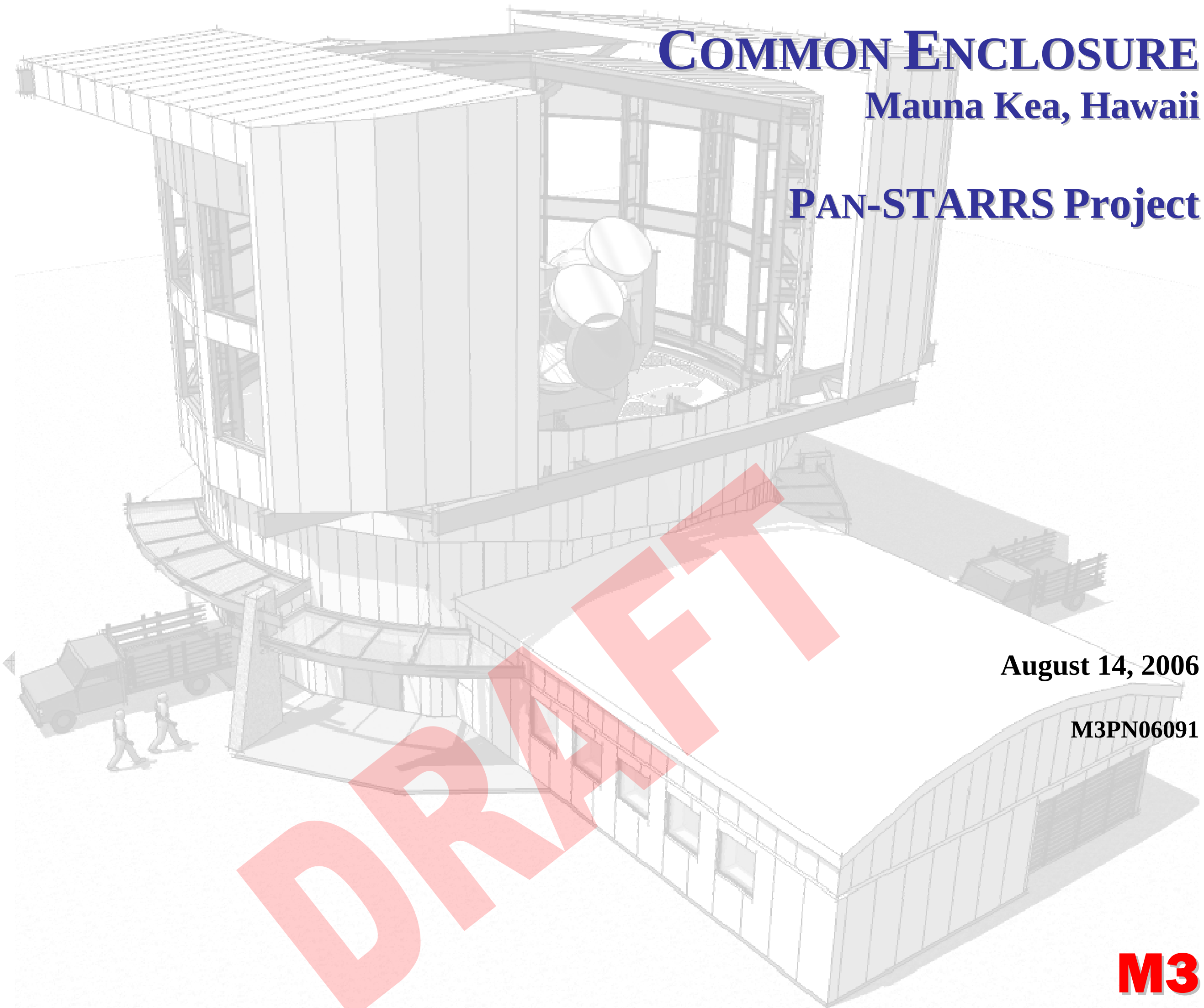
CONCEPTUAL FACILITY DESIGN
&
BUDGET ESTIMATE



COMMON ENCLOSURE
Mauna Kea, Hawaii

PAN-STARRS Project

August 14, 2006

M3PN06091

M3

1. EXECUTIVE SUMMARY

M3 was retained by the University of Hawaii at Manoa, to provide a concept design and budgetary, rough order of magnitude (ROM) cost estimate of the common enclosure on Mauna Kea, Hawaii. The enclosure is to house a four-telescope array for Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) project. The proposed project is to reside at the existing UH-88-inch telescope enclosure site.

M3 used as a basis for this evaluation and development of the Concept Facility Design the following documents:

- Notice to Bidders/Offerors, RFP131013A: A Design Study of a Common Enclosure on Mauna Kea to House the Four-Telescope Array Comprising the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS)
- Available Site Documentation.
- Project review teleconferences.

The Concept Design was progressively reviewed with Pan-STARRS staff and their revisions and input have been incorporated in the report.

The Study focused on the Evaluation and Concept Design of the following components.

- Site Infrastructure and Site Layout
- Telescope Pier
- Fixed Lower Enclosure
- Rotating Enclosure

2. BASIS OF DESIGN

A. Site and Enclosure Design Parameters

Mauna Kea is at an altitude of 14,000-foot elevation with an average temperature of 0-degrees Celsius and a compacted cinder soil base. The following are design parameters provided by Pan-STARRS.

