STATE OF WASHINGTON

DEPARTMENT OF ENTERPRISE SERVICES

1500 Jefferson Street SE, Olympia, WA 98501

ADDENDUM NO. 3
July 14, 2014

The Washington State Department of Enterprise Services
Project No. 2013-295
Request for Proposal – Design-Build
Pierce County Readiness Center
Camp Murray, Tacoma, WA

This Addendum consists of two parts: (1) responses to nine submitted questions; (2) eleven decisions arising from the second round of proprietary meetings and/or clarifications or new Owner requirements

1. This following responses are offered to submitted D/B Finalist questions:

#	Date	Reference Section	Question or Comment	DES Response
1	06-23-2014	Section V Room Data Sheets Physical Training	Please provide a listing of anticipated equipment that we should accommodate in the PT room.	The equipment in this room is purchased by the Unit using MWR Funds. There is no specific list. The type of equipment typically purchased includes universal gyms, free weights, elliptical, stationary bikes, stair climbers, etc.
2	06-23-2014	UFC 4-010-01	Please confirm no ATFP standoff requirements at Camp Murray for the controlled GOV vehicle access area behind the PCRC.	The military parking is considered secure and per ATFP, stand-off is not required.
3	06-23-2014	UFC 4-010-01	UFC 4-010-01 requires all exterior glazing and door into inhabited areas, as well as exterior wall and roof elements that do not meet the conventional construction parameters in Table 2-3, to be analyzed and hardened for blast effects at the actual standoff distance to parking, roadways, and trash containers. Please confirm that the actual standoff distance can be used for each element location, rather than a prescriptive standoff distance of 30' for the entire building.	Actual stand-off distances should be used per the referenced UFC.
4	06-23-2014	UFC 4-010-01	Request ATFP review of overhead door from Assembly Hall into controlled GOV vehicle access area behind the PCRC. UFC 4-010-01 does not allow for overhead doors into occupied spaces. If an overhead door is required, it may need an unoccupied vestibule to separate the occupied space from the exterior.	A vestibule/separation space at the vehicle door into the assembly hall is not required provided the vehicle door opens into the secured military vehicle parking area.

5	06-23-2014	**Design-Build Proposal Requirements**, Section IV, Paragraph 7.0 Site Civil Design	There is conflicting reference in the RFP regarding PCC and ACP at the MEP pavement. Please confirm that PCC is desired.	Change the first paragraph in paragraph 10 to read as follows: *"Provide asphalt concrete paving at POV parking and roadways, and Portland cement concrete paving at military vehicle parking and vehicle access to building. All paving to comply with DG 415-15."* Add the following in paragraph 11: *"Striping is not required at military vehicle parking."* *Roller-compacted concrete is acceptable.*
6	06-23-2014	**Design-Build Proposal Requirements** Section IV, Paragraph 7.0. B.12	We note that pavement curbing at Camp Murray is almost non-existent. Please confirm that pavement curbing is not required as part of this project.	Curbs are required where pedestrian sidewalks adjoin vehicle paving. At all other locations, thickened paving edge is acceptable.
7	06-23-2014	**Design-Build Proposal Requirements** Section IV, Paragraph 11.0. D.8	Is infrastructure for future solar HW required? If so, what scope?	If solar hot water heating is not provided, provide pathway from Mechanical Room to roof and a weatherproof penetration where future piping can be installed.
8	06-23-2014	**Design-Build Proposal Requirements** Section IV, Paragraph 14.0. S.1	Is a lightning protection system required? This is rare in western Washington	No.
9	N/A	**Design-Build Proposal Requirements** 14.0 Electrical D. Emergency and Stand By Power	In the Design Program under item 15 it states "The facility will include an emergency power generator with capacity adequate to support 100 percent of the facility functions." While under the RFP Sec 4, Design Program Narratives under section 14.0 Electrical – Power Distribution Design Criteria sub paragraph D it states "Provide a diesel engine/generator for this project that serves Emergency, Legally Required, and Optional Standby loads as follows:…" The loads listed are specific sub systems and not the entire facility. Please confirm if the generator is to power the entire facility	The generator shall be sized for 35% of design electrical load. The remaining 75% load shall be included in the Stand-By Load category which shall automatically shed in the event of overload.

2. This following identify decisions made during the second round of proprietary meetings and/or clarify or define new Owner requirements:

#	Date	Reference Section	Issue	DES Response
10	N/A	**Design-Build Proposal Requirements**, Section V.10 Room Data Sheets: Assembly Hall	Assembly Hall Air Conditioning Overhead Door	Under Doors; Change "Sectional" to Overhead Insulated Coiling" Under HVAC, delete the following: *"A/C provided under state funds"*
11	N/A	**Design-Build Proposal Requirements**, Section V.10 Room Data Sheets: Unit Storage Training Workbays	Overhead Doors	Clarification: All doors to be sectional overhead insulated. Motorized at Training Work Bays and manual at Unit Storage.
12	N/A	**Design-Build Proposal Requirements**, Section V.10 Room Data Sheets: Unit Storage	Quantity of Storage Shelving	Provide 90 each, 5-ft length sections of 3-tier industrial 3-tier shelving as described on the attached Section 10 6700. Distribute in caging in Unit Storage .
13	N/A	**Design-Build Proposal Requirements** Appendix 1-F DG 415-5	Enclosure of Exit Stairways. The IBC does not require enclosure of exit stairs in a fully-sprinklered building of not more than two stories whereas UFC 3-600-01 referenced in DG-415-5 incorporates NFPA 101 which does require enclosure of all exit stairs	Section IV Paragraphs 2.0.B and 10.0.A identifies the 2012 IBC as adopted by Pierce County, the permitting authority, as the basis of design code. DG415-5 Section 1-3.15 identifies the IBC as the minimal acceptable standard for life safety. Exit pathways that comply with 2012 IBC are acceptable.
14	N/A	**Design-Build Proposal Requirements**, Section V.10 Room Data Sheets: AV Storage; Training Aid Storage; Mechanical/Electrical/Telecom	Air Conditioning	Under HVAC, delete the following: *"HVAC"* At Mechanical/Electrical/Telecom HVAC, Add the following: *"AC in IDF/MDF as required for equipment"*
15	N/A	**Design-Build Proposal Requirements**	Unheated Vehicle Storage Building	Refer to the attached description of the Unheated Vehicle Storage Building located on Sheet A1.00 and A1.10 and included as Alternate No.1. Note Roof slope can be 1.5/12. Roof panels to be concealed fasteners
16	N/A	**Design-Build Proposal Requirements**, Appendix 1.b. NGB Pam 415-12	Flagpoles	Delete the requirement for 2 flagpoles identified in NGB PAM 415-12 Table 1-5.

17	N/A	**Design-Build Proposal Requirements**	Helipad	Refer to the attached description of the Helipad located on Sheet A1.00 and included as Alternate No.2. Provide FAA approved unlighted windsock. Additionally, if this alternate is selected, the successful proposer will need to relocate the 30-ft flagpole currently located near 41st Division Way.
18	N/A	**Design-Build Proposal Requirements**	Cavity wall construction at Vaults	A cavity (vibration isolation) at vault walls that face circulation space is not a requirement.
19	N/A	**Design-Build Proposal Requirements**	Roof Equipment Access	Service access to any roof-top located equipment shall not be provided by means of a vertical ladder.
20	N/A	**Design-Build Proposal Requirements** Section IV, Paragraph 18.K.1	Outside Plant Backbone and Pathways This paragraph indicates the number and composition of fiber optic cables to be provided from one of the two existing communication vaults indicated on the survey.	Change the first sentence to read as follows: *" The data system will require new fiber optic cabling to bring data service into the building from the existing head-in at Building 19, through existing conduits to one of the two existing communication vaults indicated on the survey and then in new conduits into the EF." Length from the com vault at Infantry Dr. and Signal Corps Rd to building 19 via the existing pathway is approximately 4,000 feet. Proposer is responsible for verifying needed cable length to include all terns, bends, splices, terminations etc."* *Provide 48 strands of single-mode fusion spliced terminated LC.* *Provide 50 pair OSP Copper* *There are existing copper conductors in the vault at Infantry Dr. and Signal Corps Rd. that can be spliced and used for this project.* Add the following item 3: *"Provide six 4" empty conduits from the EF to the other communication vault and from the EF to a point 5-ft from the east side of the building (towards the future HQ Readiness Center).*

Attachments:

Section 10 6700 Metal Storage Shelving (2 pages)
Data on Unheated Vehicle Storage Building- Alternate 1 (5 pages)
Data on Helipad - Alternate 2 (23 pages including excerpts from UFC and FAA Advisory Circular.)
Note: Excerpts provided for bidder convenience. Bidder is responsible to determine if any other portions of the excerpted material apply to their design of the element noted)

This Addendum does not amend the due date or time for Proposals. Proposals continue to be due on July 31, 2014 not later than 3:00 PM.

SECTION 10 6700 – METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes heavy-duty industrial shelving designed to contain manually loaded material with all major parts designed to fit or snap into place without tools.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Suggested Manufacturers Manufacturer:
1. Penco Products, Inc.; Subsidiary of Vesper Corporation “Wide Span Shelving”
2. Lyon Metal Products, Inc.
3. Republic Storage Systems Co., Inc.

