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Concealment Roles and Responsibilities

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INTRODUCTION

As the need for reliable connectivity has grown so has the need for new sites, greater RF coverage and capacity, changing code requirements and more mounting solutions. Alternative infrastructure such as buildings can be a siting solution to help fill voids in the network. However, the same aesthetic obstacles that may prevent a new tower's construction may also limit macro builds on rooftop structures.

What was once acceptable, such as flush mounted antennas upon a penthouse wall, are no longer acceptable for the end user MNOs due to different RF requirements such as new frequency bands and PIM. As a result, telecommunication equipment must be located closer to the edge of the building and hidden behind architectural elements such as a screen wall or concealment structure that meets jurisdictional and building owner requirements. Concealment structures give the illusion that the telecommunications equipment is not there. Also, concealment structures give MNOs a structure on which to mount equipment. Using concealment structures meets the local jurisdiction's and owner's aesthetic requirements and creates a mounting solution.

Due to the added responsibility of concealment structures, multiple disciplines and often multiple vendors are involved in their design and construction. A successful rooftop project requires strong communication between all parties. It is recommended that all parties work together in tandem because the results of each party affect the others both upstream and downstream. Coordination between each party ensures the engineer of record's (EOR) loads are passed on accurately and integrated into all subsequent analyses without the need for additional review and repeat work.

The goals of this paper are to define the multiple parties involved in concealment structure design and analysis and to provide a pathway of communication between all. This paper explains each party's role and how each impacts the scope of work beyond their area of specialty/contractual obligation. Upon proper installation completion and a Post-Installation Inspection of the install, future changes to equipment without changed conditions as defined by the International Existing Building Code (IEBC) and ANSI/TIA 222 may be allowed without reanalysis.

PARTIES IN A CONCEALMENT PROJECT

Mobile Network Operator (MNO)

The Mobile Network Operator (MNO) is the owner of the concealment structure and the client for whom all services are performed. It will be the MNO that chooses a search ring and identifies the need for additional wireless service. Upon project completion the MNO's equipment will be hidden inside the concealment structure as required by the local jurisdiction and/or the building owner. At the end of the lease term, the lease agreement between the MNO and the building owner will specify if the MNO may leave the concealment structure for the building owner's use or remove the concealment structure.

RF Engineer

The radio frequency (RF) design engineer works for the MNO. They will have knowledge of the proposed antenna systems and their RF propagation. The RF engineer is also responsible for providing the concealment engineer and supplier with the exact equipment specifications and the operating frequencies required for the installation. They will share any limits to the proposed concealment structure that may interfere with the antenna's ability to transmit and receive signal. The RF engineer will be responsible for providing a radio frequency data sheet (RFDS) containing this information. This data shall be relayed to the concealment engineer to ensure the concealment structure does not interfere with the antenna equipment's signal.

A&E Vendor

The architectural and engineering (A&E) vendor initiates the design as requested by the MNO and acts as the architect who oversees conceptual design through final construction. The vendor coordinates the preferred location of the antenna equipment taking into consideration the coverage objective, interferences, RF safety and maintenance. The vendor also coordinates the logistical aspects of site development from power distribution, backhaul, civil design and other issues.

Like a coordinating engineer (See Chris Ply and Peter Ludas, 2025, *The Coordinating Engineer Framework for Wireless Telecommunications Projects* [White Paper], TIF, www.tifonline.org) the A&E vendor will engage the various engineers, the MNO's agents, the structure owner's agents and jurisdictional contacts responsible for the full site design and approvals. It is their duty to share the Expectation List (provided at the end of this paper) at the onset of the work so that the various engineers downstream can work together to implement the A&E vendor's vision.

It is not the responsibility of the A&E vendor to engineer a solution but to outline a framework for the basis of design. They may share preliminary site measurements and photos to help assist the structural engineer with their design.

Structural Engineer

The structural engineer is responsible for reviewing the rooftop structure's ability to support the concealment structure, the connection between the two, the concealment structure's load path via positive attachment to the rooftop structure or via an intermediate dunnage subframe, and the scope of all subsequent analysis regarding the impact of the concealment structure to the underlying rooftop structure.

The structural engineer must determine the suitability of placing a concealment structure on an existing rooftop structure and must confirm any pre-existing loads on the structure. They must have expertise in working with the structure type for the project. The structural engineer must have knowledge of additional loads on the proposed concealment structure and sub framing beyond loads provided by the concealment engineer. For example, often grating is added to a

concealment structure's supporting subframe for access. Dead, live and snow load should be considered on the grating in accordance with ASCE 7.

The structural engineer must also be knowledgeable about constructability, influence on architectural elements and influence on members and connections (i.e. blind bolting, water proofing, adding a support post to a protected zone of a seismic connection). Existing constraints may limit the proposed concealment structure or sub frame's interface to the supporting rooftop structure.

