Large Synoptic Survey Telescope

LSST Telescope and Site Overview

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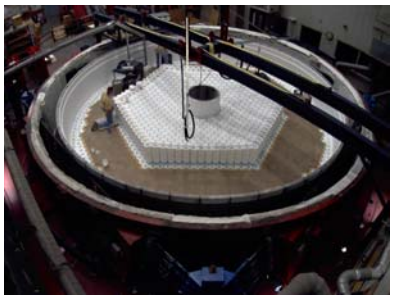
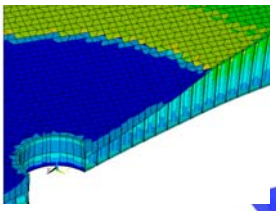
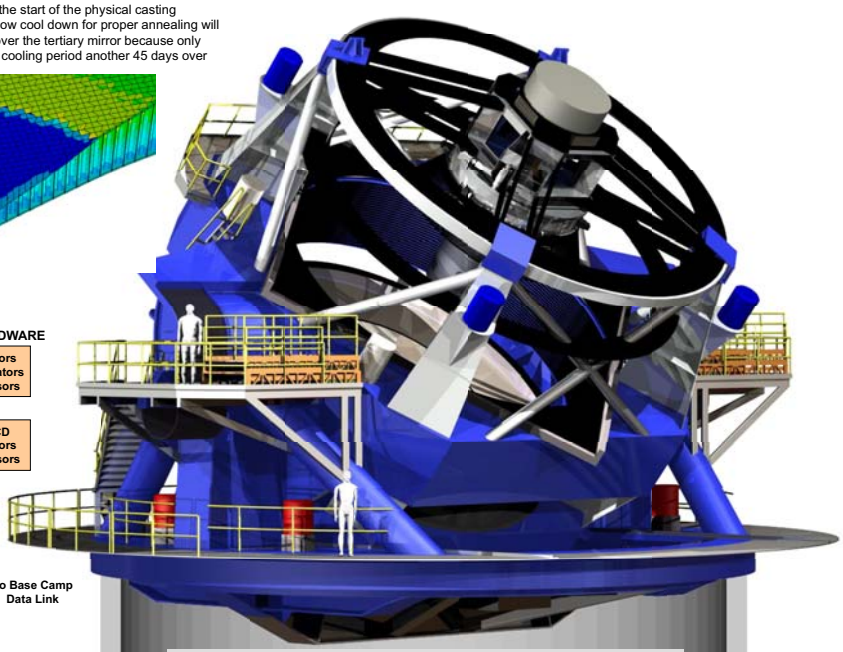
The LSST Telescope and Site has been designed to meet the stringent goals of the survey in terms of image quality and throughput. The telescope system delivers 0.25 arc sec FWHM seeing to the overall system image quality error budget. The primary-tertiary monolithic mirror is being fabricated at the Steward Observatory Mirror Lab using their structured borosilicate spin casting technology. Fabrication of the mold is underway, with "high fire" scheduled for spring 2008, and final delivery in late 2011. Baseline designs for active mirror support and optical testing for the monolith and conventional secondary mirror systems have been developed. The telescope is compact, stiff, and agile to maximize observing efficiency. The 300 ton structure can make 3.5 degree moves (at a 30 degree zenith angle) on the sky in less than 5 seconds. The dome will track and slew to follow the telescope pointing with minimal power. The summit facility has been designed to support operations and maintenance for minimal down time.



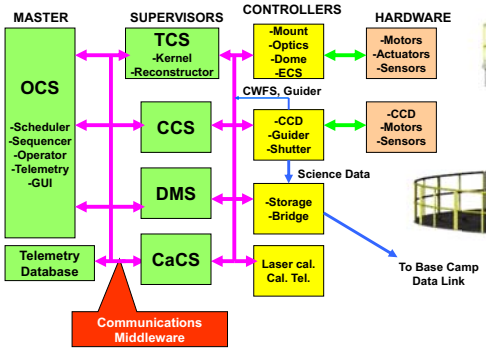
Watch LSST.org for daily progress of the casting process

Primary Mirror Fabrication continues at the Steward Observatory Mirror Lab in Tucson Arizona. The mold is being assembled in preparation for the start of the physical casting process in March 2008. The casting time, including the slow cool down for proper annealing will be 143 days. The 2.1 m^3 of additional glass that "pools" over the tertiary mirror because only one surface can be spun cast is a factor in extending the cooling period another 45 days over the previous LBT castings. The thermal uniformity in the glass during cool-down defines the level of residual stress in the mirror. The model on the right shows the hollow core structure of the mirror and the solid glass (light blue) that is in the casting and later ground off to form the tertiary mirror



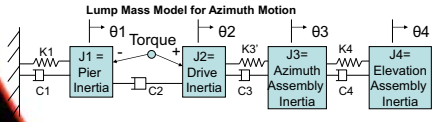


LSST Control System: LSST will use a Publish-Subscribe paradigm for the control network. The system will utilize a Data Distribution Service (DDS) standard that provides efficient topic based anonymous communications with Quality of Service (QoS) controls for real time conformance and tactical information management. QoS is configured on a per topic basis to tune the priority and control latency. Standard APIs are provided to all applications, each only needing to declare intent to publish or receive topic based data. The Middleware DDS also provides automated data storage for broadcast telemetry and recording of communication history. LSST is testing a DDS product from RTI which has a Real Time Connect service to feed an SQL (and other) database.