2.2 STEEL SHELVING

A. Components: Shelving units to be 3-shelf units, total height 120”, 5-ft lengths. Form from heavy gauge steel, MIG welded into one rigid assembly containing posts, diagonal and horizontal braces and foot plates

1. Frames shall be from heavy gauge steel, MIG welded into one rigid assembly containing posts, diagonal and horizontal braces and foot plates. Frames shall have a minimum capacity of 10,000 pounds with a 1.92 safety factor for vertical beam spacing not exceeding 60".
2. Posts shall be punched on the face to provide positive independent beam placement on 2" vertical centers and marked on 12" centers to facilitate placement of shelf levels. A slot on each side of the post shall be designed to accept a nib on the end of each beam for locking in place.
3. Rigidity beams, constructed of 3" high steel channels with return flanges and a beam end connector welded to each end providing lateral stability for the shelving shall be provided. Minimum 2 per unit. Provide beam braces as required if beams are load-bearing.
4. Shelves shall be 1-3/4" high with double flanges at front and rear edges with a full width reinforcing pan welded to the center of the bottom.
5. Shelf side supports: Heavy gauge steel angles supporting steel shelves, engaging the upright frame at four points. One or more tangs stamped into the surface engages the reinforcing pan on the shelf bottom to prevent accidental dislodging of the shelf. One pair required for each steel shelf.

2.3 ACCESSORIES

A. Wall Brackets: Where shelving is adjacent to walls, provide manufacturers standard bracket to fasten upright frames to the wall. Include hardware to fasten to frame.

B. Row Spacers: Provide to space and join back-to-back shelving units.

C. End Racks: Manufacturer's standard where necessary.

2.4 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

B. Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer finish consisting of a thermosetting powder topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Contracting Officer from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal storage shelving and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.

B. Connect groups of shelving together with standard fasteners,

C. Anchor to floors and walls at intervals recommended by manufacturer.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Protect shelving from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.

END OF SECTION 10 6700

UNHEATED VEHICLE STORAGE (UVS) BUILDING (Alternate #1)

PART 1 GENERAL

1.1 BASE BID

A. Provide 16,000-sf military vehicle parking in the secure military parking area in lieu of UVS Building.

1.2 ALTERNATE BID NO. 1

A. Provide a 16,000-sf (approximately 64'x250') pre-engineered, shop-fabricated building on cast concrete foundation with 6" slab with structural steel building frame, insulated metal wall and roof panels, openings for personnel and vehicle doors, and all trim, flashings, and accessories indicated or required for a complete metal building system. The general configuration shall provide a series of open bays of approximately 32-ft x 64-ft with a 10-ftx16-ft overhead coiling doors permitting a drive-through function. Provide a concrete apron (same as military vehicle parking) 60-ft deep along the vehicle access sides of the building. This apron is in addition to the area indicated for military vehicle parking.

B. Provide lighting and general service (housekeeping) power in the UVS Building in accordance with code requirements.

C. Provide heating and ventilation system that will enable the building to maintain interior temperatures above 50 degrees and to prevent condensation on interior surfaces of the building and/or its contents.

D. The attached diagrams provide general information regarding the expectation of the UVS Building

1.3 DESIGN REQUIREMENTS

A. Installed Thermal Resistance: Wall System: R value of 19; Roof System: R value of 30.

B. Design metal building to withstand all loads required by codes in effect at the project site.

C. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of 1/180 of span.

D. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

E. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature ranges of 120 degrees F ambient and 180 degrees F for material surfaces.

F. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

1.4 QUALITY EXPECTATIONS

A. Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this Work.
   1. Design Engineer Qualifications: Licensed in the State of Washington.

B. Perform work in accordance with AISC 360 - Specification for Structural Steel Buildings.

C. Perform welding in accordance with AWS D1.1.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and the following:
   1. Member of MBMA (Metal Building Manufacturers Association).
   2. AISC Category MB: Manufacturing facility certified by AISC.

1.5 WARRANTY

A. Provide five year manufacturer warranty for wall and roof panels.
   1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 PRE-ENGINEERED BUILDING

A. Single span rigid frame.

B. Primary Framing: Rigid frame of rafter beams and columns, end wall columns, and wind bracing.

C. Secondary Framing: Purlins, and other items detailed.

D. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly and insulation, and accessory components.

E. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly and insulation, and accessory components.

F. Roof Slope: 3 inches in 12 inches.

2.2 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A 572, Grade 50.

B. Structural Tubing: ASTM A 500, Grade B cold-formed.

C. Plate or Bar Stock: ASTM A 529, Grade 50.

D. Anchor Bolts: ASTM A 307, galvanized to ASTM A 153.

E. Bolts, Nuts, and Washers: ASTM A 325, Type 1, galvanized to ASTM A 153, Class C.

F. Welding Materials: Type required for materials being welded.

G. Primer: SSPC-Paint 20, zinc rich.

H. Grout: ASTM C 1107, Non-shrink type, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2400 psi in two days and 7000 psi in 28 days.

2.3 MATERIALS - WALLS AND ROOF

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A 653, SS Grade 33, with G90 coating.

B. Insulation: ASTM C 665 Type II Class A.

C. Joint Seal Gaskets: Manufacturer's standard type.

D. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A 153, finish to match adjacent surfaces when exterior exposed.

E. Bituminous Paint: Asphaltic type.

F. Sealant: Manufacturer's standard type.

G. Trim, Closure Pieces, Caps, Flashings, Fascias and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.4 COMPONENTS

A. Doors and Frames: Hollow metal

B. Overhead Doors: Manual overhead coiling

2.5 FABRICATION - FRAMING

A. Fabricate members in accordance with AISC Specification for plate, bar, tube, or rolled structural shapes.

B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.

2.6 FABRICATION - WALL AND ROOF PANELS

A. Wall Panel: 22 gauge, exposed fastener type, with high ribs (1-1/4 inch nominal) spaced 12 inch on center and minor ribs spaced 4 inches nominal on center.
   1. Panel Width: 36 inches.
   2. Surface Texture: Smooth. *Embossed texture is prohibited.*

B. Roof Panel: 22 gauge, exposed fastener type, with high ribs (1-1/4 inch nominal) spaced 12 inch on center and minor ribs spaced 4 inches nominal on center.
   1. Panel Width: 36 inches.
   2. Surface Texture: Smooth. *Embossed texture is prohibited.*

C. Girts/Purlins: Rolled formed structural shape to receive siding, roofing sheet.

D. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners.

E. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.

F. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.7 FABRICATION - GUTTERS AND DOWNSPOUTS

A. Fabricate of same material and finish as roofing metal.

B. Form gutters and downspouts to profiles and size indicated to collect and remove water. Fabricate with connection pieces.

C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.

D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.8 FINISHES

A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.

B. Exterior Surfaces of Wall Components and Accessories:
   1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a total minimum dry film thickness of 1 mil and 30 percent reflective gloss when tested according to ASTM D 523.
      a. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D 4214; and without fading in excess of five Hunter units.
      b. Wall Panel Color and Sheen: As selected by Architect from manufacturer's full range of standard colors.
      c. Roof Panel Color and Sheen: As selected by Architect from manufacturer's full range of standard colors.

C. Interior Surfaces of Wall Components and Accessories: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

A. Erect framing in accordance with AISC 360 - Specification for Structural Steel Buildings.

B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.

C. Set column base plates with non-shrink grout to achieve full plate bearing.

D. Do not field cut or alter structural members without approval.

E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOF PANELS

A. Install in accordance with manufacturer's instructions.

B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.

C. Fasten cladding system to structural supports, aligned level and plumb.

D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.

E. Provide expansion joints where indicated.

F. Use concealed fasteners.

G. Install sealant and gaskets to prevent weather penetration.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

B. Slope gutters minimum 1/32 inch/ft.

C. Connect downspouts to storm sewer system.

3.5 INSTALLATION - ACCESSORIES

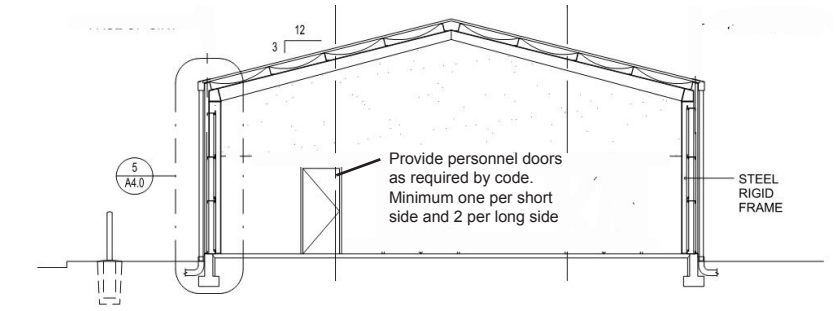
A. Seal wall and roof accessories watertight and weather tight with sealant in accordance with Section 07900.

3.6 TOLERANCES

A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.

