06**	**0.00064525639**

Table 6-1

Mass-Weighted Average

Model	Zone	Max	Min	Total
Fluid model wing	**Static Pressure(pascal)**	**306.1982**	**0**	**306.1982**
	Average Velocity Magnitude (m/s)	**117.42899**	**0**	**117.42899**
	Max Velocity Magnitude (m/s)	**181.50932**	**0**	**181.50932**
	Min Velocity Magnitude (m/s)	**0.38699782**	**0**	**0.38699782**

Table 6-2

CONCLUSION

The new design of Rotor is meant in Unigraphics and therefore the analysis of the blade has been through with the assistance of ansys software. The aerodynamic forces and wake structure are examined for a completely unique rotor design which may be a rotating disc with blades extended from its periphery. The thrust and torque from the model were measure via a two-component load cell. Results follow expected trends from momentum theory but show high non-ideal effects due to the disc and blade airfoil shape. Pressure and velocity measurements were performed within the wake of the model. Immediately downstream of the rotor, a neighborhood of “dead air” (low pressure and low velocity) was found due to the presence of the disc. Moving downstream, the wake was shown to collapse upon this pause region.

According to the recent analytical report the component is in much good position to uphold the pressure and maintain its strength, explains the prefect feature of this upcoming configuration it's feasible in nature.

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