Introduction to Architectural Design: Fire Stations

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Credit: 2 PDH

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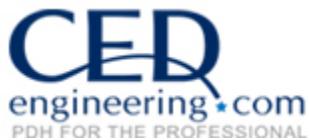
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An Introduction to Architectural Design: Fire Stations

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CONTENTS

1. INTRODUCTION

Architectural design is a largely subjective process that is best illustrated using a "casebook" approach. In this course the "case" is fire stations.

This course provides guidance for development of fire stations appropriate for fighting the two primary types of fires: Structure fires and Airport Crash fires. This information may be used by architects, engineers, designers, and others involved in the development and approval of fire station projects. It is intended to help all participants better understand fire station requirements, programs, and design criteria so they can effectively participate in the project development process. This course is not intended to provide all of the information needed to identify project requirements or successfully prepare project designs. Additional information on the unique program and design requirements of projects must be obtained.

2. PLANNING AND LAYOUT

2.1 SIZE DETERMINANTS.

Several factors determine the size of the facility.

2.1.1 General. Generally, the size of the station depends on the class of station, the number of companies housed, the number and types of vehicles housed, and any additional spaces required. The class of station will partially drive the number of spaces required.

2.1.2 Needs Validation Assessment. Conduct a Needs Validation Assessment to determine the class and required capacity in terms of personnel and vehicles of the new or renovated station.

2.1.3 Types of Spaces. For a complete list of spaces, see Table 2-1. Fire Station functional spaces fall into three main categories:

2.1.3.1 Maintenance and Apparatus. This includes the Apparatus Room which houses the firefighting vehicles and the supporting maintenance spaces. The maintenance spaces include both vehicle maintenance and storage and equipment maintenance and storage (fire extinguishers, self-contained breathing apparatus (SCBA), protective clothing, hoses, firefighting agents, etc.)

2.1.3.2 Administration and Training. This includes the appropriate offices, training spaces, dispatch areas, administrative areas, etc.

2.1.3.3 Residential and Living. This includes the on-duty firefighters' bedrooms, toilets/showers, kitchen/dining, recreation, and "living room" areas.

Space	Notes
Maintenance and Apparatus	
Apparatus Room/Bays	Made up of bays—either single- or double-length bays. Sized according to truck modules: See Paragraph 2-2.2.1.
Personal Protective Equipment (PPE) Gear Storage	One per station.
Hose Storage	One per station.
SCBA Compressor Room	At least one per department.
SCBA Maintenance	One per department.
Protective Clothing Laundry	One per station.
Equipment Wash/Disinfection	One per station.
Work Room/Equipment Maintenance	One per station.
Vehicle Maintenance Equipment Storage	One per station. Tools and minor parts.
EMT Storage (basic first aid supplies)	One per station.
Medical Storage Cabinet/Locker (drugs, needles, etc.)	One per station. Lockable. This may be combined with or a sub-space of the EMT Storage Room.
HAZMAT/CBRNE Equipment Storage	One per department. (CBRNE = Chemical, Biological, Radiological, Nuclear, Explosive.)
Agent Storage	At least one per department.
Spare Gear Storage	At least one per department.
Fire Extinguisher Maintenance and Storage	One per department, as dictated by Installation mission requirements.
Flightline Fire Extinguisher Maintenance and Storage	One per department.
Vehicle Maintenance Bay	Addition to Apparatus Room, as dictated by Installation mission requirements.
Vehicle Maintenance Office	As dictated by Installation mission requirements if Vehicle Maintenance Bay is provided.
Reserve and Active Duty Mobility/Deployment Gear Storage	As dictated by Installation mission requirements.
Administration and Training	
Station Officer Office	One per station.
Watch Desk	One per station only if no Dispatch in station and then made part of Station Officer Office. (Receives calls from Dispatch.)
Fire Chief Office	One per department.
Chief's Conference Room	One per department. May be a part of the Fire Chief's Office.

Table 2-1
Fire Station Program Spaces

Space	Notes
Deputy Chief Office	The requirement for a Deputy Chief is driven by the size of the department.
Administrative Assistant	Provided only in conjunction with Chief and Deputy Chief.
Lobby Area	Generally provided only in conjunction with Chief and Deputy Chief.
Assistant Chief/Shift Supervisor	One per department.
Assistant Chief of Fire Prevention	One per department, as dictated by Installation mission requirements.
Inspector(s) Offices	Several workstations per department—may be located in several stations.
EMS Office	Space for EMS to complete confidential paperwork, as dictated by Installation mission requirements.
HAZMAT/Safety Office	One per department.
Logistics Office	One workstation per department, as dictated by Installation mission requirements.
Department Training Room	At least one per department (in HQ station). May be provided in other stations, as dictated by Installation mission requirements.
Training Officer Office	One per department.
Computer Training/testing Area	One per station. Separate room or alcove.
General Admin Storage	One per station.
Fire-only Dispatch	One per department; provided only if no requirement for Consolidated Dispatch. Dispatch receives emergency calls from the public.
Consolidated Dispatch	Provided in lieu of Fire-only Dispatch. Combines fire, security, and medical dispatch functions.
Dispatch Supervisor	Provided in conjunction with Consolidated Dispatch.
Dispatch Bathroom	Dedicated facilities close to Dispatch.
Dispatch Kitchenette	Dedicated facilities close to Dispatch.
Information Technology (IT) Room	One per station. Consider presence/size of dispatch and/or watch room in size and location of room.
Generator Space	One per station. May need to be located inside as a security concern.
Residential and Living	
Day/Training Room	One per station. Includes kitchen, training/dining, and lounge areas. The station training area is incorporated as part of the dining portion of the Day Room.
Dorm Rooms	Per station. Quantity depends on number of crews.
Bathrooms/shower/changing	Male and female facilities per station.
Fitness Room	One per station.
Laundry Room	One per station.
Physical Therapy/sauna	Addition to Fitness Room, as dictated by Installation mission requirements.
Recreation Room	Addition to Day Room for noisier activities such as games, as dictated by Installation mission requirements.
Covered Outdoor Patio	One per station.
Other Spaces	