Mount Analysis Engineer

The mount analysis engineer oversees the design of the antenna and the associated ancillary equipment's proposed structural framing and connections inside the concealment structure. They will follow MNO requirements for antenna spacing, equipment setbacks, etc. and ensure the mount is large enough to meet the MNO's requirements or design individual mounts for each appurtenance. They will make the decision with the concealment engineer if the mount may or may not be integrated into the concealment structure's frame. They will also specify attachment points and required fixity for the mount to be structurally sound and stable. Mounting details must be shared with the concealment engineer and supplier.

Concealment Engineer

The concealment engineer designs the concealment structure including cladding, gravity framing, lateral force resisting system (LFRS), and respective attachment hardware. This party will ensure that any pultruded FRP structural framing members shall be in conformance with *ASCE 74-23 Load and Resistance Factor Design (LRFD) for Pultruded Fiber Reinforced Polymer (FRP) Structures*. This engineer will have the freedom to choose the concealment structure design that meets the local jurisdiction's and building owner's requirements such as the front of the structure requires shielding or if full shielding is required from all sides.

The concealment engineer will be expected to follow the Expectation List. If a directive is given in the Expectation List such as "all boundary conditions must induce axial forces only" then the design must include this directive. This ensures an equal opportunity for one concealment engineer and another to be tied to the same constraints. If not, a concealment engineer may be incentivized to reduce the quantity of connections, sizes and structural members if they can treat the columns as a cantilevered column LFRS regardless of the impact to the structural framing below.

The concealment engineer should incorporate rigging and tether points into the concealment panels and structures as applicable to facilitate construction. If included, these shall be relayed to the supplier to be incorporated into the concealment structure and installation instructions to be used by the installation contractor.

At the concealment structure's interface to the supporting structure, it is preferred that the concealment engineer design a steel or other appropriate transfer plate/connection capable of transferring the boundary condition's forces to the supporting structure below. From this transfer plate/connection, the structural engineer can design an intermediate or final connection to the rooftop structure below.

Supplier

The supplier sources the fiber reinforced polymer (FRP) or other RF-friendly material to build the concealment structure per the concealment engineer's specifications. The supplier should have innate knowledge of RF-friendly material. They will review the RF engineer's requirements and operating frequencies and share with the concealment engineer if there is a problem with the proposed cladding/structural members that may cause interference with the RF equipment. The supplier may recommend a different material or a change in concealment structure design to accommodate a reduced section that meets the RF engineer's requirements.

The supplier can camouflage the concealment structure with different exterior concealment panel facades to ensure the concealment structure fits seamlessly into the existing environment. To ensure the structure matches the existing environment the supplier will require photos, color samples, texture samples, and/or measurements of the existing structure from the A&E vendor to match. The supplier may choose to send samples of the final product back to the A&E vendor that they will share with the local jurisdiction or building owner for final approval. In some instances, a site visit may be required.

Contractor

The general contractor will be the party charged with the construction of the concealment structure and its attachment to the supporting rooftop structure below. Prior to construction they will thoroughly review the final plans submitted by all three engineers (mount, concealment, and structural) and visit the site to field-verify the design is accurate and can be implemented as designed. If any questions or inconsistencies are found they will coordinate with the responsible party to clarify. They will dictate the means and methods to erect the structure as well as coordinate the schedule of construction and ensure inspectors have timely access to review all items required by the engineers.

The general contractor will utilize the supplier's recommended attachment hardware and follow specific installation requirements as outlined by any instructions provided by the supplier. The contractor will utilize appropriate rigging and tether points as dictated by the supplier's installation instructions.

Should the general contractor identify any substantial discrepancies between the materials supplied and the approved plans or drawings during installation, they shall notify the appropriate party (supplier, mount, concealment, or structural engineer) prior to continuing work.

DUTIES PER ENGINEER

All engineers must produce a stamped set of calculations and drawings prior to the addition of the concealment structure to a rooftop structure and before commencement of construction. Due to the scope of work and capability of various A&E vendors, each engineering task may be performed by separate firms although a turnkey firm may choose to take on all three analyses/designs (mount design, concealment structure design and structural analysis of rooftop structure).

BEST PRACTICES

It is best practice that the MNO's site acquisition team confirms that the proposed concealment structure will satisfy the building owner and is feasible by the structural engineer. Upon completion and once the project has been awarded, the A&E vendor, acting like a coordinating engineer, shall host a kick-off meeting or communicate expectations where the mount, concealment and structural engineer can meet and discuss the project. During this meeting, they review the Expectation List. Each engineer can take the Expectation List, review the intent of the proposed concealment structure, limits of the supporting rooftop structure and provide feedback to each another. The Exception List acts as a jumping off point for the various engineers to outline their expectations. The goal is to ensure all parties are working together and not individually to limit iterations, increase communication and ultimately speed to deployment. For example, the antennas must be supported via a mount. The mount engineer and concealment engineer will determine together how one influences the other. Their loads will be passed on to the structural engineer to determine the impact to the rooftop structure below.