- Soil Conditions:
  - Young Modulus = 121,000 psi
  - Poisson's Ratio: 0.28
  - Dynamic Shear Modulus: 5 x 105 lbs ft2

- Enclosure Survival Conditions
  - 150 mph maximum wind gusts with the shutter doors closed
  - 50 mph maximum wind gusts with the shutter doors open
  - Earthquake zone 4 (ground accelerations ≤ 0.3 g)

- Snow load ≤ 20 lb ft2

- Enclosure Operational Conditions
    - Wind gusts ≤ 4o mph (with shutter doors pointing away from the wind)

B. Facility Space Requirements

The enclosure design must satisfy the following restrictions:

- Telescope height (at base of telescope): ≥ 5m
- Enclosure height: ≤ 23 m
- Enclosure shall not limit the telescope requirement to step 3.0-degress for all four telescopes when fully opened with sufficient margin to allow for the five second step and settle specification at zenith angles ≥ of 10 degrees.
- The enclosure shall incorporate at least 100 m^2 of insulated floor space for support functions (this includes both lab and control spaces). It should be expected that approximately 30 kW of heatying will need to be dissipated from the support space.
- The enclosure design should include remotely-controllable venting of the outside air into the interior of the observatory occupied by the telescope systems.
- Dome cooling system
- The enclosure will not include any "human amenities" such as dayrooms or restrooms.

C. Existing UH 88-inch Enclosure Site

The UH 88-inch observatory on Mauna Kea is located on the summit ridge between the UK Infrared Telescope and the Gemini Telescope (see figure 1). There is vehicular access on all sides and a utility building southwest of the enclosure. A concrete tunnel connects the two structures. Vehicle parking and the main entrance is on the east side of the enclosure and utility access doors on the northwest of the enclosure and west elevation of the support space.

Figure 1. UH 88-inch telescope enclosure.

The infrastructure on Mauna Kea and at the site is well established and has the capabilities of accommodating the needs of the Pan-STARRS project. It is assumed that the existing electrical service and underground water and septic tanks will not have to be upgraded for the new facility.

The existing enclosure is a concrete fixed base and a steel rotating dome. The top of the fixed base is approximately 38-feet and the dome is about 80-feet above ground floor elevation. Off-center of the dome to the south is a concrete pier and small elevator just east of the pier.

3. Pan-STARRS COMMON ENCLOSURE DESIGN

A. Site

In order to accommodate the new facility, the existing enclosure needs to be demolished. M3 studied the benefits of salvaging portions of the building such as the foundation and determined that it is not feasible. It complicates the demolition of the existing structure and construction of the new facility making it difficult to install all of the underground utilities and grounding. Also, It is difficult to determine the whether the existing portion to remain in place is structurally sound or adequate to today's building code requirements for the new facility.

The existing utility building and tunnel can be incorporated into the new facility and utilized for their original purpose. During the next design phase, the size and volume of these structures need to be verified for the new equipment. It may be necessary to modify and upgrade these structures.

B. Common Enclosure Envelope

One of the design goals is to keep the new enclosure within the three dimensional volume of the existing UH-88 enclosure. This also includes maintaining the required excavation of the new facility shallower than the existing pier depth. The new pier depth is 72-inches below grade. This fits within the depth of the existing pier and excavation is within the existing pier depth. All of the required excavation for underground utilities does not appear to disturb native soil. It can all be done within the excavated and backfill of the existing structure.

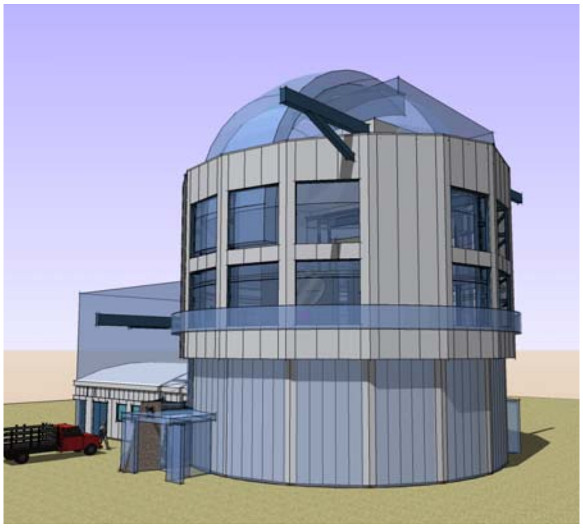


Figure 2. The existing enclosure is depicted in transparent blue and the new facility is in full value.

The proposed enclosure overall height of 59-feet is lower than the existing structure and the fixed base diameter is the same. The support building height is significantly lower than the existing. The new cylinder type dome has vertical walls that extend slightly beyond the curved surface of the existing spherical dome. Although the walls are taller, this type of dome with a highly reflective finish should make the new observatory less visible than the existing structure (see figures 2 and 3).

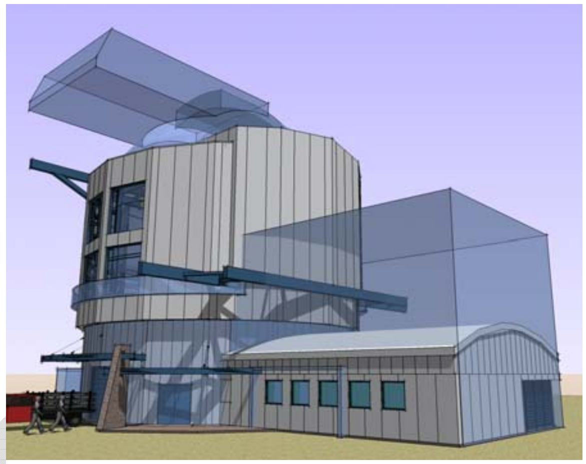


Figure 3. The existing enclosure's dome and support building are taller than the proposed facility.

C. Telescope Pier

The new pier is octagonal and supports all four telescopes. It is physically detached from the other structures maintaining vibration isolation between the pier and the rest of the enclosure. Metal studs and insulation around the entire perimeter maintains thermal isolation.

The concrete pier has 12-inch thick inner and outer walls and rests on a 40-inch thick by 45-foot diameter footing. The bottom of footing is 72-inches below grade level finish floor elevation and the top of pier is 16.40-feet above. The pier cap is 24-inch thick reinforced concrete with openings for the telescope cables and conduits. The center of the pier is open provide space for the mirror cell lift (see figure 4).