Table 2-1 (continued)
Fire Station Program Spaces

2.2 SPACE PROGRAM. The space program for Fire Stations may be developed through the use of an interactive worksheet. It is completed by first entering the appropriate Service branch and then selecting the following: the type of station, the class of station, the number of companies to be housed/dorm room count, the number and class of vehicles to be housed, and the additional spaces required. As selections are made, the program areas are calculated and summed for both the building and the site. The worksheet must be filled out in collaboration with the appropriate fire department representative(s). This interactive worksheet is available as a downloadable Microsoft© Excel© file from the Whole Building Design Guide Web site (http://dod.wbdg.org).

2.2.1 Critical Dimensions. To understand how the numbers in the interactive worksheet are calculated, there are several critical dimensions that must be understood.

2.2.2.1 Apparatus Bays.
The apparatus bays are sized based on the class of truck to be housed. See Table 2-2 for a list of common truck types. These types have been classified as follows in order to standardize the size criteria:

• **Large.** These typically include structural aerial (ladder) trucks or large tanker trucks with lengths greater than 11.58 m (38 ft.). The standardized footprint (floor space occupied by the truck, not considering the space around it) is 3.05 m by 15.24 m (10 ft. by 50 ft.).

• **Medium.** This class covers a wide range of vehicles from structural pumper trucks and smaller tanker trucks to rescue and HAZMAT trucks.

• **Small.** These typically include ambulances, small rescue or HAZMAT trucks, small brush units, and command vehicles. Small trucks have lengths less than 9.14 m (30 ft.). A separate vehicle bay size class is not designated for these trucks. Depending on the actual size of the Small class truck, it may be housed in

its own bay or in a bay with another truck. For example, two 6.10-m- (20-ft.-) long vehicles may be housed in a Large bay, either Aircraft Rescue Fire Fighting (ARFF) or not. The interactive worksheet makes a recommendation for the area of additional Apparatus Bays, as appropriate, for the quantity of Small vehicles indicated. However, this area must be carefully reviewed by the planning team to ensure it provides the correct space, accounting for the actual length of the Small vehicles anticipated and the space that may be available in other bays. In addition to the truck footprint, the space program takes into account the space around the parked truck. This space varies depending on whether the truck is parked next to a wall or another truck. The space program uses the middle-sized bay for each truck class to calculate an "average" sized bay for the given vehicle.

Type of vehicle	Size Class of Vehicle
Structural	
Pumpers	Medium
Telesquirts	Medium
Aerial/Ladders	Large
Tankers	Medium or Large
ARFF	
Large Water Tankers	ARFF Medium
ARFF Foam (vary from 5700 L (1500 gal.) up to 24,600 L (6500 gal.)	ARFF Medium or ARFF Large
Ambulance	
Ambulances	Small
Rescue	
Small/Light Rescue	Small
Medium Rescue	Medium
Heavy Rescue	ARFF Medium
HAZMAT	
HAZMAT Support/Small	Small
HAZMAT Squad	Medium
Brush	
Small Brush	Small
Large Brush	Medium

Taable 2-2
Common Types of Vehicles and Their Size Classes

2.2.2.2 Dorm Room Counts. The worksheet uses two methods to calculate the number of dorm rooms needed (dorm room count). First, the user enters the number of Structural companies and the number of ARFF companies, as appropriate. (If it is a Structural station, ARFF companies are not permitted and vice versa.) The worksheet will calculate the number of dorm rooms using the number of companies entered. Second, the user adds or subtracts dorm rooms to accommodate ambulance companies, rescue companies, or cross-staffing of companies. The initial number of rooms plus or minus the modified number of rooms is the Final Dorm Room count. Dorm room counts must be coordinated with the Fire Chief. Cross staffed (x-staffed) vehicles are staffed on an as needed basis by personnel assigned to another vehicle or vehicles. X-staffed vehicles have no dedicated staff of their own.

Type of vehicle				
Structural				
Pumpers	4	4	4	4
Telesquirts	4 or x-staffed	4	4	4
Aerial/Ladders	4 or x-staffed	4	4	4
Tankers	x-staffed	1 or x-staffed	n/a	1 or x-staffed
ARFF				
Large Water Tankers	x-staffed	1 or x-staffed	1	1 or x-staffed
ARFF Foam	3	3	3	4
Ambulance				
Ambulances	2 or x-staffed	2	n/a	2 or x-staffed
Rescue				
Small/Light Rescue	x-staffed	3 or x-staffed	3	3 or x-staffed
Medium Rescue	x-staffed	3 or x-staffed	3	3 or x-staffed
Heavy Rescue	x-staffed	3 or x-staffed	3	3 or x-staffed
HAZMAT				
HAZMAT Support/Small	x-staffed	x-staffed	x-staffed	x-staffed
HAZMAT Squad	x-staffed	x-staffed	x-staffed	x-staffed
Brush				
Small Brush	x-staffed	x-staffed	x-staffed	x-staffed
Large Brush	x-staffed	x-staffed	x-staffed	x-staffed

Table 2-2
Sample Staffing by Vehicle Type

2.2.3 Total Area. The space program developed through the use of the interactive worksheet serves as a guideline for the Fire Station planning team and generally represents the maximum space allowed. The final space program for a new Fire Station will need to be carefully determined by Installation representatives and the appropriate program office.