Prior to the kick-off meeting, the structural engineer should review the building framing to ensure the installation of a concealment structure in the proposed location(s) is feasible and supporting structural framing is present. If no existing structural information exists, the structural engineer can request mapping services, record document requests, etc. Armed with this knowledge, the structural engineer can confirm that the concealment structure can adequately connect to the existing structural framing or if a sub frame is required to span between structural framing members beyond the limits of the concealment structure's footprint.

It is common to allow the MNO the opportunity to perform a feasibility analysis of the rooftop structure prior to ordering and fabricating materials. The purpose of the feasibility analysis is to ensure the rooftop structure can support the existing and proposed loading. During this review, the initial concealment structure design can be vetted more thoroughly to determine the effects of the proposed loads on the rooftop structure. Ideally, the rooftop structure will withstand the proposed loading. If not, it is during this phase that the structural engineer can consult with the concealment engineer to find alternative solutions to mount a concealment structure. For example, can the concealment engineer add additional bracing, add additional posts, revise the lateral force resisting system? Typically, it will be cheaper to modify the proposed structure and

redistribute force rather than modify the existing rooftop structure, however, this will be determined by the structural engineer.

Upon completion of the concealment structure's design, the A&E vendor should host an additional coordination meeting with the same parties who attended the kick-off meeting and the contractor who will construct the concealment structure and attachments to the rooftop structure. During this meeting the contractor will be introduced to the parties responsible for design where contact information should be shared. Should an issue arise in the field, the contractor will have direct contacts with whom they can reach out to resolve issues. During this meeting the engineers can also reiterate the minimum requirements for inspection in accordance with their drawings that the contactor must implement.

All concealment and structural framing beneath (if appliable) shall be inspected in accordance with the engineer's design documents. For penetrating/anchored mounts, connections and anchorages will be verified prior to covering and final application of finishes and/or waterproofing. The contractor shall coordinate inspection based upon their knowledge of the construction schedule.

CONCLUSION

Close coordination between all the parties will ensure smooth project delivery with less iterations as compared to the current process where engineers work independently from one another. Less rework increases deployment speed resulting in the site coming on-air faster and an increase in network coverage. Additionally, documenting the loads between engineers creates a historic record of all information pertinent to the design of each subsystem. Future deployments may not require a full structural analysis because the proposed loads may be less than the design loads. Therefore, the proposed loading can be reviewed and certified as appropriate, streamlining follow up analyses in accordance with ANSI/TIA 222 and the IEBC evaluation of significantly changed conditions.

APPENDIX A – VARIOUS CONCEALMENT SUPPORT STRUCTURES

1. Intermediate Dunnage Subframe

2. Intermediate Dunnage Subframe Supporting FRP Shroud

3. Intermediate Support Frame Between FRP and Building Structure

4. Six Foot Concealment Extension Above 210 foot Tower

APPENDIX B - MNO BEST PRACTICE EXPECTATION LIST

This list must have been reviewed and parties should be ready to discuss prior to the A&E vendor's kick-off meeting and should include, but not limited to:

1) Preliminary documentation list detailing proposed concealment structure, anticipated equipment to be concealed and existing structural framing (if present).

2) What is the concealment structure's structural framing intent? Is the design a braced frame, moment frame, shear walls, etc.? Please provide details.

    a. Like AISC 16th Ed. *A4.1(g) Structural Design Documents and Specifications* shall provide and give the following information regarding the *identification of the lateral force-resisting system and connecting diaphragm elements that provide for lateral strength and stability in the completed structure.*

3) Does the sheathing provide restraint / stability to the frame? Is it structural?

4) Material properties, member dimensions, connection design, etc. must be provided. This is in line with *ASCE 74-23 1.6 Structural Design Drawings and Specifications.*

5) Is the mount (equipment support structure) integrated into the concealment structure or is it separate? How does one influence the other and vice versa?

6) The concealment engineer must provide a means of connecting the concealment structure to the rooftop structure or structural engineer's sub framing below via a steel or other appropriate transfer plate / connection.

    a. Some type of intermediate connection must be provided to join the two structures together.

    b. Structural engineer to provide guidance of base attachments and type of fixity.

7) Batch of reactions, key of nodes, design methodology (ASD or LRFD)

    a. Scope of work typically begins and ends at the boundary conditions of each analysis. Therefore, the reactions per load combination can be shared. This is preferable rather than providing the worst-case scenario of controlling reactions because the supporting subframe can be optimized.

    b. Batch reactions shall be shared in a digital format (such as MS Excel) so that the data can easily be sorted for subsequent analyses.

    c. This is like the data required for delegated design given in AISC A4.1.

