KOPERNIK ASTRONOMICAL SOCIETY

ROLL-OFF-ROOF-OBSERVATORY GUIDELINES

TYPICAL RORO –visual aid only

VERSION 1.0

27 MARCH 2024

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I. Roll Off Roof Observatory (RORO) Overview

In the late 2022-time frame casual discussions were initiated among the KOSC Board, KOSC Staff, and KAS members regarding the addition of a 4th observatory to the KOSC grounds. This 4th observatory would be a roll-off-roof-observatory (RORO) similar to other roll off structures many of us had already seen. The intent of this document is to centralize the many informal discussions conducted within the KAS during 2022 & 2023.

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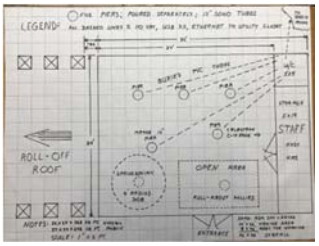
II. Introduction & Background

In the early 2023-time frame, it became known that a very generous gift of extremely high-end astronomical equipment could be made available to Kopernik if that gift could be appropriately utilized. The potential gift would consist of two high-end telescope systems, one being a 12-inch Meade telescope that would primarily be a visual viewing scope; i.e. via eyepieces. The other system would be a Celestron C-14 with HyperStar that would primarily be an imaging scope; i.e. via astronomical digital cameras. This equipment could not be housed within any of the existing three dome observatories, thus the idea of erecting a 4th observatory in roll-off-roof format suddenly took on serious overtones. The main RORO design requirement is that it **must** be handicap accessible (more on this later in Section III of this document). In April 2023 a rough pen & pencil drawing was created to help crystalize the thoughts at that time for a 32' x 24' structure. In November 2023, to serve as a visual-aid, stakes were pounded in the ground to outline the proposed site on the KOSC tract and the proposed 32' x 24' footprint.



The nature of this document is to serve as a general guideline for the RORO. It is beyond the scope of this document to provide specific and detailed engineering specifications. It is expected that Delta Engineering Corporation will utilize this outline to develop the actual specifications and to provide cost estimates accordingly.

III. Code Compliance

- **American Disabilities Act (ADA) of 1990:** The U.S. Department of Justice enforces ADA regulations governing state and local government services (Title II) and public accommodations (Title III). This RORO must satisfy ADA requirements regarding handicap accessible to the RORO facilities, and especially to the "one-of-a-kind" Springsonian DOB telescope that has been designed for wheel-chair bound individuals.
- The goal of "handicap accessible" means being able to gain access into the RORO building in a wheel-chair without any steps in the ingress or egress areas, or the walkway to the building. Being able to enter the building, seeing the piers, OTAs & other equipment, and seeing that equipment in use by other folks, will be educationally and personally rewarding. There are no specific RORO design requirements within this document for "eyeballs to glass" viewing by wheel-chair bound visitors thru eye pieces on OTAs & permanent piers. Repeating - "eyeballs to glass" via astronomical eye pieces should be encouraged for the Springsonian which was designed for that purpose. ***However***, under unique conditions, wheel-chair viewing could work when the SCT or refractor happens to be in just the right position and would be a bonus. A scope or two should be equipped with a rotating diagonal, like we have on the 6" AP and the 14" SCT. A 120 mm Orion refractor in the yard has been used with people in wheel-chairs, with fair results. Another scope that would work well for ADA compliance is the ZWO Seestar S50. It could be in the middle of the RORO, protected from the wind. Using personal cell phones and/or tablets, multiple patrons could connect to it. Perhaps, a rubber mat under it would be useful.
- **Building codes:** it is expected that Delta Engineering Corporation will work with the Town of Vestal, NY to obtain all permits, conduct all required inspections, and satisfy all local building codes.

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IV. The RORO Building – General

- The RORO structure at 32' X 24' is expected to be wooden frame construction with an attractive weather resistant finish; i.e. vinyl siding.
- The roof of the RORO is expected to be constructed with "engineered trusses" and is desired to match the material used for the gazebo roof. However, depending on roof weight considerations, a light weight metal roof may be necessary.
- The roof must be moveable to roll off eastward via an electric motor controlled system.

- The walls (north, east, south & west) will be solid, non-moveable, of a very specific height detailed in Section VIII. This height will be tested and confirmed by KAS members in early 2024 to present acceptable views of the various N-E-S-W horizons.
- A warming room and/or a storage room is not desired. The KOSC Lobby serves as a fine warming area.
- All concrete piers will require permanent wiring (details in Section VII and VIII). Thus, buried PVC tubing is required for every concrete pier.
- A control panel, located on the **north** side wall, will be necessary to terminate the buried PVC tubing and pier wiring. The control panel may be constructed to extend thru the permanent, non-moveable, portion of the north wall.