2.3 LOCATION DETERMINANTS. Several factors determine the most appropriate and cost-effective location for a Fire Station.

2.3.1 Access/Response Time. The most critical determinant for the location of a Fire Station is response time. In addition to response time, consider access to the station by delivery vehicles, staff, and visitors. Consider that direct access and response time may conflict with tightening antiterrorism (AT) criteria—ensure that trucks will not have to cross access control points to reach a target structure or flightline.   Facility site should be prominent and easily visible from the target areas (structures or flightlines).

2.3.2 Size. Ensure adequate site space is available to accommodate the firefighting vehicular turning radii, personnel parking, visitor parking, storage requirements, and reserve vehicles (if applicable).

2.3.3 Sustainable Design. The location of a facility can have a significant impact on achieving sustainable design rating points. Consider issues such as brownfield redevelopment, access to public transportation, and reuse of existing paving and hardscape when selecting a site.

2.4 COST. Facilities should be designed with the objective of achieving the lowest life cycle cost over a 30-year period. To do so, the project's design program must adequately define the scope and performance requirements and match those needs against a budget. Conversely, the budget must adequately support an appropriate and high quality program and performance requirements.

2.5 LAYOUT AND ADJACENCIES. As with the location determinants, the key internal adjacencies are driven by response time. The location of the residential and living areas must accommodate quick and clear access to the Apparatus Room for response in the event of an alarm. The appropriate layout and adjacencies are illustrated through a bubble diagram and a series of illustrative layout diagrams. In HQ/Main Stations and Large HQ Stations, consider the relationship between the administrative areas and the living areas. There may be a desire to separate these areas to provide a sense of functional identity for each.

2.5.1 Functional Relationship Bubble Diagram. The bubble diagram in Figure 2-1 indicates the acceptable relative adjacencies of the functional spaces. Some of these key adjacencies may be accommodated through a hallway rather than a direct entrance/exit from one space to another. This is particularly true with the Apparatus Room and the Day Room as many facility spaces need an adjacency with these two spaces. Note that the "Apparatus Bay Support" area indicated in the diagrams includes the following spaces, some of which may not be included in every station, depending upon Installation mission requirements:

- SCBA Maintenance
- SCBA Compressor Room
- Work Room/Equipment Maintenance
- Equipment Wash/Disinfection
- Protective Clothing Laundry
- EMT Storage
- HAZMAT/CBRNE Equipment Storage
- Spare PPE Gear Storage
- Fire Extinguisher Inspection
- Fire Extinguisher Maintenance & Storage
- Flightline Fire Extinguisher Maintenance
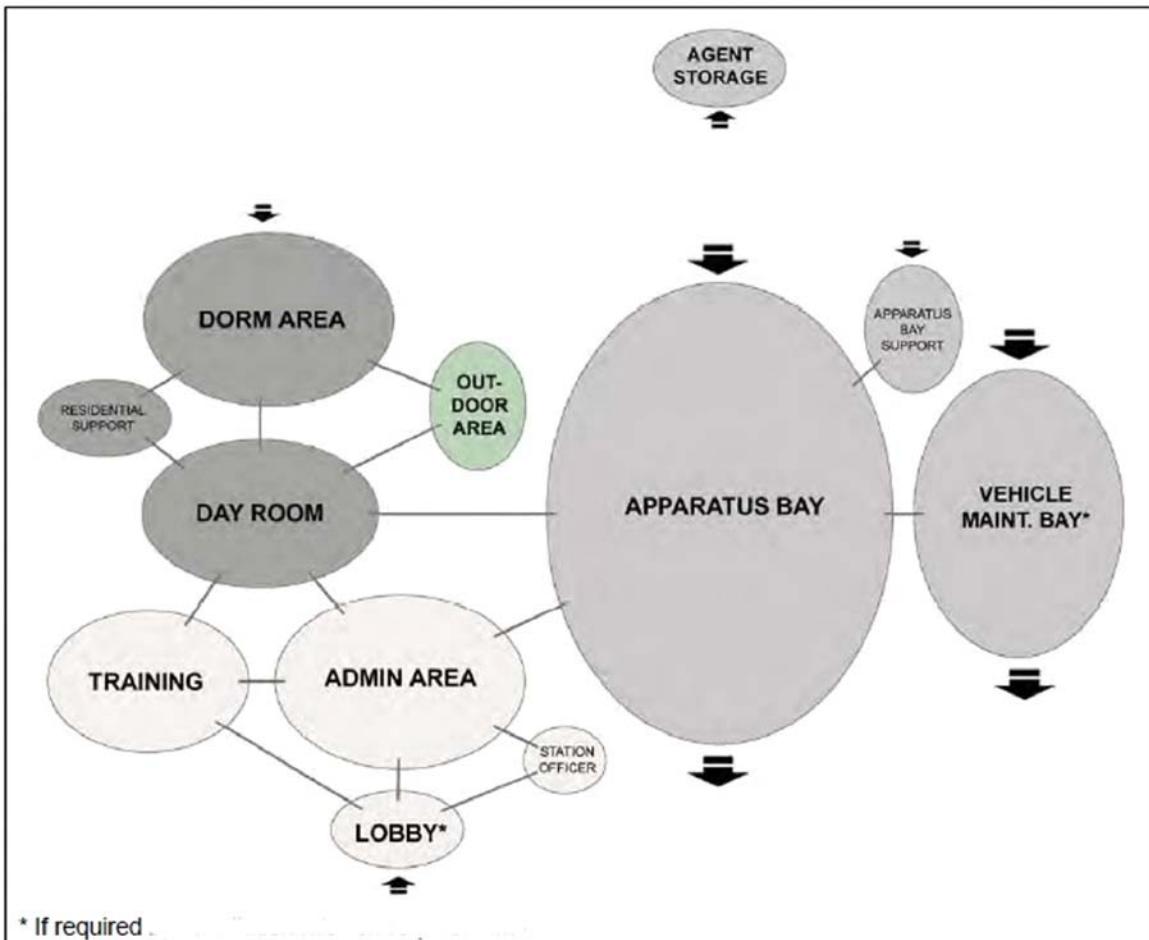
Figure 2-1
Functional Relationship Bubble Diagram

