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Prevention of Thermal Failures in Down-The-Hole Button Bit

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ABSTRACT: DTH is short for "down-the-hole". The down-the-hole drilling is used to produce large-diameter holes or bores in to the hard rock surfaces of earth crust. Generally the life of bit is 200 Metres because of insufficient of cooling or rough handling the life of button bit reduces. To avoid the cracks, wear and tear on the button bit there is a necessity to change material and design. The bottom surface of the button bit subjected to high thermal stress. Due to high temperature and impact force there is a chance of deflection of the head. In my paper we are going to design a new model to improve the heat transfer rate as well as high strength material. The results taken based on ANSYS software .Because while manual testing in the lab we got 98% nearer values to software value.

KEYWORDS: ANSYS[1], Button bit[2], DTH[3], Handling[4], impact force[5], strength[6], Thermal stress[7]

I. INTRODUCTION

In DTH drilling, the percussion mechanism commonly called the hammer is located directly behind the drill bit. The drill pipes transmit the necessary feed force and rotation to hammer and bit plus compressed air for the hammer and flushing of cuttings. The drill pipes are added to the drill string successively behind the hammer as the hole gets deeper. The piston strikes the impact surface of the bit directly, while the hammer casing gives straight and stable guidance of the drill bit. This means that the impact energy does not have to pass through any joints at all. The impact energy.

Different types of bits depending on the type of soil and the working conditions. The different types of bits are concave, convex and flat. The holes can be drilled ranging from 4 1/2 inch to 32 inch. The way to choose suitable drilling equipment is complicated and a lot of information is required to reach performance and economy in the operation. Aspects that have to be taken into consideration are the purpose of the borehole, geology, hydrogeology pump, method of drilling, flushing media and so on.

II. DTH BUTTON BIT

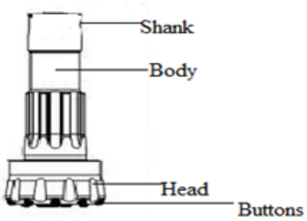

Fig: 2.1. DTH button bit

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This is to be made of strong metal for making a hole into earth It receives blows from piston so it should be ready to absorb shock loads. And generally any bit should be wear resistant. Any low carbon steel is ready to absorb the shock loads and it is wear resistant. Coming to the case of high carbon steel it is strong but cannot receive shock loads and it is not wear resistant. So our low carbon steel is carburized in order to get all the qualities we require.

They are all hot pressed and excellent heat treatment, which guarantee our quality are always consistent and reliable. Bits can come in different types: Flat-faced, Convex, Concave, drop enter, ballistic bits and dome bits.

III. MATERIAL USED FOR BUTTON BIT

EN-36-C is the material used for making button bit. EN-36-C material is an alloy steel. It possesses all the required qualities whatever properties required for the making of button bit and hammer. The higher chromium content of EN36C allows a much higher core strength of approximately 37~39HRC compared to a maximum of 33~35HRC for EN36A after tempering.

IV. THERMAL ANALYSIS OF DTH BIT

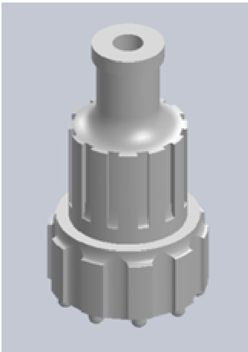

Fig: 4.1.design model of DTH Bit

Table 4.1.Model Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	4.12930 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition

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Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	Yes
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	11075
Elements	6451
Mesh Metric	None

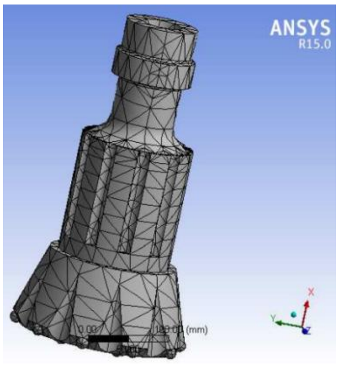

Fig: 4.2.Model Mesh

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4.1. Steady-State Thermal

Table 4.2.Model Analysis

Object Name	*Steady-State Thermal (A5)*
State	Solved
Definition	
Physics Type	Thermal
Analysis Type	Steady-State
Solver Target	Mechanical APDL
Options	
Generate Input Only	No

TABLE 4.3.Model Steady-State Thermal Initial Condition

Object Name	*Initial Temperature*
State	Fully Defined
Definition	
Initial Temperature	Uniform Temperature
Initial Temperature Value	295.15 K

Table 4.4.Model Steady-State Thermal Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Radiosity Controls	
Radiosity Solver	Program Controlled
Flux Convergence	1.e-004
Maximum Iteration	1000.
Solver Tolerance	1.e-007 W/mm²
Over Relaxation	0.1
Hemicube Resolution	10.
Nonlinear Controls	
Heat Convergence	Program Controlled
Temperature Convergence	Program Controlled
Line Search	Program Controlled
Output Controls	
Calculate Thermal	Yes

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Flux	
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\kishore\AppData\Local\Temp\WB_CHANDU_kishore_2992_2\unsaved_project_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	Yes
Solver Units	Active System
Solver Unit System	nmm

Table 4.5.Model Steady-State Thermal Loads

Object Name	*Temperature*	*Convection*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	8 Faces	1 Body
Definition		
Type	Temperature	Convection
Magnitude	873.15 K (ramped)	
Suppressed	No	
Film Coefficient		Tabular Data
Coefficient Type		Average Film Temperature
Ambient Temperature		295.15 K (ramped)
Convection Matrix		Program Controlled
Edit Data For		Film Coefficient
Tabular Data		
Independent Variable		Temperature