B. Wall and Roof Panels: 1/8 inch from true position.

END OF DATA



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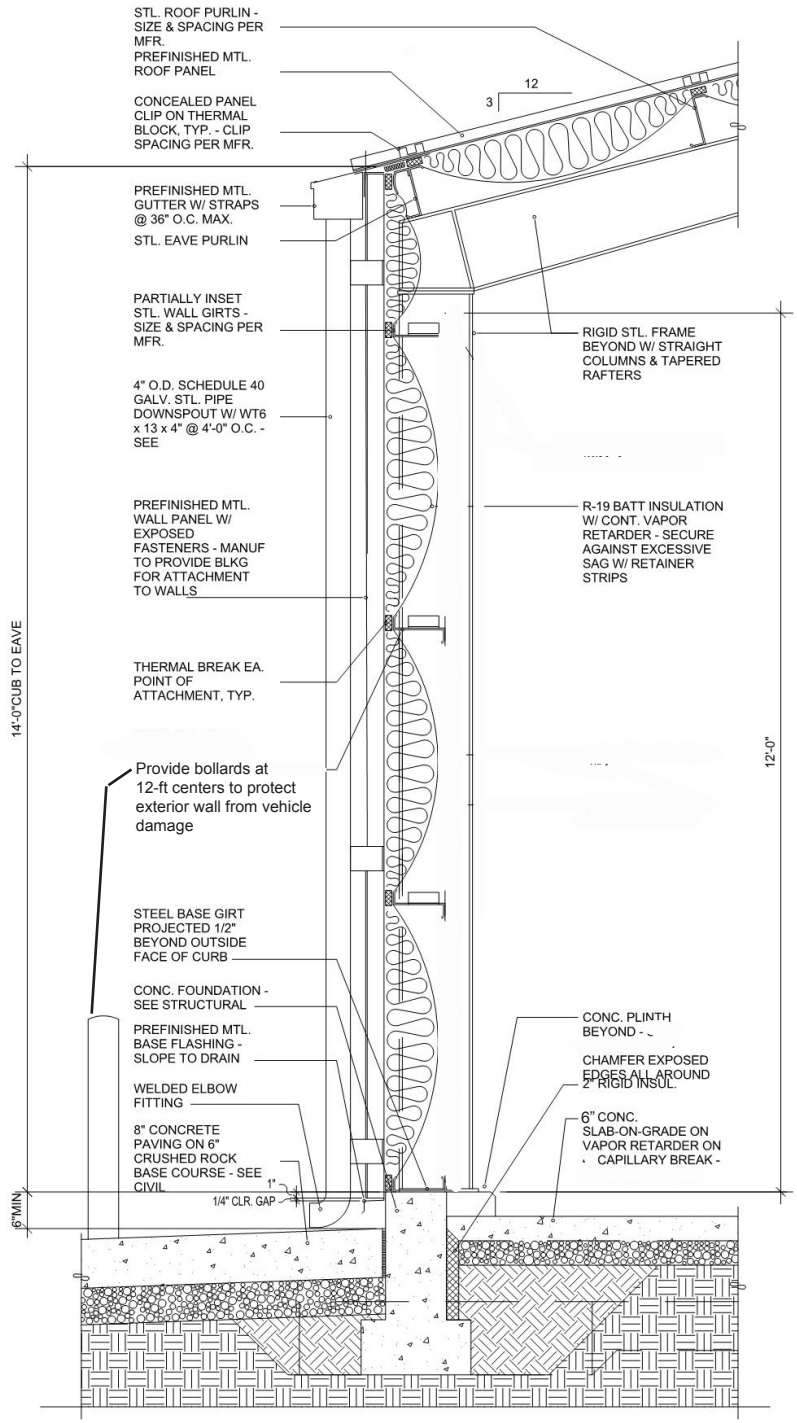


Wall Section

Section at typical Unheated Vehicle Storage Building

HELIPAD Data (Alternate #2)

PART 1 GENERAL

1.1 BASE BID

A. No work is provided

1.2 ALTERNATE BID NO. 2

A. Provide a Limited-Use VFR Helipad as defined by UFC 3-260-01, Chapter 4, Table 4-2. (see attached excerpts)

B. Surface to be grass paving turf capable of supporting OH-60 up to CH-47 (see attached)

C. Markings to be flush and anchored concrete per Paragraph 215 of Aviation Circular AC150/5390-2C and Example 1 of Figure 2.2 and Figure 2.3 (see attached)

D. Provide FAA Approved Windsock

PART 2 PRODUCTS

2.1 GRASS PAVERS

A. Suggested Manufacturers:

1. (Grasspave2, Hydrogrow) Invisible Structures, Inc., 1600 Jackson Street., Suite 310, Golden, Colorado 80401. Call from USA and Canada 800-233-1510 toll free, International 303-233-8383, Fax 303-233-8282.

2. (Bodpave 85) Boddingtons, Inc., 2780 Snelling Ave. N., Ste 306, Roseville MN 55113 Tel. 6651-330-2920, Fax 651-797-2319.

2.2 MATERIALS

A. Base Course: Sandy gravel material from local sources commonly used for road base construction, passing the following sieve analysis.

Sieve	%Passing
1”	100
3/4"	90-100
3/8”	70-80
#4	55-70
#10	45-55
#40	25-35
#200	3-8

B. Hydrogrow Mix: A mixture made from several commercial products including: 1) cross-linked polyacrylimide (<0.1%) polymer, which is non-toxic and neutral in pH, and will absorb 150 to 350 times its weight in water from most tap sources; 2) ZeoPro zeolite mineral, amended with small amounts of starter fertilizers, from Zeoponix, Inc.; 3) Isolite porous ceramic, designed to hold large amounts of water without physical degradation or change of size of particle, from Sumitomo Group; 4) and aggromolated Humate, a natural source of nutrients and micronutrients, from Tri-C Enterprises.

C. Grass Paving Units: Lightweight injection-molded plastic units 0.5x0.5x0.025m (20"x20"x1" high, 2.7 ft2 each) with hollow rings rising from a strong open grid allowing maximum grass root penetration and development. The plastic shall be 100% post-consumer recycled plastic resins, predominately HDPE, with minimum 3% carbon black concentrate added for UV protection.

Loading capability is equal to 5700 psi when filled with sand, over an appropriate depth of road base. Standard color is black. Unit weight = 18 oz., volume = 8% solid. Units may also be shipped in pre-assembled into rolls that vary from 108 sf to 1345 sf.

D. Sand: Obtain clean sharp sand (washed concrete sand- AASHTO M6 or ASTM C-33) to fill the one inch high rings and spaces between the rings when seeding or using half inch thick sod (soil thickness).

E. Grass: Use species resistant to wear by traffic generally a Blue/Rye/Fescue mix used for athletic fields.
1. Seed: Use seed materials, of the preferred species for local environmental and projected traffic conditions, from certified sources. Seed shall be provided in containers clearly labeled to show seed name, lot number, net weight, % weed seed content, and guaranteed % of purity and germination. Pure Live Seed types and amount shall be as shown on plans.

F. Mulch: (Needed only for seeding.) Shall be of wood or paper cellulose types of commercial mulch materials often used in conjunction with hydroseeding operations. Mulches of straw, pine needles, etc. will not be acceptable because of their low moisture holding capacity.

G. Fertilizer: A commercial "starter" fertilizer, with Guaranteed Analysis of 17-23-6, or as recommended by local grass supplier, for rapid germination and root development.

PART 3 EXECUTION

3.1 PREPARATION

A. Ensure that subbase materials are structurally adequate to receive designed base course, wearing course, and designed loads. Generally, excavation into undisturbed normal strength soils will require no additional modification. Fill soils and otherwise structurally weak soils may require modifications, such as geotextiles, geogrids, and/or compaction (not to exceed 90%). Ensure that grading and soil porosity of the subbase will provide adequate subsurface drainage.

B. Place base course material over prepared subbase to grades shown on plans, in lifts not to exceed 6", compacting each lift separately to 95% Modified Proctor. Leave minimum 1” to 1.5" for Grasspave2 unit and sand/sod fill to Final Grade.

C. Spread all Hydrogrow mix provided (spreader rate = 10 lbs per 1076 sf) evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader. The Hydrogrow mix should be placed immediately before installing the paver units to assure that the polymer does not become wet and expanded when installing the units.

3.2 INSTALLATION OF PAVER UNITS

A. Install the paver units by placing units with rings facing up, and using pegs and holes provided to maintain proper spacing and interlock the units. Units can be easily shaped with pruning shears or knife. Units placed on curves and slopes shall be anchored to the base course, using 12” spiral spikes with fender washer, as required to secure units in place. Tops of rings shall be between 0.25" to 0.5" below the surface of adjacent hard-surface pavements.

B. Install sand in rings as they are laid in sections by "back-dumping" directly from a dump truck, or from buckets mounted on tractors, which then exit the site by driving over rings already filled with sand. The sand is then spread laterally from the pile using flat bottomed shovels and/or wide "asphalt rakes" to fill the rings. A stiff bristled broom should be used for final "finishing" of the sand. The sand must be "compacted" by using water from hose, irrigation heads, or rainfall, with the finish grade no less than the top of rings and no more than 0.25" above top of rings.

3.2 INSTALLATION OF GRASS

A. Hydroseeding/hydro-mulching - A combination of water, seed and fertilizer are homogeneously mixed in a purpose-built, truck-mounted tank. The seed mixture is sprayed onto the site at rates shown on plans and per hydroseeding manufacturer's recommendations. Coverage must be uniform and complete. Following germination of the seed, areas lacking germination larger than 8" x 8" must be reseeded immediately. Seeded areas must be fertilized and kept moist during development of the turf plants.

B. Install grass seed at rates per grass type. A light “dusting” of commercial topsoil mix, not to exceed 1/2” can be placed above the rings and seed mix to aid germination rates. Seeded areas must be fertilized and kept moist during development of the turf plants.

END OF DATA

UFC 3-260-01
17 NOVEMBER 2008

UNIFIED FACILITIES CRITERIA (UFC)

AIRFIELD AND HELIPORT PLANNING AND DESIGN

CHAPTER 4

ROTARY-WING RUNWAYS, HELIPADS, LANDING LANES, AND HOVERPOINTS

4-1 **CONTENTS.** This chapter presents design standards and requirements for rotary-wing (helicopter) landing facilities: runways, helipads, helicopter landing lanes, and hoverpoints.