Based on a preliminary finite element analysis (FEA), the natural frequency of the pier is 7.43 Hz. During the next design phase, the FEA needs to be refined and the pier design adjusted to the project performance specifications. Due to the soil conditions on Mauna Kea it may be difficult to achieve the desired frequency.

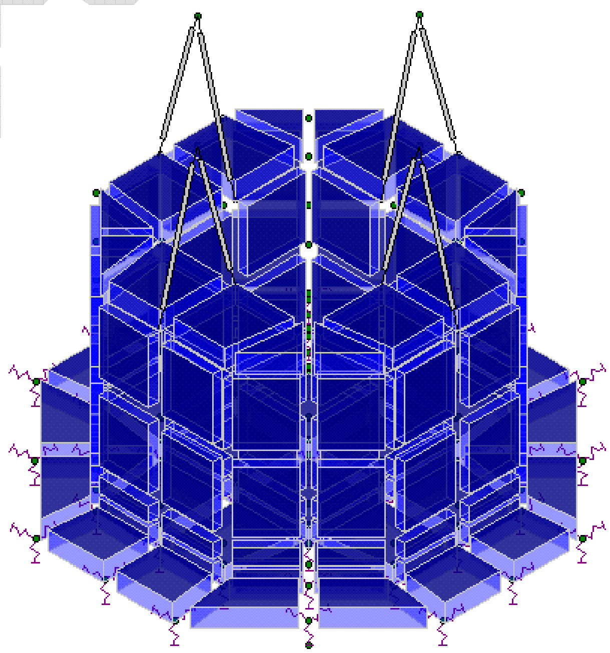


Figure 4. Telescope Pier FEA diagram

D. Fixed Enclosure

The fixed enclosure is a steel structure with metal panels, R-30 insulation, metal studs and gypsum board along the exterior walls. The footprint fits within the existing building outline. Similar to the existing facility, the main entrance is on the east side and an equipment roll-up door on the west side (see figure 5).

A steel structured canopy and screen above the entrances provides protection from falling ice. Circulation around the facility has not been changed from the original site design.

Instrument and mirror box storage is located directly below the observing floor. Access into the space is through the roll-up door from the exterior and a pair of doors from the support building. The roll-up door is directly opposite of the 5-ton mirror cell lift platform located at the center of pier.

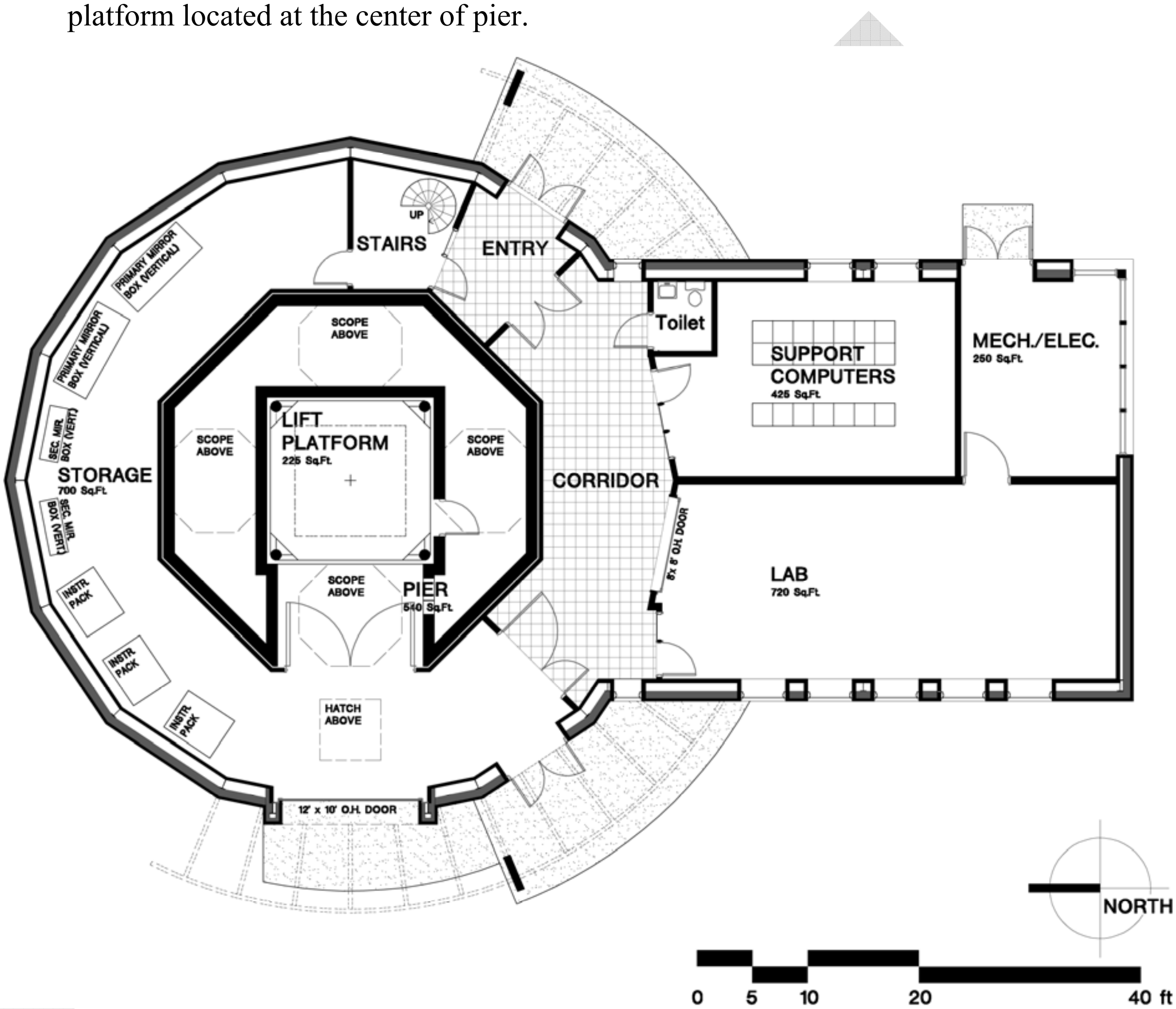


Figure 5. Grade Level Floor Plan

The support building has a computer room, instrument lab and service spaces. Since this facility is operated remotely, amenity spaces have not been provided. The corridor linking all of the spaces has been sized to accommodate the instruments between the support building and the storage room.