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V. The RORO site location

Several possible locations for the RORO foundation were evaluated (see the FAQ's for details). The recommended site is adjacent to the walking track around the playground. The actual floor of the site must be level, with no steps in the ingress and egress areas from and to the walking track. The RORO must be handicap accessible via wheel chair.

- Refer to Section IX: IMAGE 0 shows the view west towards the children's playground.
- IMAGE 1 shows the view north; Polaris is visible from each of the four corners of the RORO foot print (confirmed via two KAS members).
- IMAGE 3 is probably the most important view. It shows the view towards the east, into some scrub trees, and towards the KOSC tract's eastern boundary. This is the direction that the roll off roof should travel to its external supporting structure. A roll off direction of east is unusual but fits well with the sloping ground, the trees, the walking track, the ham radio club antenna, and the eastern boundary of the KOSC tract.

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VI. RORO Excavation within the KOSC tract

This section is intended for the Kopernik Society "Building & Grounds Committee" along with Delta Engineering Corporation regarding the footprint of the RORO and the ground excavation necessary prior to any of the actual pier(s) or building construction.

CAUTION #1: the concrete base for each of the 4-piers must be poured after the dirt is excavated & levelled and before the RORO concrete floor is poured. See Section VII and Section VIII for details.

CAUTION #2: the “thick wall” PVC tubing for all of the pier electrical wiring must be buried after the pier concrete bases have been setup and before the concrete floor is poured. See Section VIII for details.

CAUTION #3: a safety fence surrounding the entire excavation site is required as classes and youth activities will continue throughout the construction period.

WORK FLOW NET:

1. Excavate & level the dirt;
2. Build the 4-pier concrete bases;
3. Construct the drainage and retaining walls;
4. Bury the PVC tubing;
5. Construct the bases for the roll-off roof supporting structure;
6. Finally, pour the concrete floor and the ingress / egress ramps all with a non-slip surface such as a “broomed” finish.

DETAILS:

- The general 32’ x 24’ area to be excavated has been outlined by the KAS with red stakes and yellow twine. The permanent concrete pier bases are to be located at the orange “Home Depot” buckets; specific pier layout measurements are included in Section VIII. The roll-off roof supporting structure has been outlined with white stakes and extends into the scrub trees.
- The excavated area will be somewhat larger than the 32’ x 24’ building to accommodate drainage and retaining walls. Actual excavated dimensions are TBD by Delta Engineering. The excess material removed should be moved across the road to the property owned by Kopernik.
- The excavated area will be adjacent to the walking path. REPEAT – handicap accessibility by wheel-chair from the walking path into the RORO must be maintained. Thus, the excavated area must be “close to level” with the walking path.
- The footprint of the RORO includes ground with a significant slope. Retaining walls will be necessary for the north, east, and west-facing walls. The south-facing wall will be level with the existing walking path. The north-facing retaining wall will be the deepest and will be 3-foot or more in depth. For the overall “dig depth” considerable dirt must be excavated. Certainly, back-hoe and dump truck access to the RORO site must be planned.
- Drainage around the building, and footers for the actual walls of the RORO, are required. These items could be constructed at the same time that the 4-pier concrete bases are built and before the “thick wall” PVC tubing is buried. Likewise, the concrete bases for the roll-off roof supporting structure could also be constructed at this time frame.
- The poured concrete floor is anticipated to be 4” to 6” deep along with steel mesh reinforcement. Special consideration should be given to the ingress and egress walkways for continuous movement of large crowds at noteworthy astro events such as eclipses, conjunctions, etc.
- The finished RORO floor should be finished with a non-slip surface such as a “broomed” finish.

- To further aid in handicap accessibility, an additional paved wheel-chair path from the alleyway between the main KOSC lobby and the domes lobby should be included in the general excavation for the RORO.

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VII. Permanent Telescope Piers

Comments from KAS Discord – RORO folder (2024 Feb 03)

The following items from the KAS Discord are significant and affect the planning for the proposed RORO.