8) Application of code parameters (Risk Cat., Exp. Cat., Topo. Cat., etc.)

    a. Structural engineer may have local knowledge that exceeds the assumed values the concealment engineer may or may not know about. For example, in the Village of Key Biscayne only allows Exp. (D) for its structural designs. Many

jurisdictions in South Florida have their own specific local requirements for wind speeds which are different than the values shown in the ASCE Hazards Reports.

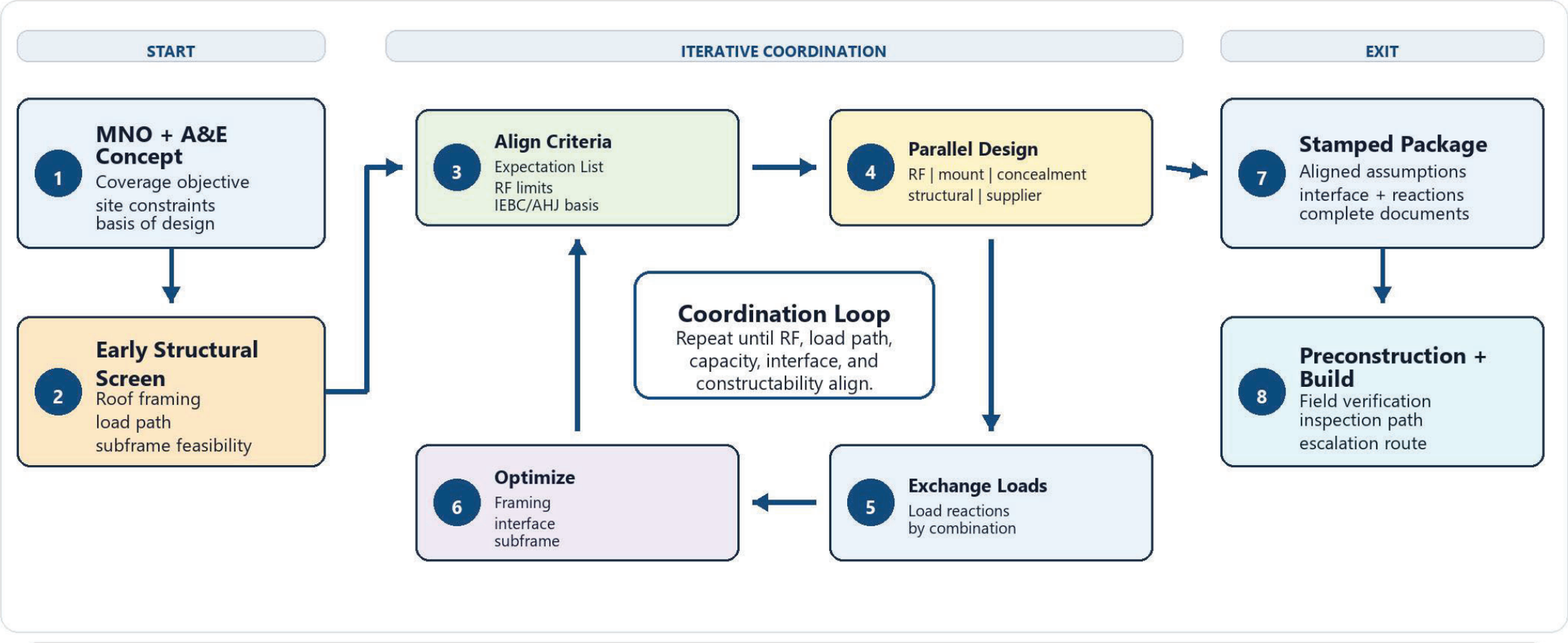
9) RF Sensitivity

   a. Do the proposed panel antennas have any issues with different screen wall thicknesses? Will a screen wall need to be thinner in certain areas for certain antennas due to RF propagation through the material?

   b. If a screen wall was being used structurally, the screen that was previously a shear wall has now been perforated and must be treated as such in the analysis.

RF-Friendly Concealment Structure Coordination Flow

When concealment is necessary, perform early structural screening, then coordinated RF, mount, concealment, structural, supplier, and construction review.



Active parties in coordination loop

MNO	A&E	RF	Mount	Concealment	Structural	Supplier	Contractor

Key message

Bring the structural engineer in before the concealment design is locked.

A&E role

Owns concept, site data, and coordination. Final engineering remains with the applicable engineers.

Exit gate

Fabrication proceeds after RF limits, reactions, interface/fixity, rooftop capacity, and inspections align.

Scope: substantial rooftop RF-friendly concealment structures requiring coordinated mount, concealment, and supporting-structure review.

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