2.5.2 Illustrative Diagrams. The illustrative diagrams include Figures 2-2 through 2-4. They do not represent mandatory or even suggested layouts but are provided to expand on Figure 2-1 and illustrate the relative sizes of the functional spaces along with the acceptable adjacencies. By including the relative sizes of the spaces, these diagrams convey a possible means to accommodate the needed adjacencies.

2.5.2.1 **Figure 2-2**.

This diagram illustrates a layout for a small, one- or two-company Satellite station.
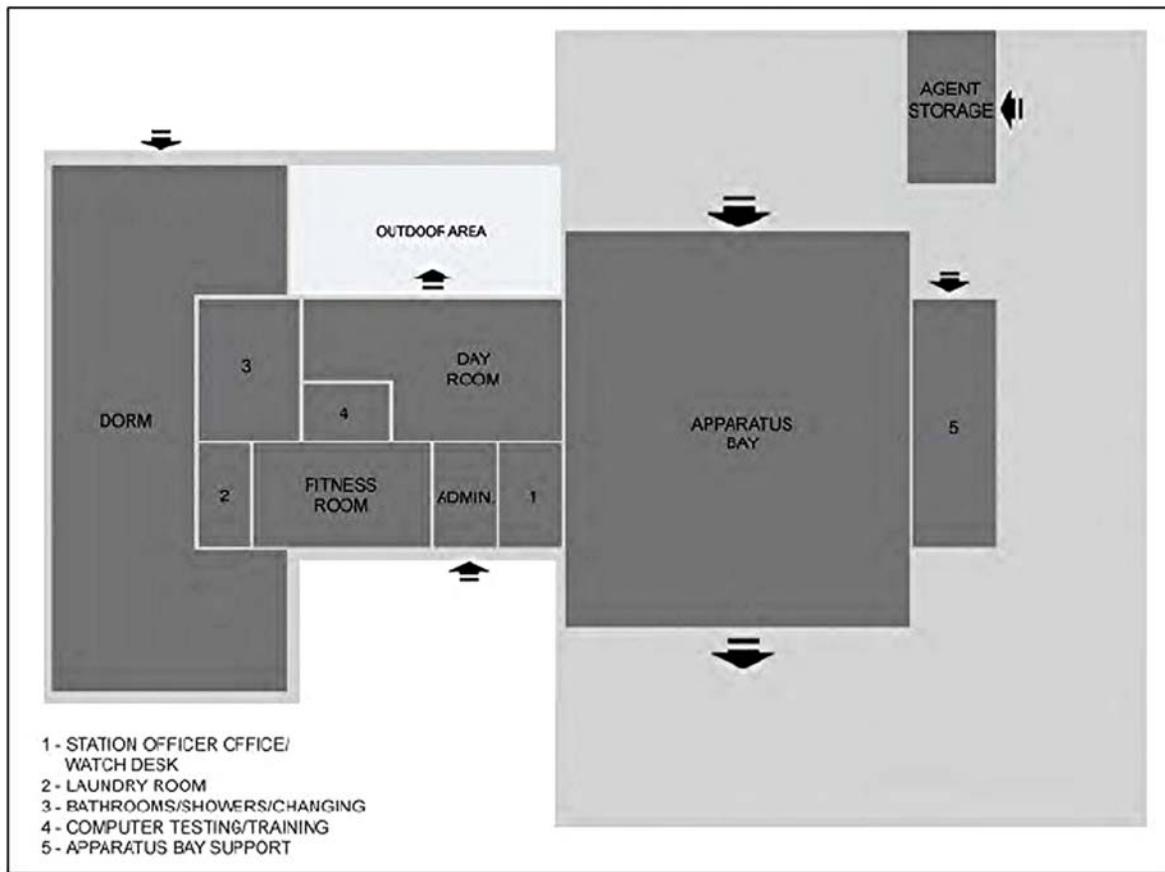
Figure 2-2