COPY FROM DISCORD: kreegan99 —
Whether you go with concrete or steel (practically religion) - Start here first. Dan has been doing this a long time. The pier plate I bought 15 years ago "defined" my pier in 2018.

https://www.pierplates.com/index.html

Dan's Pier Top Plates
Dan's Pier Top Plates

So @Dave D - I suggest this page starts at my prior post and EVERYTHING else, including the building gets built off of pier selections and pier plates. The pier you select has to be the right height, and needs the right supported bolting pattern to mate the mount and pier.

Submitted by Patrick Manley (2024 Feb 03)

COPY FROM DISCORD: Dave D —
So what action plan do we need to determine both pier selection and height? I am thinking we need a plan for early Spring 2024 (say Aprilish) to model a virtual wall in the roro footprint and simulate the view looking over the virtual wall. That should help to determine the piers' heights and location within the footprint. I am leaning towards a concrete base(s) along with metal pier(s) – likely to be electro-mechanical height adjustable piers such as the PT-2 by Pier Tech Inc.

https://www.youtube.com/watch?v=oBvBjGFh5L8&t=6s

Submitted by Dave Daniels (2024 Feb 03)

COPY FROM DISCORD: Joe Bergeron —
If you want to include my scope, it needs a 5-foot pier intended for a G11. This height is necessary to keep the eyepiece off the floor when pointed near the zenith. Or, you could have a 4-foot pier and I could add my 12" pier extension. That way, if I ever remove my scope, you'll have a 4-foot pier, probably more versatile.

Submitted by Joe Bergeron (2024 Feb 03)

Discussion:

During the January 2024 KAS monthly meeting two things became apparent via the 45-minute free-wheeling discussion (great discussion – especially by George & Patrick).

- The RORO will need 4 piers: 2 piers for Rod's gifted equipment; 1 pier capable of holding Joe's AP refractor; 1 pier for the 8" Celestron now with KOSC.
- All 4-piers should have an adjustable height capability – such as an electro-mechanical telescope pier such as the PT-2 product by Pier Tech Inc.

Check out the following:

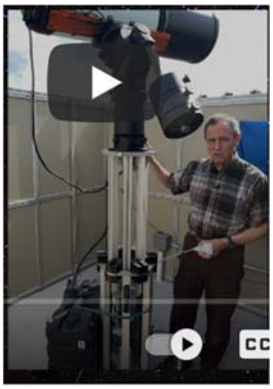
Pier-Tech 2 Height Adjustable Piers - Pier Tech (piertechinc.com)

Office: 1251 Humbracht Cir #G, Bartlett, IL 60103

Phone: (847) 751-6261

Email (copy/paste): piertechinc@gmail.com

Video (copy/paste): https://www.youtube.com/watch?v=oBvBjGFh5L8&t=6s



By having an adjustable height for the piers, the exact height of the concrete base and the exact height of the N-E-S-W walls become less critical and provides maximum flexibility for future advancements in astro equipment. Minimum PT-2 pier height is 34 inches - 34 1/2 inches. Maximum pier extended height is 54 – 54 1/2 inches (all dimensions are +/- 1/2 inch). Lew subsequently reported that adjustable pier costs **start** in the range of $3K/ea.

Additional astronomy pier manufactures include Sky Shed Observatories - Dublin, Ontario, Canada (https://skyshed.com/skyshed-piers), and Boston Astronomy https:/www.bostonastronomy.com/telescope-elevating-pier-200.

Proposed Action Plan:

Since an early Spring 2024 was forecast by Paux Phil, (local ground hog) the following is proposed for early April, just after the solar eclipse excitement calms down:

- Revisit the RORO footprint presently in the Kopernik tract and determine if fine adjustments may be required to accommodate the walkway and ramps into & out of the RORO. Presently, the footprint is tight adjacent to the walking track with no real clearance for ingress/egress ramps.
- Determine and layout a footprint for a second access from the walkway between the main building and the existing observatory building (ADA compliant).
- Determine and mark precise locations for the 4-piers. Need George/Rod's input on preferred location within the footprint; Joe's input herein.
- Construct a virtual wall to simulate various wall-heights; i.e. 5'-9"; and 6' 0"; and 6'3", etc.
- Utilize an actual tripod-mounted scope and determine the FOV for each of the 4 pier locations inside the footprint. Adjust the tripod height as practical for various wall heights. Carefully document each tripod and wall configuration.
- Revisit the Appendix videos regarding "engineered trusses" and determine the center truss height so that equipment parked @ home on the piers will clear when the roll-off-roof is in travel mode.
- Establish concrete base heights; the 4-heights may not all be identical.
- Confirm if the PT-2 electro-mechanical adjustable pier referenced above is to be specified or another similar product.
- Verify acceptable clearance between trusses and parked OTA's.
- Establish the top plate for each pier via Dan's website referenced above.