4-2 **LANDING AND TAKEOFF LAYOUT REQUIREMENTS.** The landing design requirements for rotary-wing landing facilities, which include rotary-wing runways, helipads, landing lanes, slide areas (autorotation lanes), and hoverpoints, are similar to the requirements for fixed-wing runways as discussed in Chapter 3.

4-3 **ROTARY-WING RUNWAY.** The rotary-wing runway allows for a helicopter to quickly land and roll to a stop, compared to the hovering stop used during a vertical helipad approach.

4-3.1 **Orientation and Designation.** Consider the strength, direction, and frequency of the local winds when orienting a runway to minimize crosswinds. Follow the methods in Chapter 3 for fixed-wing runways. Runways are identified by the whole number, nearest one-tenth (1/10), of the magnetic azimuth of the runway centerline when viewed from the direction of approach.

4-3.2 **Dimensions.** Table 4-1 presents dimensional criteria for the layout and design of rotary-wing runways.

4-3.3 **Layout.** The layout for rotary-wing runways, including clear zones, are illustrated in Figure 4-1 for VFR runways and figures 4-2 and 4-3 for IFR runways.

Table 4-1. Rotary-Wing Runways

Rotary-Wing Runways			
Item		Requirement	Remarks
No.	Description		
1	Basic length	490 m (1,600 ft)	For Army and Air Force facilities, use basic length up to 1,220 m (4,000 ft) in elevation above mean sea level (AMSL). Increase basic length to 610 m (2,000 ft) when above 1,220 m (4,000 ft) in elevation above MSL. For Navy and Marine Corps facilities, basic length to be corrected for elevation and temperature. Increase 10 percent for each 300 m (1,000 ft) in elevation above 600 m (2,000 ft) MSL and add 4.0 percent for each 5 degrees C (10 degrees F), above 15 degrees C (59 degrees F) for the average daily maximum temperature for the hottest month. For a special mission or proficiency training such as autorotation operations, the length may be increased up to 300 m (1,000 ft); in that case, make no additive corrections.
		137.2 m (450 ft)	For facilities constructed prior to publication of this manual.

4-4 **HELIPADS.** Helipads allow for a helicopter hovering, landing, and takeoff. Except at facilities where helicopter runways are provided, helipads are the landing and takeoff locations for helicopters. The Army and Air Force provide for three types of helipads: standard VFR helipad, limited use helipad, and IFR helipad. The Navy and Marine Corps provide only one type of helipad: standard size helipad. The type of helipad depends on these operational requirements:

4-4.1 **Standard VFR Helipad.** VFR design standards are used when no requirement exists or will exist in the future for an IFR helipad. Criteria for this type of helipad permit the accommodation of most helipad lighting systems.

4-4.2 **Limited Use Helipad.** This is a VFR rotary-wing facility for use only by observation, attack, and utility (OH, AH, and UH) helicopters. These type of helipads support only occasional operations at special locations such as hospitals, headquarters facilities, missile sites, and other similar locations. Limited use helipads may be located on airfields where one or more helipads are required to separate OH, AH, and UH traffic from heavy and cargo (HH and CH) helicopter traffic or fixed-wing traffic.

4-4.3 **IFR Helipad.** IFR design standards are used when an instrument approach capability is essential to the mission and no other instrument landing facilities, either fixed-wing or rotary-wing, are located within an acceptable commuting distance to the site.

4-4.4 **Helipad Location.** A helipad location should be selected with regard to mission requirements, overall facility development, approach-departure surfaces, and local wind conditions.

4-4.4.1 **Near Runways.** When a helipad is to be located near fixed- and rotary-wing runways, its location should be based on the type of operations in accordance with the criteria in Table 4-1.

4-4.4.2 **Above Ground Helipads.** The construction of helipads on buildings or on any type of elevated structure above ground is not authorized for the Air Force and Army. For these Services, helipads will be constructed as a slab on grade. For Navy and Marine Corps facilities, contact the agency aviation office with safety waiver approval if a deviation is required.

4-4.4.3 **Parking Pads.** At individual helipad sites where it is necessary to have one or more helicopters on standby, an area adjacent to the helipad but clear of the landing approach and transitional surfaces should be designated for standby parking. This area will be designed as a parking apron in conformance with the criteria in Chapter 6.

4-4.5 **Dimensional Criteria.** Table 4-2 presents dimensional criteria for the layout and design of helipads.

Table 4-2. Rotary-Wing Helipads and Hoverpoints

Rotary-Wing Helipads and Hoverpoints			
Item		Requirement	Remarks
No.	Description		
1	Size	15 m x 15 m (50 ft x 50 ft) min.	Air Force and Army VFR limited use helipads
		30 m x 30 m (100 ft x 100 ft) min.	Standard VFR and IFR helipad
		9 m (30 ft) diameter	Hoverpoints
2	Grade	Min. 1.0 percent Max. 1.5 percent	Grade helipad in one direction. Hoverpoints should be domed to a 150-mm (6-in) height at the center.
3	Paved shoulders		See Table 4-4.
4	Size of primary surface (center primary surface on helipad)	45.72 m x 45.72 (150 ft x 150 ft) min.	Hoverpoints Air Force and Army limited use VFR helipad
			Navy and Marine Corps Standard VFR helipad
		91.44 m x 91.44 m (300 ft x 300 ft)	Air Force and Army standard VFR helipad
		472.44 m x 228.60 m (1,550 ft x 750 ft)	Standard IFR. Long dimension in direction of helicopter approach.
		228.60 m x 228.60 m (750 ft x 750 ft)	Army and Air Force IFR same direction ingress/egress.
5	Grades within the primary surface area in any direction	Min. of 2.0 percent prior to channelization.* Max. 5.0 percent	Exclusive of pavement and shoulders. For IFR helipads, the grading requirements apply to a 91.44 m × 91.44 m (300 ft × 300 ft) area centered on the helipad. The balance of the area is to be clear of obstructions and rough graded to the extent necessary to reduce damage to aircraft in event of an emergency landing. For VFR helipads, the grade requirements apply to the entire primary surface.
6	Length of clear zone**	121.92 m (400 ft)	Hoverpoints, VFR, and standard IFR helipads. Begins at the end of the primary surface.
		251.46 m (825 ft)	Army and Air Force IFR same direction ingress/egress.
7	Width of clear zone**		Corresponds to the width of the primary surface. Center clear zone width on extended center of the pad.
		45.72 m (150 ft)	Air Force and Army VFR limited use helipads and hoverpoints. Navy and Marine Corps Standard VFR.
		91.44 m (300 ft)	Air Force and Army standard VFR helipad and VFR helipad same direction ingress/egress.

Rotary-Wing Helipads and Hoverpoints			
Item		Requirement	Remarks
No.	Description		
		228.60 m (750 ft)	Standard IFR helipad
8	Grades of clear zone** any direction	5.0 percent max	Area to be free of obstructions. Rough grade and turf when required.
9	APZ I length***	243.84 m (800 ft)	Hoverpoints, VFR, and standard IFR
		121.92 m (400 ft)	Army and Air Force IFR same direction ingress/egress
10	APZ I width***	45.72 m (150 ft)	Army and Air Force VFR limited use and hoverpoints; Navy and Marine Corps standard VFR
		91.44 m (300 ft)	Army and Air Force standard VFR
		228.60 m (750 ft)	Standard IFR
11	Distance between centerline of helipad and fixed- or rotary-wing runways		See Table 4-1.

* Bed of channel may be flat.

** The clear zone area for helipads corresponds to the clear zone land use criteria for fixed-wing airfields as defined in DOD AICUZ standards. The remainder of the approach-departure zone corresponds to APZ I land use criteria similarly defined. APZ II criteria is not applicable for rotary-wing aircraft.

*** There are no grading requirements for APZ I.

NOTES:

1. Metric units apply to new airfield construction and, where practical, modification to existing airfields and heliports, as discussed in paragraph 1-4.4.
2. The criteria in this manual are based on aircraft specific requirements and are not direct conversions from inch-pound (English) dimensions. Inch-pound units are included only as a reference to the previous standard.
3. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are shown as a direct conversion from inch-pound to SI units.

4-4.6 **Layout Criteria.** Layouts for standard, limited use, and IFR helipads, including clear zones, are illustrated in figures 4-4 through 4-6.

4-5 **SAME DIRECTION INGRESS/EGRESS.** Helipads with same direction ingress/egress allow a helicopter pad to be located in a confined area where approach-departures are made from only one direction. The approach may be either VFR or IFR. For the USAF and Army, single direction ingress/egress VFR limited use helipads are configured as shown in Figure 4-8 using the criteria given in tables 4-2 and 4-7.

4-5.1 **Dimensions Criteria.** Table 4-2 presents dimensional criteria for VFR and IFR one direction ingress/egress helipads.

4-5.2 **Layout Criteria.** Layout for VFR, VFR limited use, and IFR same direction ingress/egress helipads are illustrated in figures 4-7, 4-8, and 4-9.

4-6 HOVERPOINTS

4-6.1 **General.** A hoverpoint is a prepared and marked surface used as a reference or control point for air traffic control purposes by arriving or departing helicopters.

4-6.2 **Hoverpoint Location.** A hoverpoint is located in a non-traffic area.