Illustrative Layout Diagram A – Small Satellite

2.5.2.2 Figure 2-3. This diagram illustrates a layout for an HQ/Main station with larger administrative and training components.
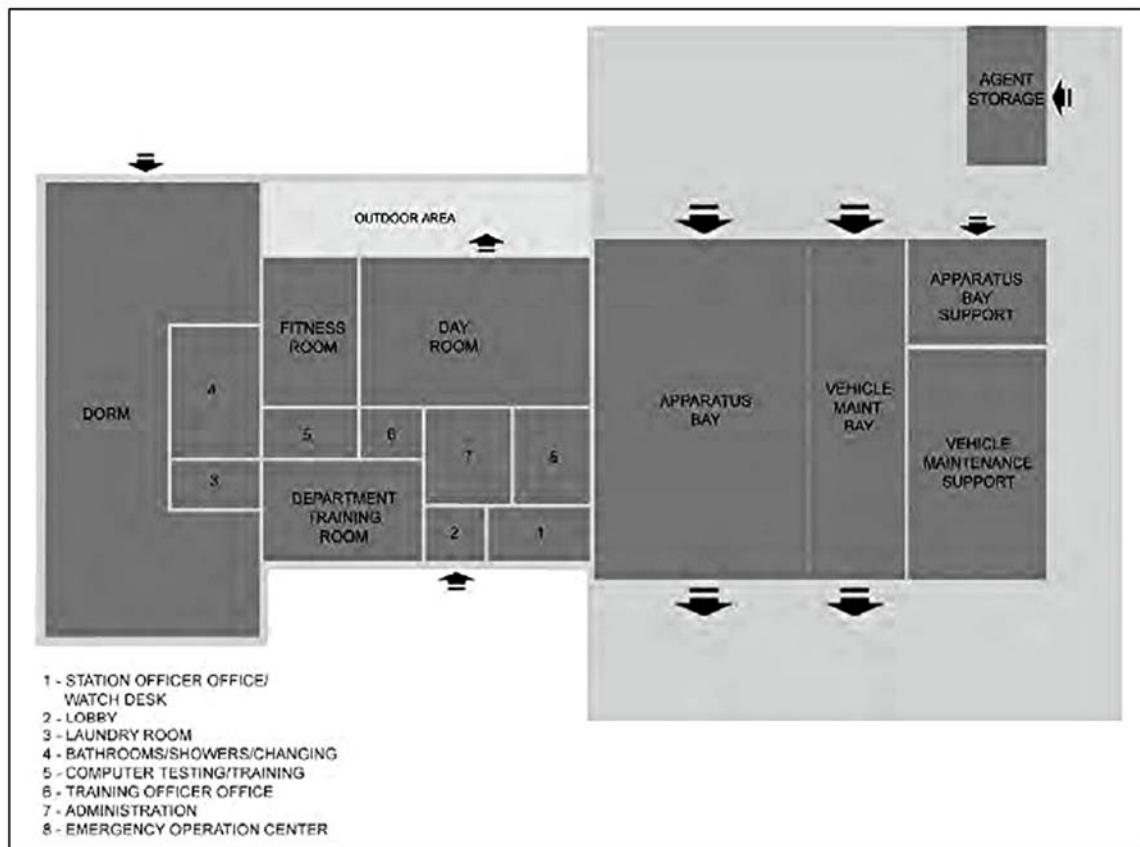
Figure 2-3
Illustrative Layout Diagram B – Headquarters (HQ)/Main Station

2.5.2.3 Figure 2-4. This diagram illustrates a layout for a Large HQ station. This diagram also captures some of the key relationships for any combination station, regardless of size—in particular the need for separation of ARFF and Structural trucks relative to a flightline.
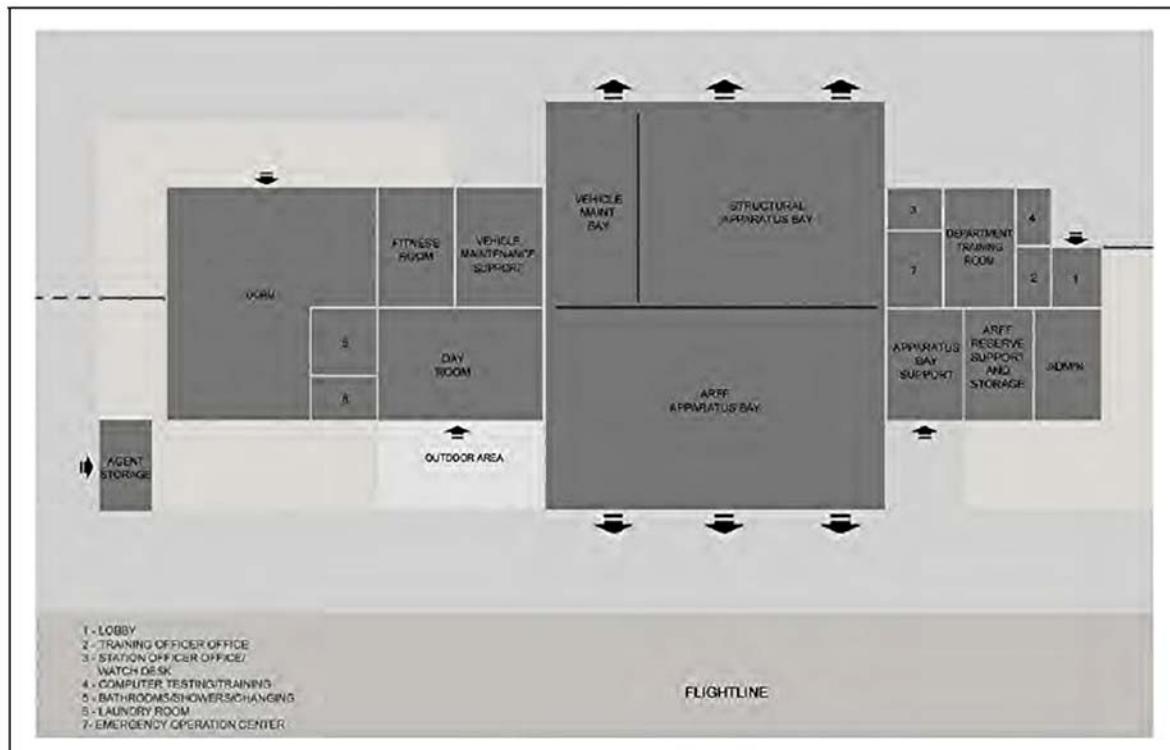
Figure 2-4
Illustrative Layout Diagram C – Large HQ