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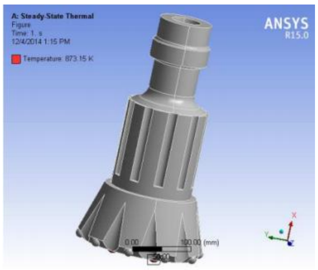
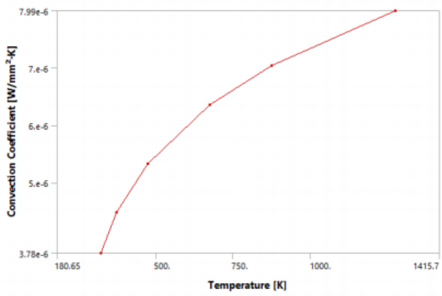


Figure 4.6.Model Steady-State Thermal Temperature



Graph: 4.1.Model Steady-State Thermal Convection

TABLE 4.6.Model Steady-State Thermal Convection

Temperature [K]	Convection Coefficient [W/mm²·K]
323.15	3.78e-006
373.15	4.49e-006
473.15	5.34e-006
673.15	6.35e-006
873.15	7.03e-006
1273.2	7.99e-006

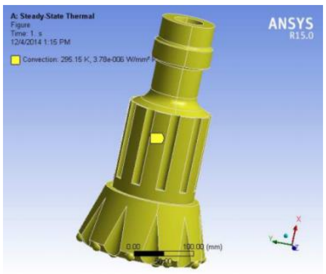


Figure 4.7.Model Steady-State Thermal Convection

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4.2. Solution

Table 4.7.Model Steady-State Thermal

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done

Table 4.8.Model Steady-State Thermal Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

Table 4.9.Model Steady-State Thermal Solution Results

Object Name	*Temperature*	*Total Heat Flux*	*Directional Heat Flux*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Temperature	Total Heat Flux	Directional Heat Flux
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Orientation			X Axis
Coordinate System			Global Coordinate System
Results			
Minimum	482.56 K	8.0736e-004 W/mm²	-6.2833e-003 W/mm²
Maximum	873.15 K	5.8318e-002 W/mm²	4.4054e-002 W/mm²
Minimum Value Over Time			

Minimum	482.56 K	8.0736e-004 W/mm²	-6.2833e-003 W/mm²
Maximum	482.56 K	8.0736e-004 W/mm²	-6.2833e-003 W/mm²
Maximum Value Over Time			
Minimum	873.15 K	5.8318e-002 W/mm²	4.4054e-002 W/mm²
Maximum	873.15 K	5.8318e-002 W/mm²	4.4054e-002 W/mm²
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	3		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

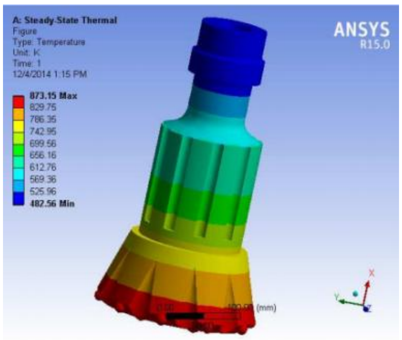

Figure 4.8.Model Steady-State Thermal Solution Temperature

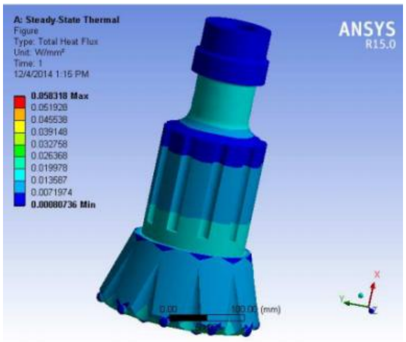

Figure 4.9.Model Steady-State Thermal Solution Total Heat Flux

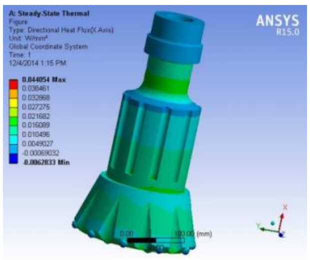

Figure 4.10.Model Steady-State Thermal Solution Directional Heat Flux

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4.3. Material Data

Table 4.10 Tungsten alloy

Thermal Conductivity	1.12e-002 W mm^-1 C^-1

V. CONCLUSION

Based on the analysis software the results are obtained. These results are taken based on the stress, strain and deflection values of button bit. In the modified design we made a groove to increase heat transfer rate. Based on results modified design can increase the heat transfer rate. Because of sufficient cooling the material can with stand high thermal stress. So the modified model will give the more life as well as it also reduces the wear and tear. We increased the strength of material by using tungsten alloy materials.

VI. ACKNOWLEDGEMENT

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REFERENCES

[1] R. Hamilton P.Makulsawatudum, & D. Meckenzie, “Stress concentration On Dth Button Bit”, Journal of Strain Analysis, Vol 4, pp 415-421, 2011.
[2] www.dthrotarydrilling.com
[3] www.drillingrigsindia.com
[4] Teale, R.: “The Concept of Specific Energy in Rock Drilling,” International Journal of Rock Mechanics and Mining Science (1999) vol. 5, 821-832.