4-6.3 **Dimensions.** Table 4-2 presents dimensional criteria for the layout and design of hoverpoints.

4-6.4 **Layout.** Hoverpoint design standards are illustrated in Figure 4-10.

4-7 ROTARY-WING LANDING LANES.

Except when used as an autorotation lane, these lanes permit efficient simultaneous use by a number of helicopters in a designated traffic pattern.

4-7.1 **Requirements for a Landing Lane.** Occasionally at airfields or heliports, helicopters are parked densely on mass aprons. When this occurs, there is usually a requirement to provide landing and takeoff facilities that permit more numerous rapid launch and recovery operations than otherwise could be provided by a single runway or helipad. Increased efficiency can be attained by providing one or more of, but not necessarily limited to, these options:

- Multiple helipads or hoverpoints
- A rotary-wing runway of length in excess of the criteria in Table 4-1
- Helicopter landing lanes

4-7.2 **Landing Lane Location.** Landing lanes are typically located in front of the paved apron on which the helicopters park, as shown in Figure 4-11.

4-7.3 **Touchdown Points.** The location at which the helicopters are to touchdown on the landing lane are designated with numerical markings.

4-7.4 **Dimensions.** Table 4-3 presents dimensional criteria for the layout and design of rotary-wing landing lanes.

4-7.5 **Layout.** A layout for rotary-wing landing lanes is illustrated in Figure 4-11.

Figure 4-4. Standard VFR Helipad for Army and Air Force

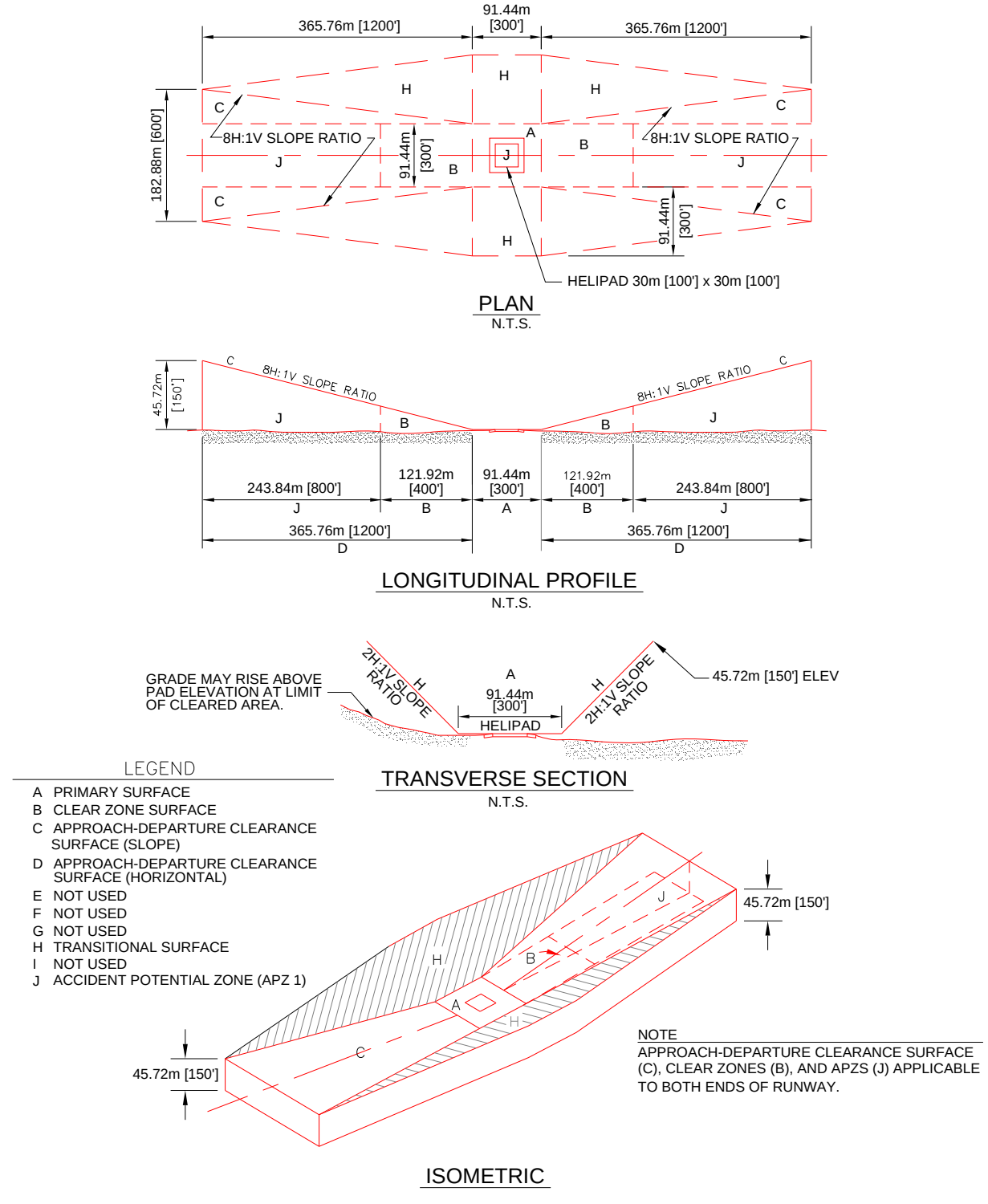
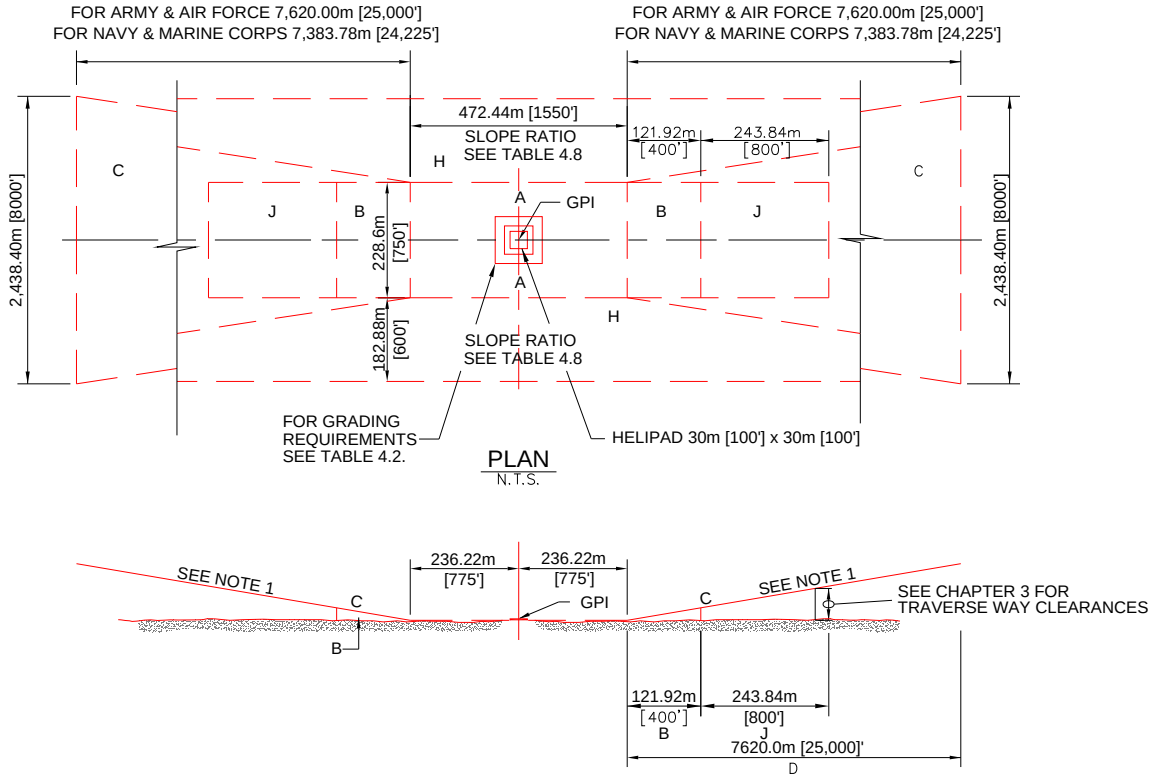


Figure 4-6. Standard IFR Helipad



LEGEND

- A PRIMARY SURFACE
- B CLEAR ZONE SURFACE
- C APPROACH-DEPARTURE CLEARANCE SURFACE (SLOPE) SEE NOTE 1
- D APPROACH-DEPARTURE CLEARANCE SURFACE (HORIZONTAL)
- E INNER HORIZONTAL SURFACE (NOT SHOWN)
- F NOT USED
- G NOT USED
- H TRANSITIONAL SURFACE
- I NOT USED
- J ACCIDENT POTENTIAL ZONE (APZ 1)

NOTES

1. APPROACH-DEPARTURE CLEARANCE SURFACE SLOPE RATIO IS 34H:1V FOR ARMY AND AIR FORCE AND 25H:1V FOR NAVY AND MARINE CORPS.
2. CLEAR ZONE & APZ TYPICAL AT BOTH ENDS OF RUNWAY.
3. FOR ISOMETRIC, SEE FIGURE 4.3.
4. TRANSITIONAL SURFACE SLOPE RATIO IS 7H:1V FOR ARMY AND 4H:1V FOR ALL OTHERS.

rotary-wing facilities corresponds to the clear zone land use criteria for fixed-wing airfields as defined for DOD AICUZ standards and as discussed in Chapter 3 and Appendix B, Section 3.