2.5.3 Sample Floor Plans. Sample floor plans below further expand on these illustrative diagrams. These do not represent mandatory or even suggested floor plans. They are provided to illustrate possible means to accommodate the needed adjacencies.
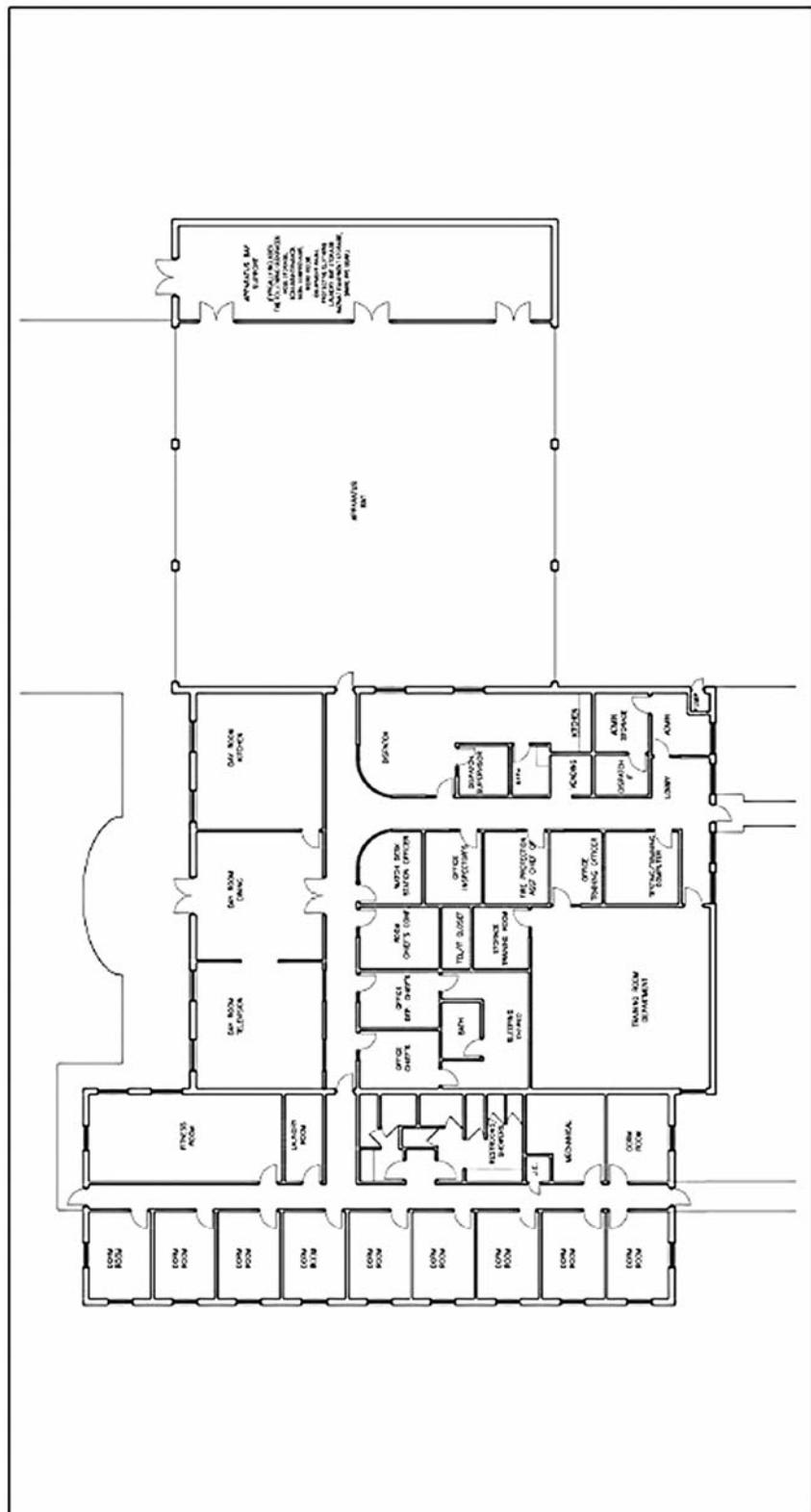
Figure 2-5
Headquarters Station
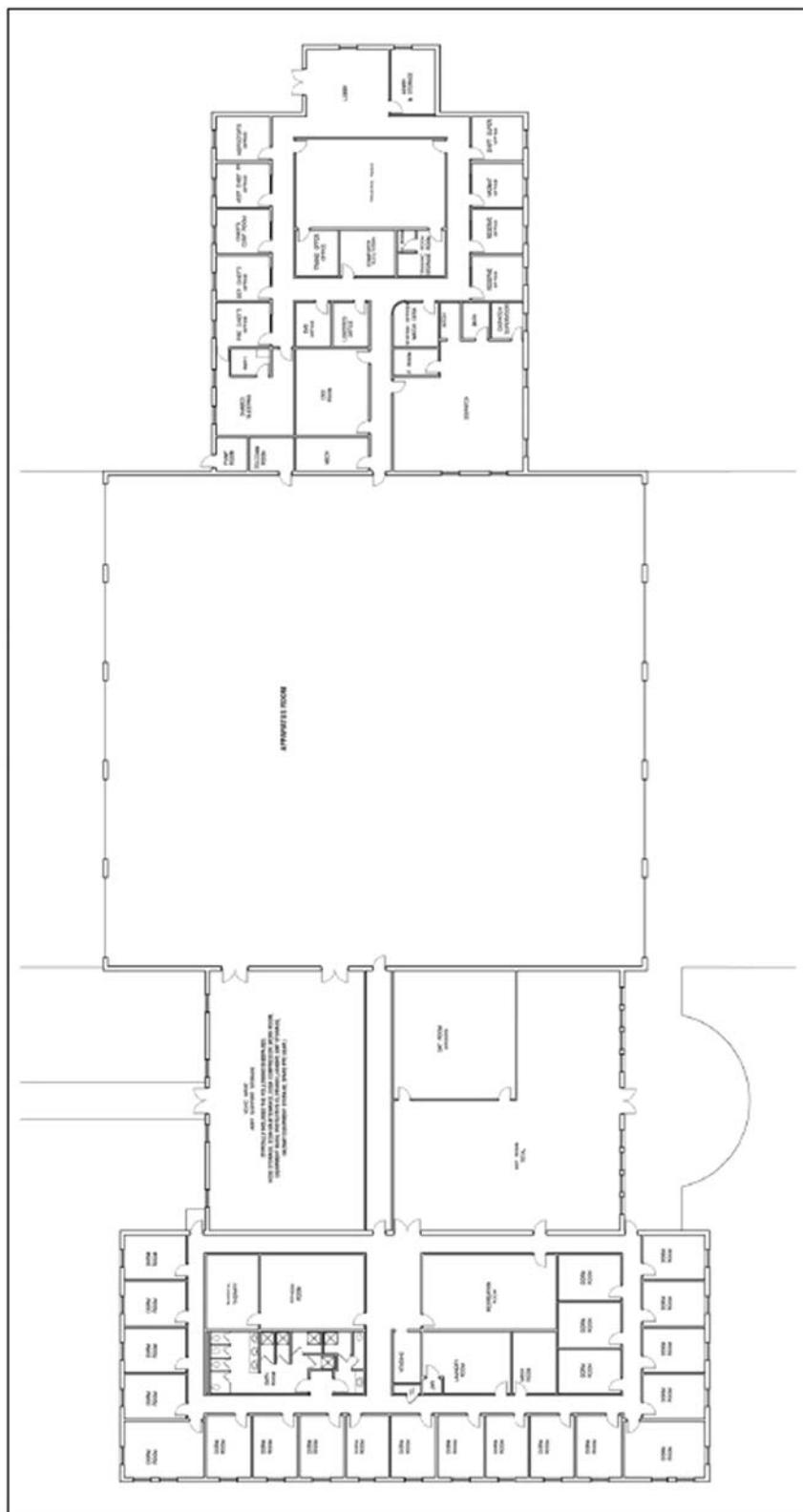
Figure 2-6