VIII. The RORO Building – Details including power roof roll off

Suggestions for the Kopernik Society Board: since the purchase of four (4) adjustable height piers is likely to be very pricey, the following is proposed.

- A separate executive pier committee (capable of committing funds) of at least 2-people should be established specifically to research and determine the way forward on electro-mechanical height-adjustable piers.
- Keep in mind that height-adjustable piers will maximize the longevity and useful life of the proposed RORO -15, 20, 25 or more years.

In addition to Pier Tech Corporation, summarized in Section VII, an alternate pier manufacturer should be considered, such as Sky Shed Observatories - Dublin, Ontario, Canada (https://skyshed.com/skyshed-piers), and/or Boston Astronomy https:/www.bostonastronomy.com/telescope-elevating-pier-200.

- A relationship between KOSC and the pier manufacturers should be established (phone calls, emails, etc.). It is felt that the KAS (all volunteers) should not establish the relationship.
- A business trip to a pier manufacturer should be considered to gain details about prices, installation support, delivery schedules, post-install & ongoing support.
- The pier committee should request & obtain formal price quotes from both (all) manufacturers.
- The proposed pier committee should recommend to the Board the specific pier part & model, bottom plates, and top plates to be utilized in the RORO.
- Ideally, the KOSC & Board should actually **purchase** (or decline) and take delivery of all of the adjustable pier equipment, including the mounting plates, prior to the initial shovel full of dirt being excavated.

Details:

BUILDING ACCESS: similar to the main KOSC lobby, access to the RORO building should be via controlled “key”.

SECURITY: similar to the main KOSC lobby, motion-detector monitoring should be implemented.

ROOF ROLL-OFF SYSTEM: an electrical motor-driven system is necessary to actually open / close the RORO roof. The operation of this system must also be via “key” access. A different “key” as used for RORO building access is suggested just in case that “roof key” is left in the RORO. If the system were to be accidentally activated by a casual person costly equipment not parked at “home”, or not in the proper position, could be damaged. It is expected that Delta Engineering will determine & select the system roll-off components based on roof weight, etc.

CRITICAL DIMENSIONS: the following dimensions will likely change during the preliminary run-up to actual construction. The most critical of these will be finalized & dated once the excavation & levelling have been performed.

As of **25 Feb. 2024**, the pier locations are specified as follows, with all measurements relative to the south & west walls. Measurements to be updated in April 2024 via KAS on-site work activities.

- Pier #1 location: xx feet from south wall; xx feet from west wall.
- Pier #2 location: xx feet from south wall; xx feet from west wall.
- Pier #3 location: xx feet from south wall; xx feet from west wall.
- Pier #4 location: xx feet from south wall; xx feet from west wall.

As of **25 Feb. 2024**, the concrete pier bases are specified as follows, with all measurements relative to the finished “broomed” concrete floor of the RORO building. Measurements to be updated in April 2024 via KAS on-site work activities. The concrete pier bases are to be constructed using 12-inch sono-tubes and rebar rods for strength; they must be a minimum of 50-inches below ground (unless they hit bedrock). It is likely that the concrete base specifics will change as the “Executive Pier Committee” (recommended above) provides pier part numbers and mounting plate details. The adjustable height piers will sit atop these concrete bases.

- Base #1 height: xx inches above the finished floor.
- Base #2 height: xx inches above the finished floor.
- Base #3 height: xx inches above the finished floor.
- Base #4 height: xx inches above the finished floor.

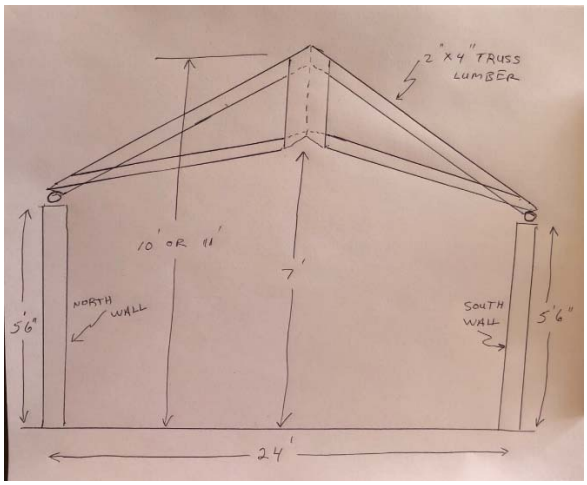
As of **25 Feb. 2024**, the RORO building wall heights are specified as follows, with all measurements relative to the finished “broomed” concrete floor of the RORO building. Measurements to be updated in April 2024 via KAS on-site work activities.