Access to the observing level is via a circular stair located next to the main entry. Since this is an un-occupied space it is assumed that a circular stair can be utilized. This needs to be verified with the local governing authority.

The observing level floor elevation is 20-feet above the grade level floor with the exterior perimeter wall at 33-foot radius. This is the highest level of the fixed enclosure and the interface point with the rotating dome. The bogies for the rotating dome are along the perimeter wall and the azimuth track and rotating dome begins at this elevation (see figure 6).

The observing level floor consists of steel plate decking with a floor loading of 100 lbs/Sq.Ft. The deck is insulated with R-30 insulation to prevent heat conduction from the lower levels.

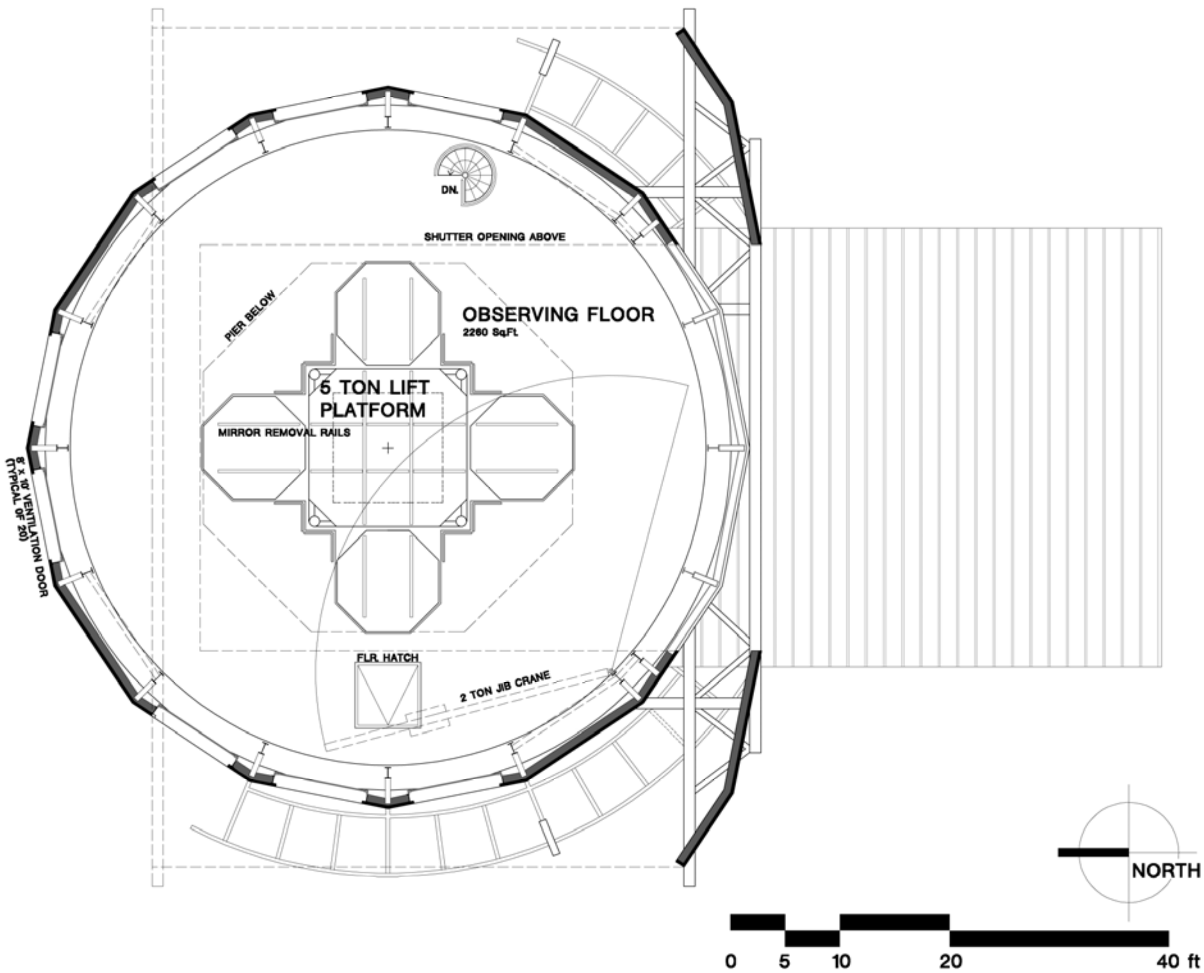


Figure 6. Observing Level Floor Plan

On the west side of the floor is a 66-inch square floor hatch for instrument and tool handling between the two levels. The 5-ton lift at the center of pier is for mirror cell handling. The lift can be raised to the level of the mirror on any of the four telescopes. Rails from the telescope to the rails on the lift allow the horizontal transfer of the cell from the telescope to the lift. Once on the lift, it is lowered and transferred to the equipment access door and vehicle on the ground level.

E. Rotating Enclosure

The rotating enclosure is the upper rotating portion of the Pan-STARRS common enclosure and is centered on the azimuth axis of the telescope. The height of the dome is 34.44-feet and sits 24.50-feet above grade (see figure 7).

The dome's viewing slit is 37-feet wide providing a field of view of 3.0-degrees for all four telescopes with sufficient margin to allow for a 5-second step and settle at a zenith angle of 10-degrees. The telescope swing clearances are 80-inches minimum on the sides and 40-inches to the overhead jib crane hook. Openings (20) through the exterior walls promote wind-forced ventilation of the inner structure and telescope chamber.