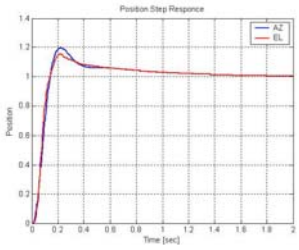


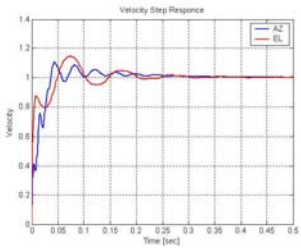
Structural Analysis: The telescope modal analysis has been further developed to include the concrete pier and rock base. A geotechnical study was performed confirming the integrity of the summit rock and providing a 6.3 e6 psi measure of the elastic modulas. A wide pier with a stepped thickness was designed to provide a stiff support of the telescope. The detailed model of the telescope indicated that the modal mass fraction of the 8.8 hz mode is 49% or 840 lb sec^2/in. This modal lumped mass and a remainder 875 lb sec^2/in lumped mass were added to the pier model (lower right) to determine a system first mode of 8.3 hz. The system model included the measured modulas of the weathered and un-weathered rock as well as the geometrical considerations of the rock for the fixed building excavations. A detailed analysis of the telescope top end was also performed to show a factor of 10 safety margin for buckling under maximum operations and earthquake (0.4 g transverse, 0.27 g vertical) loading

Lump Mass Model for Azimuth Motion



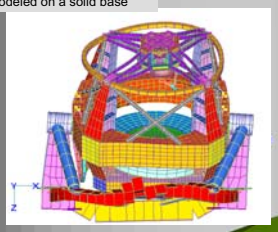
LSST Lumped Mass Model : Azimuth Axis : Summary				
K3'=K2||K3		Spring Const (Kr)	Effective Inertia (J)	Structural Damping C
		N-M / Rad	Kg-M2	N-M-S/Rad
1	Pier	8.80E+11	1.76E+07	1.05E+08
2	Azimuth Drive	2.36E+12	4.48E+06	2.68E+07
3	Azimuth Assembly	7.96E+11	5.89E+06	3.53E+07
4	Elevation Assembly	6.74E+10	3.06E+06	1.83E+07



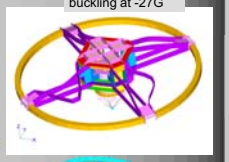


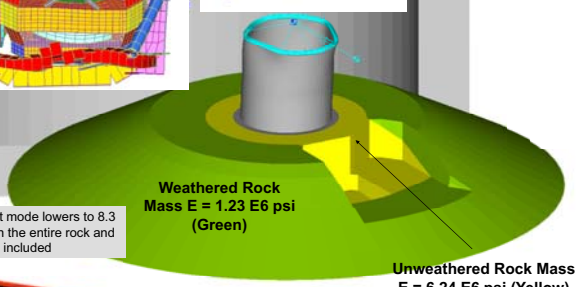
Lumped Mass Control Model: The control system model has been developed in MatLab with FEA derived stiffness and mass properties for the telescope defined by 4 sub-assemblies. The initial control parameters show rapid positioning convergence, a result of a stiff structure, even with a step impulse for the representative 3.5 degree on sky repositioning. The reference design currently has sufficient horsepower to control the acceleration with ramped profiles for better performance.

LSST Telescope structure lowest mode is an 8.8 hz transverse motion when modeled on a solid base

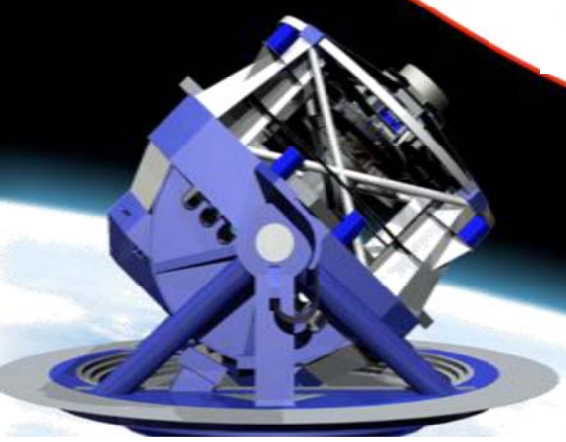


The first buckling mode is spider buckling at -27G





The first mode lowers to 8.3 hz when the entire rock and pier are included



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