- North facing wall: xx inches above the finished floor.
- East facing wall: xx inches above the finished floor.
- South facing wall: xx inches above the finished floor.
- West facing wall: xx inches above the finished floor.

ENGINEERED TRUSSES: the trusses supporting the roll-off roof are key to providing adequate clearance for each of the 4-telescopes mounted on their adjustable height piers. The base of each truss should be constructed in sections with the center section angled to be the highest above the floor and providing the most clearance. As a graphical reference, see the 01’:31” point in the following YouTube video (copy / paste the link into your browser):

https://www.youtube.com/watch?v=hIb-GxBKfoE

A sketch of a possible “engineered truss” is provided here; not to scale; all dimensions are strictly for example only.



DOOR ACCESS INTO & OUT OF THE RORO BUILDING:

Three doors are envisioned – two for the public and one for opening / closing the RORO.

PUBLIC: The roof of the RORO will likely have a short over-hang that will travel with the roof as it moves eastward to the supporting structure. This over-hang will create complications for the “public” doors (in & out) of the building. The ingress & egress door(s), on the south facing wall, for the public, may have to be in sections with the upper section that also travels with the roof and the lower section fixed on the south facing wall.

PRIVATE: A third door for opening / closing the RORO is envisioned to provide comfortable access into / out of the building by KOSC / KAS members (non-public usage). This third door should be on either the west end or the east end of the building (most likely on the east end). It is anticipated that this door should be aligned with the highest point of the engineered trusses – 7’ noted in above sketch. Note – the trusses will sit on the 5’ 6” north & south walls (approximate height in above sketch).

IX. Additional Items to Clarify Various Details

Additional #1: In the following images, the orange Home Depot buckets represent concrete piers. The blue stakes and orange cones represent the building and the white stakes in the scrub trees show the footprint of the rolled off roof on support posts.

IMAGE 0

IMAGE 1

IMAGE 2

IMAGE 3

IMAGE 4

IMAGE 5

Additional #2: There are many possible scenarios for locating various telescopes within the RORO. The following configuration is just one such scenario (this may actually be George's idea).

- Pier #1 location: 12 feet from south wall; 24 feet from west wall; on the 24' centerline.
- Pier #2 location: 12 feet from south wall; 8 feet from west wall; on the 24' centerline.
- Pier #3 location: 7 feet from south wall; 16 feet from west wall; midway on the 32' length.
- Pier #4 location: 15 feet from south wall; 16 feet from west wall; midway on the 32' length.

Pier #1 = Joe's big AP refractor (I think pier location #1 is the best spot of all of the piers).

Pier #2 = KOSC's Celestron CGE mount and C-14" moved from the dome to the RORO (GN's idea).

Pier #3 = Celestron original CGEM mount or newer CGEM-2 mount (good for C-8" or C-9.25" or C-11"). Also, the CGEM mount (only 38 lbs.) could easily be removed by one person and a ZWO AM5 & ASIair be added with associated ZWO cameras. Thus, the latest advanced imaging equipment could be demo'ed to the public and even to an advanced class of students.

Pier #4 = Rod's 12-inch Meade telescope; it would also primarily be a visual viewing scope.

Discussion: Rod's Celestron C-14 with HyperStar would exclusively be an imaging scope. By moving the KOSC C-14" to the RORO, Rod's C-14" & HyperStar could then be housed in the 14" dome. This would permit access to one of Rod's gifts without having to open the more complex RORO. Also, computer equipment & wiring that is part of imaging, could be better accommodated within a dome.

Pier #1, Joe's AP, for personal use by Joe, or under Joe's supervision, would have good southerly and westerly views and be excellent for overall viewing by the public.

Pier #2, KOSC's C-14" (moved to the RORO) would have good southerly and westerly views (M42, IC434, M45, etc.), and limited easterly views, and continue to be excellent for overall viewing by the public.

Further, with Pier #3 (CGEM and/or ZWO AM5 & ASIair) being closest to the south wall, it would offer good northerly views (M101, M51, M13, Big Dipper, Cassiopeia, etc.). The ZWO ASIair broadcasts a WiFi signal to local tablets / cell phones, eliminating the need for complex computer wiring.

With Pier #4 (Rod's 12" Meade) being closest to the north wall, it would offer good southerly & westerly views (planets, moon, etc.).