The current design allows a 40-inch increase in height to the telescope and pier without modifying the enclosure (see figure 8). Additional height increase over 40-inches increases the overall height of the dome. Optimization of telescope elevation axis and height of dome needs to be refined in the next design phase.

The rotating enclosure is non-co-rotational, has unlimited range of travel in azimuth and rotates on eight bogie assemblies and rail attached to the observing level. Mounted on the bogies is a circular ring-beam which supports the steel structure.

The structure consists of steel columns and bracing that forms the multi-faceted cylinder walls that contain the ventilation openings. The walls are braced for lateral wind and seismic loads. The thickness of the steel is ¾-inch, minimizing the thermal properties.

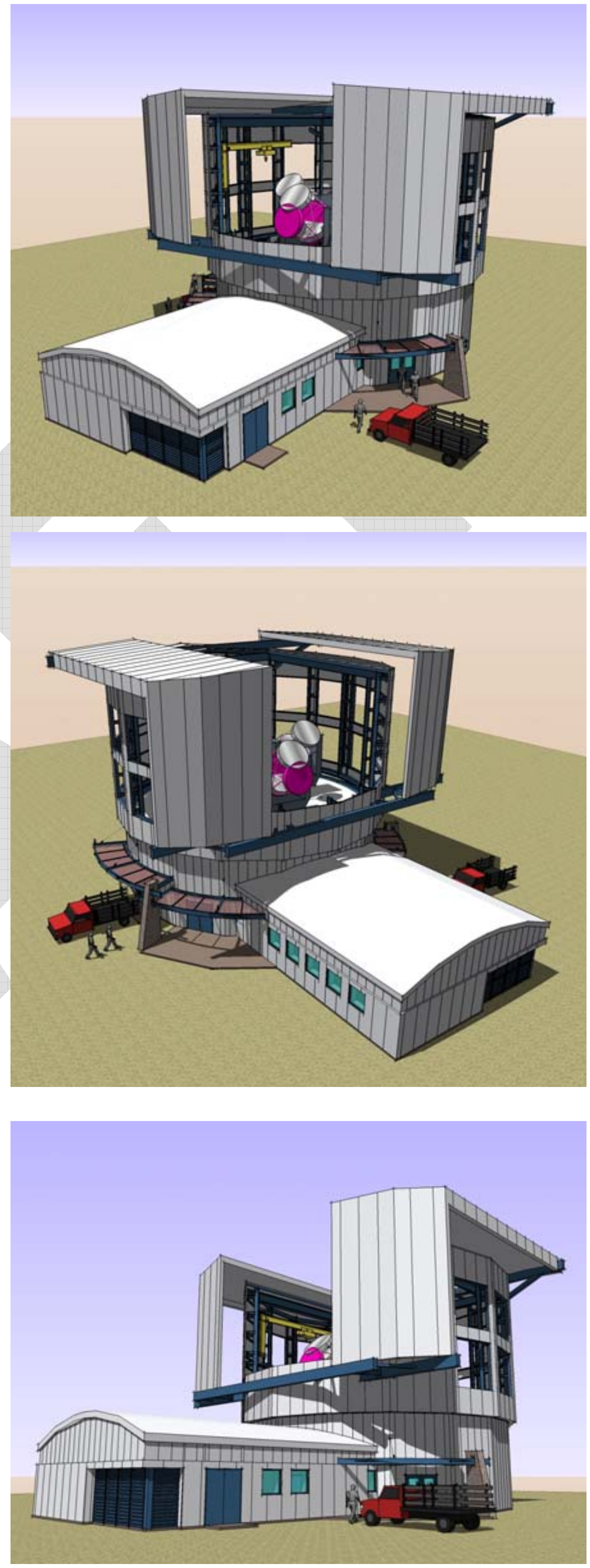


Figure 7. Exterior views of the Pan-STARRS common enclosure.

E.1 Azimuth Track, Drives and Bogies

The rotating enclosure support track provides a bearing surface for both the dome trucks and the lateral restraint cam followers. This track provides smooth rotation of the dome and for lateral restraint maintaining circular motion. The track consists of low alloy steel plate segments mechanically fastened to the supporting ring beams.

The rotating cylinder type dome is mounted on a circular plate track. Supporting this track are eight stationary bogie wheels mounted in truck assemblies which are in turn mounted to the ring beam of the fixed enclosure. During night time operations, the dome is in constant slow speed rotation.

All lateral loads on the rotating enclosure (wind and seismic) are transferred to the fixed enclosure structure via 16 lateral restraints. Each restraint consists of two cam follower bearings running against and locating the inside edge of the track plate. Each cam follower is adjustable via slotted holes and provided with individual adjustment via and eccentric bushing.