4-11.2 **Accident Potential Zone (APZ).** Land use for the APZ area at rotary-wing facilities corresponds to the APZ land use criteria for fixed-wing airfields as defined in DOD AICUZ standards and as discussed in Chapter 3 and Appendix B, Section 3. Ownership of the APZ is desirable but not required. If ownership is not possible, land use should be controlled through long-term lease agreements or local zoning ordinances.

4-11.3 **Dimensions.** Table 4-6 shows the dimensional requirements for the clear zone and APZ. These dimensions apply to rotary-wing runways, helipads, landing lanes, and hoverpoints, depending on whether they support VFR or IFR operations. Layout of the clear zone and APZ are shown in figures 4-1, 4-2, and 4-4 through 4-10.

4-12 **IMAGINARY SURFACES FOR ROTARY-WING RUNWAYS, HELIPADS, LANDING LANES, AND HOVERPOINTS.** Rotary-wing runways, helipads, landing lanes, and hoverpoints have imaginary surfaces similar to the imaginary surfaces for fixed-wing facilities. The imaginary surfaces are defined planes in space that establish clearance requirements for helicopter operations. An object, either man-made or natural, that projects through an imaginary surface plane is an obstruction to air navigation. Layout of the rotary-wing airspace imaginary surfaces is provided in tables 4-7 and 4-8 and figures 4-1 through 4-11. Rotary-wing airspace imaginary surfaces are defined in the glossary and listed here:

- Primary surface
- Approach-departure clearance surface (VFR)
- Approach-departure clearance surface (VFR limited use helipads)
- Approach-departure clearance surface (IFR)
- Horizontal surface (IFR)
- Transitional surfaces

Table 4-6. Rotary-Wing Runway and Landing Lane Clear Zone and APZ

Rotary-Wing Runway and Landing Lane Clear Zone and APZ[1,2]			
Item		Requirement	Remarks
No.	Description		
1	Clear zone length	121.92 m (400 ft)	Clear zone begins at the end of the primary surface.
2	Clear zone width (center width on extended runway/landing lane centerline) (corresponds to the width of the primary surface)	91.44 m (300 ft)	VFR rotary-wing runways and landing lanes See note 2.

Rotary-Wing Runway and Landing Lane Clear Zone and APZ[1,2]			
Item		Requirement	Remarks
No.	Description		
		228.60 m (750 ft)	IFR rotary-wing runways and landing lanes See note 2.
3	Grades in clear zone in any direction	2.0 percent Min. 5.0 percent Max.	Clear zone only Area to be free of obstructions. Rough-grade and turf when required.
4	APZ I length	243.84 m (800 ft)	See notes 2 and 3.
5	APZ I width	91.44 m (300 ft)	VFR rotary-wing runways and landing lanes See notes 2 and 3.
		228.60 m (750 ft)	IFR rotary-wing runways and landing lanes See notes 2 and 3.

NOTES:

1. The clear zone area for rotary wing runways and landing lanes corresponds to the clear zone land use criteria for fixed-wing airfields as defined in DOD AICUZ standards and summarized in Appendix B, Section 3. The remainder of the approach-departure zone corresponds to APZ I land use criteria similarly defined. APZ II criteria is not applicable for rotary-wing aircraft.
2. Exceptions to these widths are permissible based on individual Service analysis of highest accident potential area for specific rotary-wing runway/landing lane use and acquisition constraints.
3. No grading requirements for APZ I.
4. Metric units apply to new airfield construction and, where practical, modification to existing airfields and heliports, as discussed in paragraph 1-4.4.
5. The criteria in this manual are based on aircraft specific requirements and are not direct conversions from inch-pound (English) dimensions. Inch-pound units are included only as a reference to the previous standard.
6. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are shown as a direct conversion from inch-pound to SI units.

Table 4-7. Rotary-Wing Imaginary Surface for VFR Approaches

Rotary-Wing Imaginary Surface for VFR Approaches						
Item				Helipad		
No.	Description	Legend in Figures	Helicopter Runway and Landing Lane	Air Force and Army VFR Standard	Air Force and Army VFR Limited Use; Navy and Marine Corps Standard Helipad and Hoverpoints[1,2]	Remarks
1	Primary surface width	A	91.44 m (300 ft)	91.44 m (300 ft)	45.72 m (150 ft)	Centered on the ground point of intercept (GPI)
2	Primary surface length	A	Runway or landing lane length plus 22.86 m (75 ft) at each end	91.44 m (300 ft) centered on facility	45.72 m (150 ft) centered on facility	Runway or landing lane length plus 30.48 m (100 ft) at each end for Navy and Marine Corps facilities
3	Primary surface elevation	A	The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline or at the established elevation of the landing surface.			
4	Clear zone surface	B	See Table 4-6	See Table 4-2	See Table 4-2	
5	Start of approach-departure surface	C	22.86 m (75 ft) from end of runway or landing lane	45.72 m (150 ft) from GPI	22.86 m (75 ft) from GPI	
6	Length of sloped portion of approach-departure surface	C	365.76 m (1,200 ft)	365.76 m (1,200 ft)	365.76 m (1,200 ft)	Measured horizontally.
7	Slope of approach-departure surface	C	8:1	8:1	8:1	Slope ratio is horizontal to vertical. 8:1 is 8 m (ft) horizontal to 1 m (ft) vertical.
8	Width of sloped portion of approach- departure surface at start of sloped portion	C	91.44 m (300 ft)	91.44 m (300 ft)	45.72 m (150 ft)	Centered on the extended center-line, and is the same width as the primary surface.
9	Width of sloped portion of approach- departure surface at end of sloped portion	C	182.88 m (600 ft)	182.88 m (600 ft)	152.40 m (500 ft)	Centered on the extended center-line

Rotary-Wing Imaginary Surface for VFR Approaches						
Item				Helipad		
No.	Description	Legend in Figures	Helicopter Runway and Landing Lane	Air Force and Army VFR Standard	Air Force and Army VFR Limited Use; Navy and Marine Corps Standard Helipad and Hoverpoints[1,2]	Remarks
10	Elevation of approach-departure surface at start of sloped portion	C	0 m (0 ft)	0 m (0 ft)	0 m (0 ft)	Above the established elevation of the landing surface.
11	Elevation of approach-departure surface at end of sloped portion	C	45.72 m (150 ft)	45.72 m (150 ft)	45.72 m (150 ft)	Above the established elevation of the landing surface.
12	Length of approach-departure zone	D	365.76 m (1,200 ft)	365.76 m (1,200 ft)	365.76 m (1,200 ft)	Measured horizontally from the end of the primary surface and is the same length as the approach-departure clearance surface length
13	Start of approach-departure zone	D	22.86 m (75 ft) from end of runway	45.72 m (150 ft) from center of helipad	22.86 m (75 ft) from center of helipad	Starts at the end of the primary surface
14	Transitional surface slope	H	2H:1V See remark 1	2H:1V See remark 1	2H:1V See remark 2	(1) The transitional surface starts at the lateral edges of the primary surface and the approach-departure clearance surface. It continues outward and upward at the prescribed slope to an elevation of 45.72 m (150 ft) above the established airfield elevation. (2) The transitional surface starts at the lateral edges of the primary surface and the approach-departure clearance surface. It continues outward and upward

Rotary-Wing Imaginary Surface for VFR Approaches						
Item				Helipad		
No.	Description	Legend in Figures	Helicopter Runway and Landing Lane	Air Force and Army VFR Standard	Air Force and Army VFR Limited Use; Navy and Marine Corps Standard Helipad and Hoverpoints[1,2]	Remarks
						at the prescribed slope to an elevation of 26.67 m (87.5 ft) above the established airfield elevation. It then rises vertically to an elevation of 45.7 m (150 ft) above the established airfield elevation. See figures 4-5 and 4-10 for the shape of transitional surfaces.
15	Horizontal surface	G	Not required	Not required	Not required	

NOTES:

1. The Navy and Marine Corps do not have criteria for same direction ingress/egress.
2. The Army does not have VFR rotary-wing runways or landing lanes.
3. Metric units apply to new airfield construction and, where practical, modification to existing airfields and heliports, as discussed in paragraph 1-4.4.
4. The criteria in this manual are based on aircraft specific requirements and are not direct conversions from inch-pound (English) dimensions. Inch-pound units are included only as a reference to the previous standard.
5. Airfield and heliport imaginary surfaces and safe wingtip clearance dimensions are shown as a direct conversion from inch-pound to SI units.

(2) Do not locate fueling equipment in the TLOF, FATO, or safety area. Design and mark separate fueling locations to minimize the potential for helicopters to collide with the dispensing equipment. Design fueling areas so there is no object tall enough to be hit by the main or tail rotor blades within a distance of RD from the center point of the position where the helicopter would be fueled (providing ½ RD clearance from the rotor tips). If this is not practical at an existing facility, install long fuel hoses.

(3) Lighting. Light the fueling area if night fueling operations are contemplated. Ensure any light poles do not constitute an obstruction hazard.

f. Tiedowns. Install recessed tiedowns to accommodate extended or overnight parking of based or transient helicopters. Recess any tiedowns so they will not be a hazard to helicopters. Ensure any depression associated with the tiedowns is of a diameter not greater than ½ the width of the smallest helicopter landing wheel or landing skid anticipated to be operated on the heliport surface. In addition, provide storage for tiedown chocks, chains, cables and ropes off the heliport surface to avoid fouling landing gear. Find guidance on recessed tiedowns in AC 20-35, Tiedown Sense.