This configuration would keep all scopes, including the Springsonian and SeeStar, as visual scopes within the RORO, with an option for an advanced imaging rig via WiFi. The pier wiring will be simplified by having only telescopes for viewing in the RORO – thus, only 110VAC is needed at each pier via buried PVC tubing. Such viewing does not require a computer and its associated complex wiring, nor a wall-mounted control panel.

Additional #3: Sierra Remote Observatory (SRO) for enhanced roof truss design

The Sierra Remote Observatory (SRO) is located in a remote section of the Eastern Sierra Mountains of California. It is a **commercial** remote observatory about an hour outside of Fresno. SRO sits at about 4,600ft elevation and its main advantage is consistently good seeing and dark skies. SRO also has really great on-site support, power, and WiFi. It is home to many very large telescopes, contains multiple roll-off-roof buildings, and collectively houses over 125 telescopes.

The purpose of including SRO info here as a reference is due to the numerous views of the roof & truss structure in the following YouTube video. The design of the roof and the “engineered” trusses provide lots of clearance above the piers, mounts, and OTA’s. As the guided tour by Bray Falls unfolds watch the truss design, and in particular, the 2-foot roof overhang that completes the top of the stationary walls. Copy / paste this link into your browser for the guided tour (23:13 minutes; the video will play after the ads that YouTube forces everybody to watch).

https://www.youtube.com/watch?v=R3t-czoa3mU

If you want to know more about the observatory check out their website:

https://www.sierra-remote.com/

Corporate Office:
Sierra Remote Observatories
42120 Bald Mountain Road
Auberry, CA 93602 USA

Observatory Site: Auberry, California

Contact Information:
Email: Info@SROservice.com
Website: www.sierra-remote.com
Corporate Office: 559-855-2473 (PST)
Observatory Phone: 559-855-5590 (PST)

Keith Quattrocchi: President and Founder
Email: Keith@SroService.com
Phone: 530-401-0643 (PST)

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X. Appendix, References & FAQ's

- **YouTube resources:**

The following links are to "YouTube" videos, etc. As is the common custom now-a-days, YouTube requires that you watch advertisements prior to watching the desired video. So, ***copy*** each of the following links and paste it into the address field of your favorite browser; i.e. Chrome, Edge, etc. Just let the ad(s) play and then the video will begin. The videos may usually be displayed in "full screen" format by clicking on an icon similar to the following found in the lower tool bar of the YouTube screen:

The videos referenced in this Appendix are worth viewing, so – endure the ads and play them. They will certainly enhance the written comments within this document.

- **References:**

Video description	Link to Video	Length (mm:ss)
Roll Off Roof Construction Animation	https://www.youtube.com/watch?v=hIb-GxBKfoE	2:49
Adirondack Sky Center & Observatory, Tupper Lake, NY (slide show). The ADK Sky Center RORO is 42' x 26' or 1092 sq. ft. with an included 34' x 26' viewing area; the remainder of the area is a warm room which KOSC does not need.	https://www.adirondackskycenter.org/RORO	0:30 loop

RORO general construction	https://www.youtube.com/watch?v=K76JlEuIBOI	4:42
Building a pier for astrophotography. This video shows the building process for a personal pier, unprotected, in a large Wisconsin field. The process is similar to our RORO piers and serves here as a visual aid.	https://www.youtube.com/watch?v=9NEMf0g5VjU	15:28
Sierra Remote Observatory guided tour by Bray Falls. Enhanced roof & "engineered" truss details.	https://www.youtube.com/watch?v=R3t-czoa3mU	23:13

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- **Frequently Asked Questions (FAQ's):**

  1. **Q:** - Why did you select the RORO site described here?

  A: - Several sites within the KOSC tract were evaluated but rejected. The exiting 20" dome blocked the view to the western horizon, which is a prime targeting area, thus limiting use of the general 6", 14" & 20" dome areas. Plans for a future outdoor stage & theater limited access adjacent to the children's playground. Also, the walking track around the playground was deemed to be avoided. Prime areas to be targeted are the east (above the eastern tree line); the south (above the existing solar panels); and the western skyline (above the tree line in that direction). The recommended site does have the required view of Polaris for alignment of the telescopes within the RORO.

2. **Q:** – Did the KAS do a “cost sizing” for this project?

A: - A “back of the napkin” estimate was done, but only as a rough guess. That guess came in as a 6-figure dollar value. The concrete floor / retaining walls alone were estimated at greater than $25K (based on the cost of a residential concrete driveway).

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