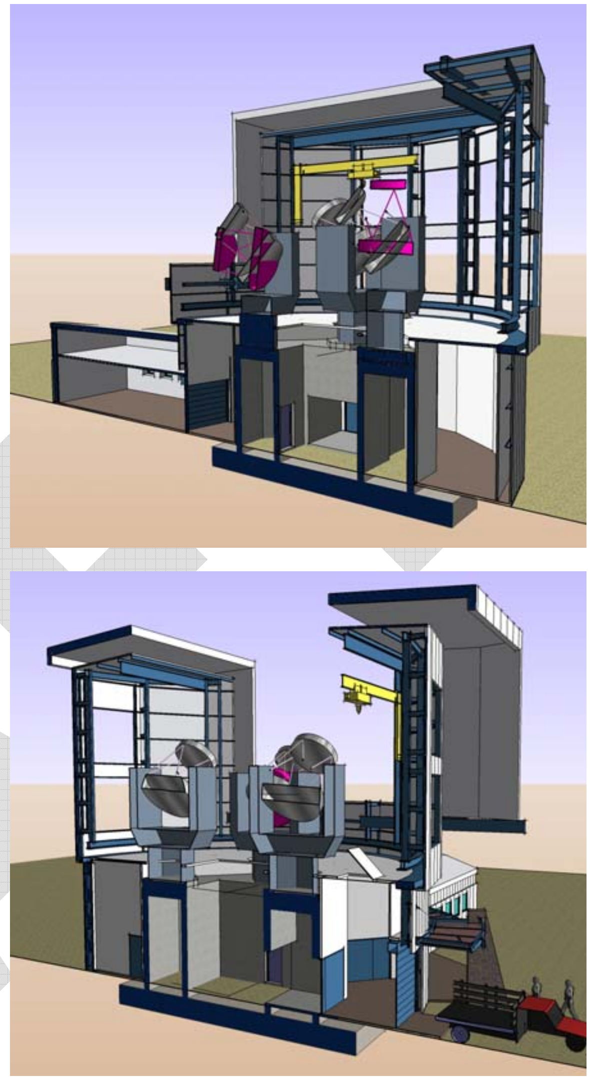


Figure 8. Section views of the Pan-STARRS common enclosure.

E.2 Azimuth Track, Drives and Bogies

The bi-parting shutters are actuated by a rack and pinion station at each end of both shutter leaves. Each leaf has a single gear motor driving shafting to gear reducers located at each rack. Pinion gears mounted on the output shaft of these reducers drive the racks. Proximity limit switches mounted on the shutter beams control the shutter travel by signaling travel limits. Rubber bumpers cushion the impact loads at travel limits.

The shutter door bogies mounted on truck assemblies consist of 10-inch diameter wheels and lateral restraint cam followers. The trucks are pre-assembled units and mounted on a typical rail road type track.

4. Mechanical Systems

A. Compressed Air

A two stage oil free air compressor provides air to the telescope and any maintenance type air tools with a delivered pressure of 125 PSIG. The air is dried to a -40 deg F (-40 deg C) dew point through a heated desiccant dryer, an energy saver module minimizes the purge cycle. To reduce the moisture removal rate a coalescing filter is used prior to the desiccant dryer. A general particulate filter is down stream from the dryer and a final filter/regulator can be used at all points of use. The air compressor and desiccant dryer are enclosed in a space which protects them from freezing conditions.

B. Air Handling Units

The spaces requiring conditioning are the telescope enclosure, computer room and lab.

The telescope enclosure has four AHU's placed around the perimeter, each discharging air from the top. The top discharge allows for effective mixing of the space air. To further increase this mixing the AHU's air flow is increased beyond what is required to cool the telescope enclosure. When cooling requirements are near freezing temperatures a means of defrosting the coil is required. An electric water heater installed in the chilled water line provides heated water to defrost the cooling coil. While the unit is in the defrost mode the fan is shut down. The AHU's are sized so that three of the units can provide all cooling requirements while one unit is in defrost cycle. A 2-inch pleated 30% ASHRAE filter is used.

The computer room has two AHU's each sized for half of the cooling with backup capabilities. These units discharge cooled air to the computer racks. Air returns to the unit where it is filtered before being cooled again by a minimum of a 2-inch pleated 30% ASHRAE filter. Higher level of filtration can be used to help prevent dust buildup within the computer racks. A CO_2 sensor is provided on the unit to regulate the amount of outside air. This minimizes the amount of outside air the unit brings in when the space is unoccupied. A minimum amount of outside air needs to be brought in to help prevent out gassing odor build up. Humidification can be provided by a self contained wall mounted unit which generates its own steam.

The lab space is provided with electric radiant heaters and controlled by wall thermostats. No outside air is provided; it is assumed the lab space meets this requirement by an operable window or door.

C. Chiller Water

Two air cooled chillers provide cooling water to the enclosure. The first one is a low temperature chiller providing water at 10 deg F (-12.2 deg C) with a minimum output capacity of 12.5 tons (44 kW) to cool the telescope chamber, AHU's and the telescope instruments. Most standard chillers do not vary the discharge water temperature to track ambient so a heat exchanger and pump is provided for the instrument cooling loop. The second chiller provides chilled water at 45 deg F (7.2 deg C) with a minimum output capacity of 12 tons (52 kW) to cool the computer room and the helium chillers. Past experience with helium chiller indicates they do not like water colder than 50 deg F (10 deg C) and have a high pressure drop through the equipment. For these reasons a separate heat exchanger and pump is provided to isolate the helium chillers. To provide freeze protection down to 5 Deg F (-15 deg C) a 30 percent by volume solution of ethylene glycol needs be used in all piping. If colder survivability conditions are required the concentration of glycol should be increased. The above minimum cooling load capacities are based on Pan-STARRS documentation and correspondence.

C. Water Side Economizer

With ambient air temperature averaging about 32 deg F (0 deg C) it is possible to use an air to water heat exchanger to cool the computer room and helium chillers. This does not save on equipment yard space but provides cooling at a reduced operating cost. This option may require the low temperature chiller's size to increase in order to compensate for the days when the ambient temperature is to high. A heat exchanger should be provided on the low temperature chiller loop to limit the chilled water supply temperature to 35 deg F (1.7 deg C) to prevent ice forming on the computer room cooling coils. The size of the chiller increase depends on how much of the telescope instrument cooling load happens during the daytime, as it maybe possible to use this diversity to cool the computer room during the day. It is possible to use an air side economizer on the computer room but the heated exhaust air need to be removed from the building through the utility tunnel. This approach does not work well if humidification is required in the room.

4. Electrical Systems

A. Power Distribution

Utility electrical power is provided by the existing electrical utility distribution on Mauna Kea to the Pan-STARRS common enclosure site via a 12.47 kV, 3 phase, 60 Hz system. An existing or new pad mounted, oil filled type transformer with internal lightning arresters located on a concrete containment pad is utilized. The transformer shall be 12.47 kV primary to 480Y/277V secondary sized approximately 300 kVA to 500 kVA. Exact requirements shall be determined considering actual loads of equipment and de-ration for altitude of 14,000-feet above sea level.