215. Heliport markers and markings. Markers and/or surface markings identify the facility as a heliport. Use paint or preformed materials for surface markings. (See AC 150/5370-10, Item P-620, for specifications for paint and preformed material.). As options, use reflective paint and reflective markers, though overuse of reflective material can be blinding to a pilot using landing lights. As an option, outline lines/markings with a 6-inch (15 cm) wide line of a contrasting color to enhance conspicuity. Place markings that define the edges of a TLOF, FATO, taxiway or apron within the limits of those areas. Use the following markers and markings.

a. Heliport identification marking. The identification marking identifies the location as a heliport, marks the TLOF and provides visual cues to the pilot.

(1) Standard heliport identification symbol. Mark the TLOF with a white "H" marking. The "H" has a minimum height of the lesser of 0.3 D or 10 feet (3 m). Locate the "H" in the center of the TLOF and orient it on the axis of the preferred approach/departure path. Place a one-foot wide bar under the "H" when it is necessary to distinguish the preferred approach/departure direction. The proportions and layout of the letter "H" are illustrated in Figure 2–23. For a height of "H" less than 10 feet (3 m), reduce other dimensions proportionately.

(2) Nonstandard heliport identification marking. As an option use a distinctive marking, such as a company logo, to identify the facility as a PPR heliport. However, a nonstandard marking does not necessarily provide the pilot with the same degree of visual cueing as the standard heliport identification symbol. To compensate, increase the size of the safety area when the standard heliport identification symbol "H" is not used. See Table 2-1.

b. TLOF markings.

(1) TLOF perimeter marking. Define the TLOF perimeter with markers and/or lines. If the heliport operator does not mark the TLOF, increase the size of the safety area as described in paragraph 209.a and Table 2-1.

(a) Paved TLOFs. Define the perimeter of a paved or hard surfaced TLOF with a continuous, 12-inch-wide (30 cm), white line. See Figure 2–25.

(b) Unpaved TLOFs. Define the perimeter of an unpaved TLOF with a series of 12-inch-wide (30 cm), flush, in-ground markers, each approximately 5 feet (1.5 m) in length with end-to-end spacing of not more than 6 inches (15 cm). See Figure 2–25.

(2) Touchdown/positioning circle (TDPC) marking. A TDPC marking provides guidance to allow a pilot to touch down in a specific position on paved surfaces. When the pilot's seat is over the

marking, the undercarriage will be inside the LBA, and all parts of the helicopter will be clear of any obstacle by a safe margin. A TDPC marking is a yellow circle with an inner diameter of ½ D and a line width of 18 in (46 m). Locate a TDPC marking in the center of a TLOF. (See Figure 2–23). As an option, at PPR heliports where the TLOF width is less than 16 feet (5 m), omit the TDPC marking.

(3) TLOF size and weight limitations. Mark the TLOF to indicate the length and weight of the largest helicopter it will accommodate, as shown in Figure 2–23. Place these markings in a box in the lower right-hand corner of a rectangular TLOF, or on the right-hand side of the "H" of a circular TLOF, when viewed from the preferred approach direction. The box is 5 feet (1.5 m) square. The numbers are 18 inches (46 cm) high. (See Figure C–1). If necessary, allow this marking to interrupt the TDPC marking. (See Figure 2–23 and Figure C–1.) The numbers are black with a white background. This marking is optional at a TLOF with a turf surface. This marking is also optional at PPR heliports, since the operator ensures all pilots using the facility are thoroughly knowledgeable with this and any other facility limitations.

(a) TLOF size limitation. This number is the length (D) of the largest helicopter the TLOF will accommodate, as shown in Figure 2–23. The marking consists of the letter "D" followed by the dimension in feet. Do not use metric equivalents for this purpose. Center this marking in the lower section of the TLOF size/weight limitation box.

(b) TLOF weight limitations. If a TLOF has limited weight-carrying capability, mark it with the maximum takeoff weight of the design helicopter, in units of thousands of pounds, as shown in Figure 2–23. Do not use metric equivalents for this purpose. Center this marking in the upper section of a TLOF size/weight limitation box. If the TLOF does not have a weight limit, add a diagonal line, extending from the lower left hand corner to the upper right hand corner, to the upper section of the TLOF size/weight limitation box. See Figure 2–23.

c. Extended pavement/structure markings. As an option, increase the pavement or structure without a corresponding increase in the length and width or diameter of the FATO to accommodate pedestrians and/or support operations. Whether or not this increased area is part of the LBA, mark the area outside the TLOF with 12-inch-wide (30 cm) diagonal black and white stripes. See Figure 2–24 for marking details.

d. FATO markings.

(1) FATO perimeter marking. Define the perimeter of a load-bearing FATO with markers and/or lines. Do not mark the FATO perimeter if any portion of the FATO is not a load-bearing surface. In such cases, mark the perimeter of the LBA (see paragraph (b) below).

(a) Paved FATOs. Define the perimeter of a paved load-bearing FATO with a 12-inch-wide (30 cm) dashed white line. Define the corners of the FATO. The perimeter marking segments are approximately 5 feet (1.5 m) in length, and with end-to-end spacing of approximately 5 feet (1.5 m). See Figure 2–25.

(b) Unpaved FATOs. Define the perimeter of an unpaved load-bearing FATO with 12-inch-wide (30 cm), flush, in-ground markers. Define the corners of the FATO. The rest of the perimeter markers are approximately 5 feet (1.5 m) in length, and have end-to-end spacing of approximately 5 feet (1.5 m). See Figure 2–26.

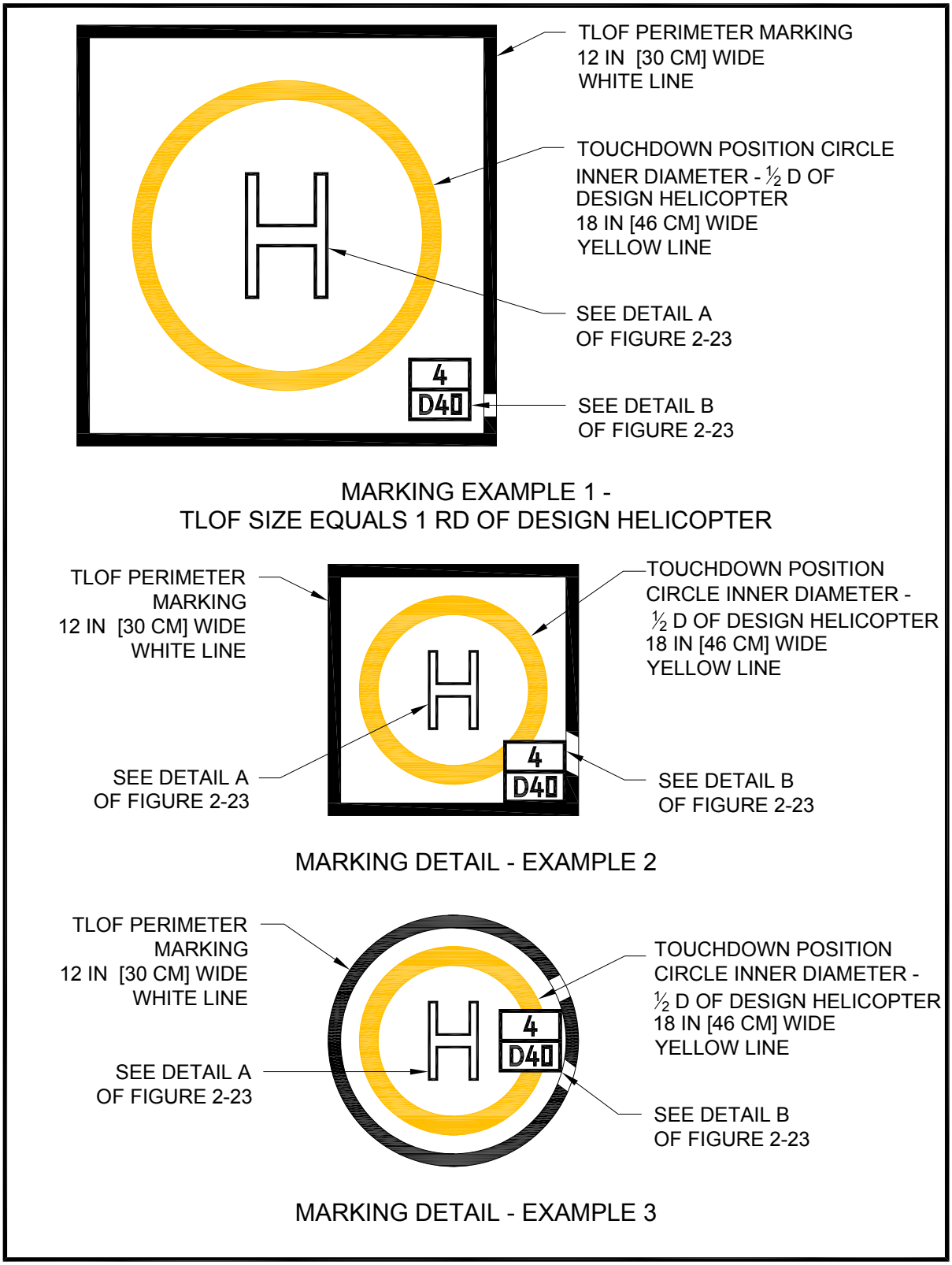
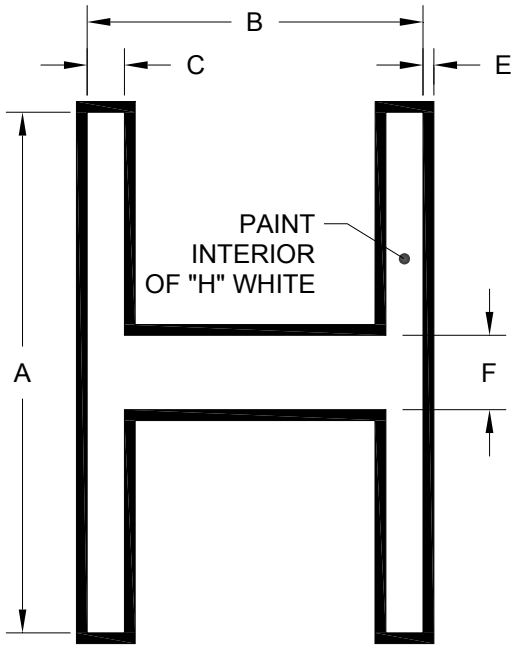
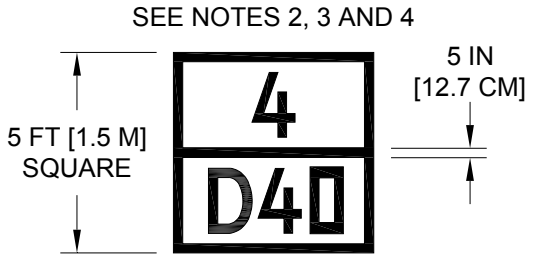