From the service transformer to the Pan-STARRS Equipment/Support Building, an underground ductbank consisting of a secondary service entrance lateral is provided serving the main electrical service entrance equipment. The main electrical service entrance equipment consists of bottom feed incoming section, main disconnect switch, TVSS, automatic transfer switch (ATS) and distribution section or panel. Overcurrent protective devices such as the main disconnect switch and devices provided in the distribution section are fully adjustable type circuit breakers sized for each feeder and main service entrance rating as determined by the facility electrical loads being served. Standby electrical power is generated on site using one diesel driven generator rated at 275 kW at 0.8 power factor (343.75 kVA), 277/480 volt, 3 phase, 4 wire. An automatic transfer switch (ATS) monitors and controls the transfer of electrical load from utility power source to the standby generator source during the loss of normal electrical utility power. The current rating and capacity of standby generator is estimated, and will be refined as the total electrical loads for the enclosure becomes available during the next design phase. Once final electrical loads and worst case motor starting event(s) are established, the standby generator can be sized with consideration for site altitude and engine/generator de-ration, and fuel type.

At the common enclosure main electrical room, the main service entrance equipment is rated at 277/480V, 3 phase, 4 wire, estimated to 400 ampere bus. From multiple feeders fed by the main service entrance equipment, electrical power is provided and distributed throughout the facility using distribution and sub-distribution panels. A second voltage transformation to 120/208V, 3 phase, 4 wire, is provided using a single dry type transformers and associated distribution and sub-distribution panels located throughout the enclosure. A single 277/480V, 3 phase, 4 wire feeder routed from the main service entrance equipment located at the equipment building to the enclosure via an underground utility duct bank connecting the two buildings together.

At the enclosures main electrical room, the main distribution panel is rated at 277/480V, 3 phase, 4 wire, estimated to 400 ampere bus. From multiple feeders fed by the main distribution panel, electrical power is provided and distributed throughout the enclosure using distribution and sub-distribution panels located at each of the two levels, including the observing level. A second voltage transformation to 120/208V, 3 phase, 4 wire, is provided using a single dry type transformers located at the main electrical room on grade level, and associated distribution and sub-distribution panels located at both levels. A central static UPS sized as determined by the Pan-STARRS electrical UPS type loads being served. UPS type electrical power is provided to mission critical type loads such as rack mounted electronic equipment, communication computer servers, etc. and is distributed throughout the enclosure and equipment building using sub-distribution panels.

B. Grounding and Lightning Protection

The facilities are provided with a electrical safety grounding system as required by the National Electrical Code (NEC). The building's grounding system consists of a continuous grounding mat/mesh made using 1#2 bare stranded copper (SDBC) conductor arranged in 36-inch squares and located directly under the building concrete floor and spread foundations. A continuous 1#2/0 SDBC ground ring is provided around the entire building foundation perimeter with ground rods exothermically connected to ground ring at 40-foot intervals and minimum of one ground test well. In addition, the building structural steel columns and concrete reinforcing rebar are bonded to grounding ring and grid using exothermic type welds. The entire building grounding system is buried at a minimum depth of 36-inches below finished grade. The grounding system is connected and tied together to form an overall facility/site grounding system. The site standby generator is also connected to this grounding system.

The enclosure lightning protection system consists of an array of copper air terminals located at the top of the rotating enclosure and support building. The air terminal array are bonded together using NFPA 780 defined Class I main conductor of 28 strand #14 copper type conductor with direct connections to the building buried grounding system made at a minimum of four to six locations around the building's perimeter. The building's complete lightning protection system shall be a listed system as acceptable to authority having jurisdiction.

5. Budget Cost Estimate

A. Basis of Budget Cost Estimate

1. All costs are in third quarter 2006 dollars.

2. The enclosure concepts described in the preceding sections are the basis for the budget cost estimate.

3. Indirect field labor costs include field payroll burden, overhead, field supervision, supervisory burden, camp costs, meal costs, utilities and trailers, vans and pickup trucks, cribbing, water trucks, safety insurance, construction permits.

4. The estimate assumes that the project will be awarded to a mid-sized construction company with appropriate subcontractors and that only one mobilization will be required; i.e., there will be a continuity of construction activity once the project has begun.

5. Several unit cost subcontracts are anticipated.

6. Construction site will be available to the General Contractor 12 hours per day Monday through Sunday.

7. It has been assumed that construction work areas would be accessible during all scheduled working hours. Allowance is not included in this estimate for stand-by time for inefficiencies resulting from work stoppages or interferences initiated by other operations.

8. Material unit prices were developed using costs gained through contacts with regional suppliers, information from recently constructed projects and M3 in-house database.

9. The contingency included in this estimate is for the Scope of Work items as defined. It is not for items outside the present Scope of Work.

10. The contingency is calculated at a percentage of the total construction.

11. Taxes are to be added by the Owner.

12. No escalation is included.

13. The accuracy of this estimate is assumed to be in the range of 30% plus 30% minus; i.e., the cost could be 30% lower to 30% higher than the estimate to the estimate total. Accuracy is an issue separate from contingency.

14. Excluded from the estimate are the following:
    a) Legal fees
    b) Finance and interest charges
    c) Depreciation and depletion allowances
    d) Environmental permits
    e) Performance bond
    f) Builders risk insurance
    g) Owners project management
    h) Legal
    i) Public relations
    j) Office equipment
    k) Communication systems
    l) Allowance for further expansion
    m) Fire protection
    n) A/E Design fees

B. Budget Cost Estimate Summary

Line No.	Item	Material Cost	Labor Cost	Other Direct Cost	Total Cost
	Summary				
1	DIVISION 1 GENERAL CONDITIONS	$204,022	$237,653	$162,472	$604,147
2	DIVISION 2 SITEWORK	$217,792	$875,424	$119,374	$1,212,590
3	DIVISION 3 EXCAVATION & CONCRETE	$290,396	$667,417	$56,590	$1,014,403
4	DIVISION 4 MASONRY	$0	$0	$0	$0
5	DIVISION 5 METALS	$501,128	$284,598	$83,508	$869,235
6	DIVISION 6 WOOD & PLASTIC	$0	$0	$0	$0
7	DIVISION 7 THERMAL & MOISTURE	$164,927	$148,229	$0	$313,157
8	DIVISION 8 DOORS & WINDOWS	$56,440	$34,245	$0	$90,686
9	DIVISION 9 FINISHES	$52,408	$94,951	$0	$147,360
10	DIVISION 10 SPECIALTIES	$0	$0	$0	$0
11	DIVISION 11 EQUIPMENT	$757,125	$271,665	$0	$1,028,790
12	DIVISION 12 FURNISHINGS	$0	$0	$0	$0
13	DIVISION 13 SPECIAL CONSTRUCTION	$0	$0	$0	$0
14	DIVISION 14 CONVEYING SYSTEMS	$0	$0	$0	$0
15	DIVISION 15 MECHANICAL	$0	$0	$762,000	$762,000
16	DIVISION 16 ELECTRICAL	$0	$0	$603,250	$603,250
LINE TOTALS		$2,244,238	$2,614,184	$1,787,195	$6,645,616
OVERHEAD (15%)					$996,842
SUBTOTAL					$7,642,458
PROFIT (10%)					$764,246
SUBTOTAL					$8,406,704
TAX (to be determined by Owner)					$0
BOND (1.0%)					$84,067
TOTAL					$8,490,771
CONSTRUCTION CONTINGENCY(20%)					$1,698,154
TOTAL CONSTRUCTION COST					**$10,188,926**
Architectural/Engineering Services					$703,036
Project Testing & Inspections					$101,889
Total Project Cost					**$10,993,851**

C. Cost of pier height increase (per linear foot) up to 40-inches.

Line No.	Item	Material Cost	Labor Cost	Other Direct Cost	Total Cost
	Per foot cost of telescope pier extension up to 40 inches				
1	DIVISION 1 GENERAL CONDITIONS	$1,374	$2,420	$382	$4,176
2	DIVISION 2 SITEWORK	$0	$351	$271	$621
3	DIVISION 3 EXCAVATION & CONCRETE	$13,737	$23,850	$3,552	$41,139
4	DIVISION 4 MASONRY	$0	$0	$0	$0
5	DIVISION 5 METALS	$0	$0	$0	$0
6	DIVISION 6 WOOD & PLASTIC	$0	$0	$0	$0
7	DIVISION 7 THERMAL & MOISTURE	$0	$0	$0	$0
8	DIVISION 8 DOORS & WINDOWS	$0	$0	$0	$0
9	DIVISION 9 FINISHES	$0	$0	$0	$0
10	DIVISION 10 SPECIALTIES	$0	$0	$0	$0
11	DIVISION 11 EQUIPMENT	$0	$0	$0	$0
12	DIVISION 12 FURNISHINGS	$0	$0	$0	$0
13	DIVISION 13 SPECIAL CONSTRUCTION	$0	$0	$0	$0
14	DIVISION 14 CONVEYING SYSTEMS	$0	$0	$0	$0
15	DIVISION 15 MECHANICAL	$0	$0	$0	$0
16	DIVISION 16 ELECTRICAL	$0	$0	$0	$0
LINE TOTALS		$15,111	$26,621	$4,205	$45,936
OVERHEAD (15%)					$6,890
SUBTOTAL					$52,826
PROFIT (10%)					$5,283
SUBTOTAL					$58,109
TAX (to be determined by Owner)					$0
BOND (1.0%)					$581
TOTAL					$58,690
CONSTRUCTION CONTINGENCY(20%)					$11,738
TOTAL CONSTRUCTION COST					**$70,429**

D. Cost of pier and enclosure height increase (per linear foot) greater than 40-inches and less than 96-inches.

Line No.	Item	Material Cost	Labor Cost	Other Direct Cost	Total Cost
1	DIVISION 1 GENERAL CONDITIONS	$2,391	$3,296	$480	$6,167
2	DIVISION 2 SITEWORK	$0	$351	$271	$621
3	DIVISION 3 EXCAVATION & CONCRETE	$13,737	$23,850	$3,552	$41,139
4	DIVISION 4 MASONRY	$0	$0	$0	$0
5	DIVISION 5 METALS	$5,767	$3,302	$977	$10,046
6	DIVISION 6 WOOD & PLASTIC	$0	$0	$0	$0
7	DIVISION 7 THERMAL & MOISTURE	$2,967	$2,652	$0	$5,619
8	DIVISION 8 DOORS & WINDOWS	$0	$0	$0	$0
9	DIVISION 9 FINISHES	$809	$2,806	$0	$3,615
10	DIVISION 10 SPECIALTIES	$0	$0	$0	$0
11	DIVISION 11 EQUIPMENT	$625	$0	$0	$625
12	DIVISION 12 FURNISHINGS	$0	$0	$0	$0
13	DIVISION 13 SPECIAL CONSTRUCTION	$0	$0	$0	$0
14	DIVISION 14 CONVEYING SYSTEMS	$0	$0	$0	$0
15	DIVISION 15 MECHANICAL	$0	$0	$0	$0
16	DIVISION 16 ELECTRICAL	$0	$0	$0	$0
LINE TOTALS		$26,296	$36,256	$5,280	$67,832
OVERHEAD (15%)					$10,175
SUBTOTAL					$78,007
PROFIT (10%)					$7,801
SUBTOTAL					$85,808
TAX (to be determined by Owner)					$0
BOND (1.0%)					$858
TOTAL					$86,666
CONSTRUCTION CONTINGENCY(20%)					$17,333
TOTAL CONSTRUCTION COST					**$104,000**