Figure 2–22. Standard and Alternate TLOF Marking: General Aviation



	"H" SIZE	
DIMENSION	STANDARD TLOF MARKING	ALTERNATE TLOF MARKING
A	10'-0" [3 M]	0.3D
B	6'-8" [1.8 M]	0.66A
C	1'-0" [30 CM]	0.1A
E	0'-3" [7 CM]	0.02A
F	2'-0" [61 CM]	0.2A

DETAIL A
HELIPORT IDENTIFICATION SYMBOL



DETAIL B
TLOF SIZE/WEIGHT LIMITATION "BOX"

Notes:

1. See Appendix C for the form and proportion of the numbers used in the TLOF Size and Weight Limitation Box.
2. Characters within the TLOF Size and Weight Limitation Box are black on a white background.
3. "4" indicates the maximum takeoff weight (4,000 lbs) of the TLOF design helicopter, in units of thousands of pounds.
4. "D40" indicates the overall length of the largest helicopter (40 ft) for which the TLOF is designed.

Figure 2–23. Standard Heliport Identification Symbol, TLOF Size and Weight Limitations: General Aviation

Appendix B. Helicopter Data

This appendix contains selected helicopter data needed by a heliport designer. These data represent the most critical weight, dimensional, or other data entry for that helicopter model, recognizing that specific versions of the model may weigh less, be smaller in some feature, carry fewer passengers, etc.

Various helicopter manufacturers have provided this information, but confirm data by contacting the manufacturer(s) of the specific helicopter(s) of interest.

Legend

A	Manufacturer name and helicopter model
B	Maximum takeoff weight in pounds.
D	Overall length in feet. (Rotors at their maximum extension.)
H	Overall height in feet. (Usually at tail rotor.)
RD	Rotor diameter in feet.
E	Number of blades.
F	Rotor plane clearance in feet.
TR	Distance from rotor hub to tip of tail rotor in feet.
I	Tail rotor diameter (in feet).
J	Number of tail rotor blades.
K	Tail rotor ground clearance in feet.
L	Type of undercarriage.
UCL	Undercarriage length in feet.
UCW	Undercarriage width in feet. (The distance between the outside edges of the tires or the skids.)
M	Number and type of engines
N	Number of crew and passengers.

Manufacturer/ Model	Max Takeoff Weight	Overall Length (ft)	Overall Height (ft)	Main Rotor				Tail Rotor			Undercarriage			Number of Engines/ Type	Crew Number/ Pax Number
				Diameter (ft)	Number of Blades	Ground Clearance (ft)	Tail Rtr Circle Radius (ft)	Diameter (ft)	Number of Blades	Ground Clearance (ft)	Type	Length (ft)	Width (ft)		
A	B	D	H	RD	E	F	TR	I	J	K	L	UCL	UCW	M	N
Boeing															
107/CH-46E	24,300	84.3	16.7	51	3	15	59	51	3	17	wheel	24.9	14.5	2-T	3&25
234/CH-47F/G	54,000	99	19	60	3	11	69	60	3	19	wheel	22.5	10.5	2-T	3&44
Brantly/ Hynes															
B-2B	1,670	28.1	6.9	23.8	3	4.8	16	4.3	2	3	skid	7.5	6.8	1-P	1&1
305	2,900	32.9	8.1	28.7	3	8	19	4.3	2	3	wheel/ skid	6.2	6.8	1-P	1&4
Enstrom															
F-28F/ 280FX	2,600	29.3	9	32	3	6	20.6	4.7	2	3.1	skid	8	7.3	1-P	1&2
480B/ TH-28	3,000	30.1	9.7	32	3	6.5	21.2	5	2	3.6	skid	9.2	8	1-T	1&4
Erickson															
S-64E/F Air Crane	42,000 - 47,000	88.5	25.4	72	6	15.7	53	16	4	9.4	wheel	24.4	19.9	2-T	3&0
Eurocopter															
SA-315 Lama	5,070	42.3	10.2	36.2	3	10.1	20	6.3	3	3.2	skid	10.8	7.8	1-T	1&4
SA-316/319 Alouette	4,850	33.4	9.7	36.1	3	9.8	27.7	6.3	3	2.8	wheel	11.5	8.5	1-T	1&4
SA-330 Puma	16,315	59.6	16.9	49.5	4	14.4	35	10	5	6	wheel	13.3	9.8	2-T	2&20
SA/AS-332, Super Puma	20,172	61.3	16.3	53.1	4	14.6	36	10	5	7.1	wheel	17.3	9.8	2-T	2&24
SA-341/342 Gazelle	4,100	39.3	10.2	34.5	3	8.9	23	Fenstron		2.4	skid	6.4	6.6	1-T	1&4
AS-350 A Star	4,960	42.5	11	35.1	3	10.6	25	6.1	2	2.3	skid	4.7	7.5	1-T	1&6
AS-355 Twin Star	5,732	42.5	9.9	35.9	3	10.3	25	6.1	2	2.3	skid	9.6	7.1	2-T	1&6
AS-360 Dauphin	6,600	43.3	11.5	37.7	4	10.7	25	Fenstron		2.6	wheel	23.7	6.4	1-T	1&13
AS-365 Dauphin/H-65 Dolphin	9,480	45.1	13.3	39.2	4	11.4	24	Fenstron		2.6	wheel	11.9	6.2	2-T	1&11
BO-105	5,732	38.9	11.5	32.3	4	9.8	23	6.2	2	6.1	skid	8.3	8.2	2-T	1&5
BK-117	7,385	42.7	12.6	36.1	4	11	25	6.4	2	6.3	skid	11.6	8.2	2-T	1&10

Manufacturer/ Model	Max Takeoff Weight	Overall Length (ft)	Overall Height (ft)	Main Rotor				Tail Rotor			Undercarriage			Number of Engines/ Type	Crew Number/ Pax Number
				Diameter (ft)	Number of Blades	Ground Clearance (ft)	Tail Rtr Circle Radius (ft)	Diameter (ft)	Number of Blades	Ground Clearance (ft)	Type	Length (ft)	Width (ft)		
A	B	D	H	RD	E	F	TR	I	J	K	L	UCL	UCW	M	N
Sikorsky/ Schweizer															
HU-269A/A-1/B, TH55A	1,850	29	9	26	3	8.8	15	3.8	2	2.5	skid	8.3	6.5	1-P	1&1
300C	2,050	30.8	8.7	26.8	3	8.7	15.3	4.3	2	2.8	skid	8.3	6.5	1-P	1&2
300CB/CBi	1,750	30.8	8.7	26.8	3	8.7	15.3	4.3	2	2.8	skid	8.3	6.5	1-P	1&1
330/330SP/ 333	2,550	31.2	11	27.5	3	9.2	15.3	4.3	2	3.2	skid	8.3	6.5	1-T	1&2-3
S-434	2,900	31.2	11	27.5	4	9.2	15.3	4.3	2	3.2	skid	8.3	6.5	1-T	1&2-3
S-55/H19	7,900	62.6	13.1	53	3			8.2	2		wheel			1-T	2&12
S-58/H34	14,600	65.8	15.9	56	4	11.4	38	9.5	4	6.4	wheel	28.3	14	2-T	2&16
S-61/H-3	22,000	72.8	19	62	5	12.3	40	10.3	5	8.6	wheel	23.5	14	2-T	3&28
S-76A/B/C/D	11,700	52.5	14.6	44	4	8.2	30.5	8	4	6.5	wheel	16.4	8	2-T	2&12
S-92	26,500	68.5	17.9	56.3	4	9.8	39.9	11	4	6.9	wheel	20.3	10.4	2-T	2&19
S-70i/UH-60L Blackhawk	22,000	64.8	16.8	53.8	4	7.7	38	11	4	6.6	wheel	29	9.7	2-T	3&12
CH-53K	74,000	99.5	27.8	79	7	17	59.6	20	4	9.5	wheel	27.3	13	3-T	3&55