Large Headquarters Station
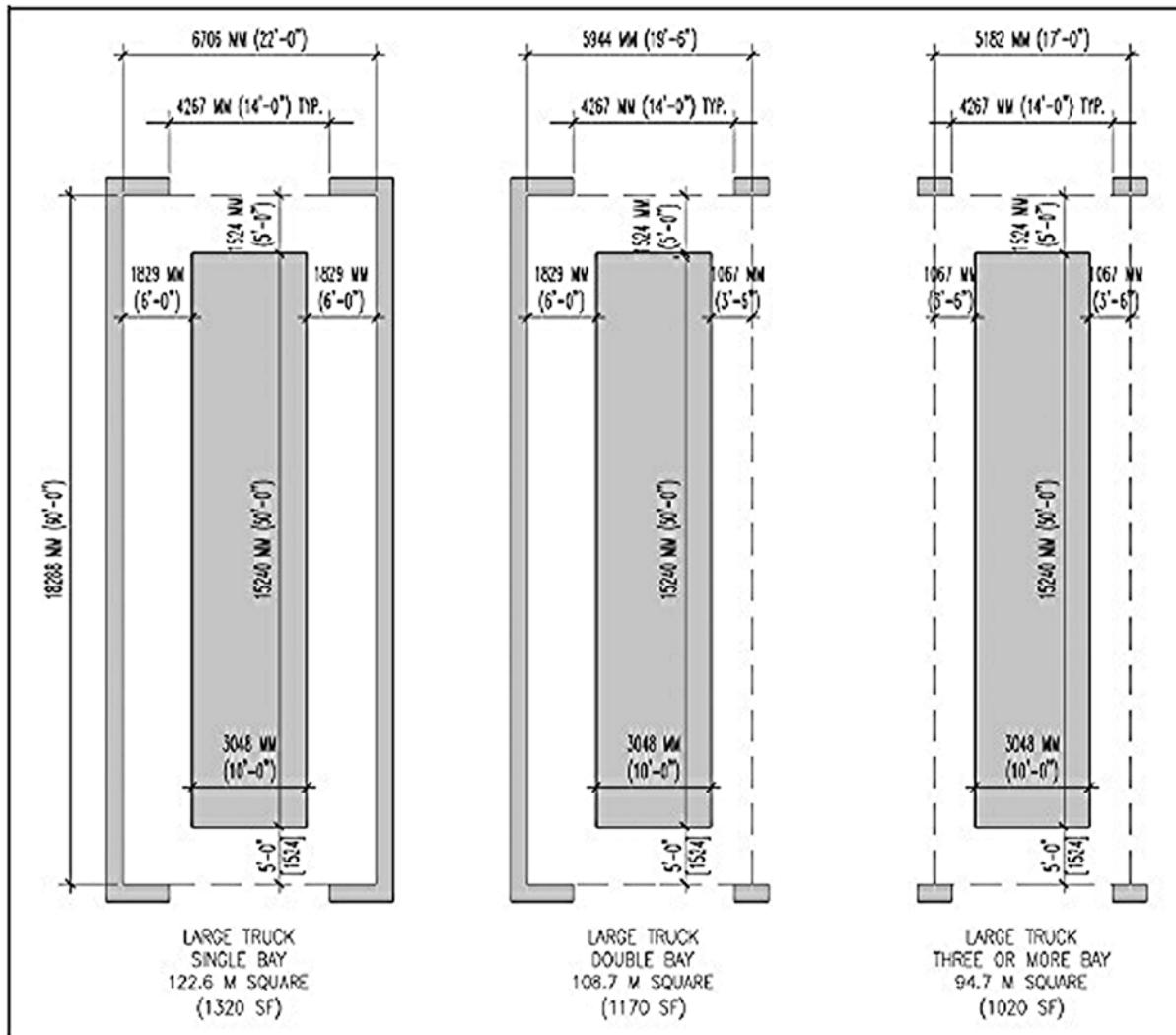
Figure 2-7
Apparatus Bays – Large Vehicle Class
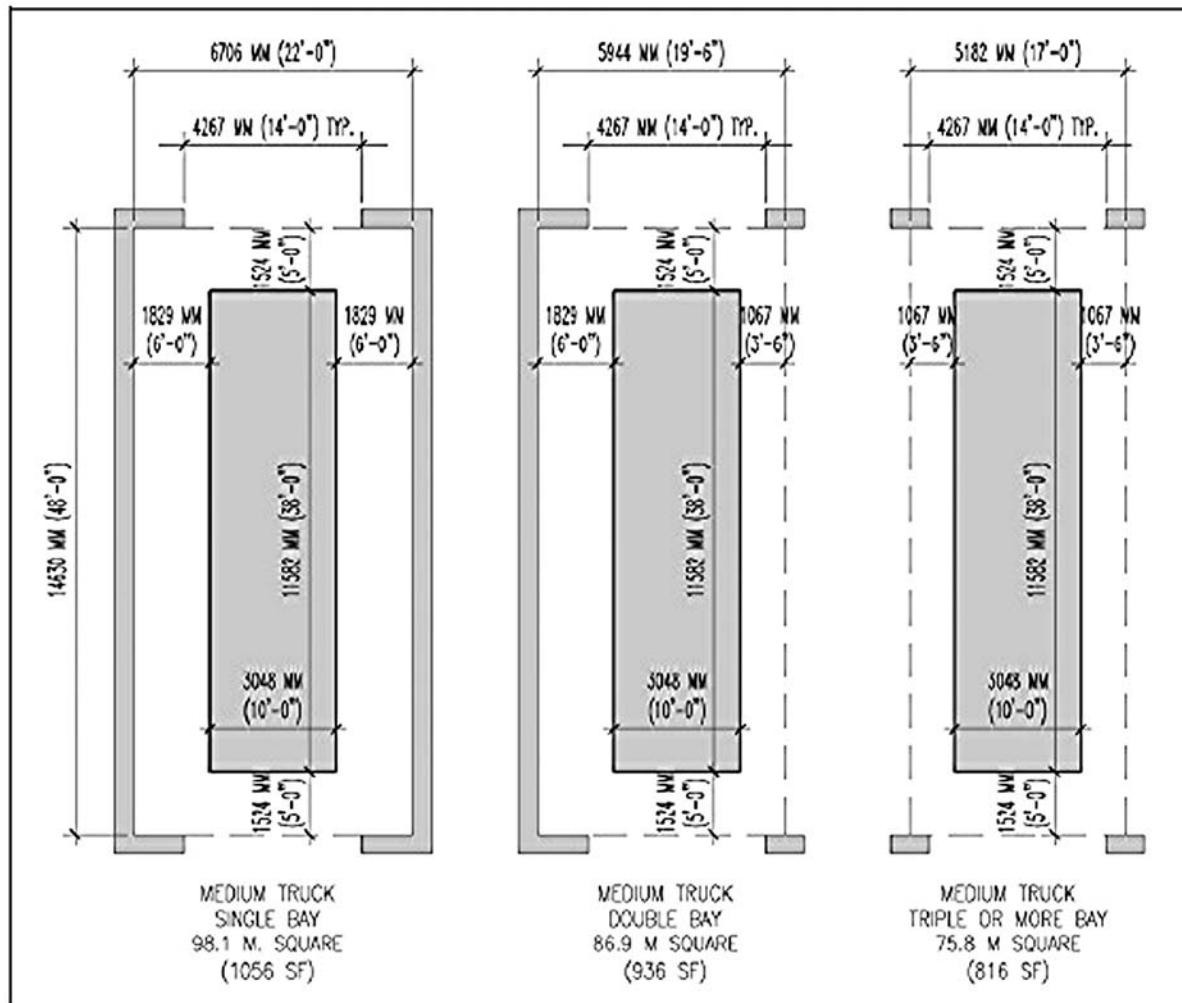
Figure 2-8
Apparatus Bays – Medium Vehicle Class
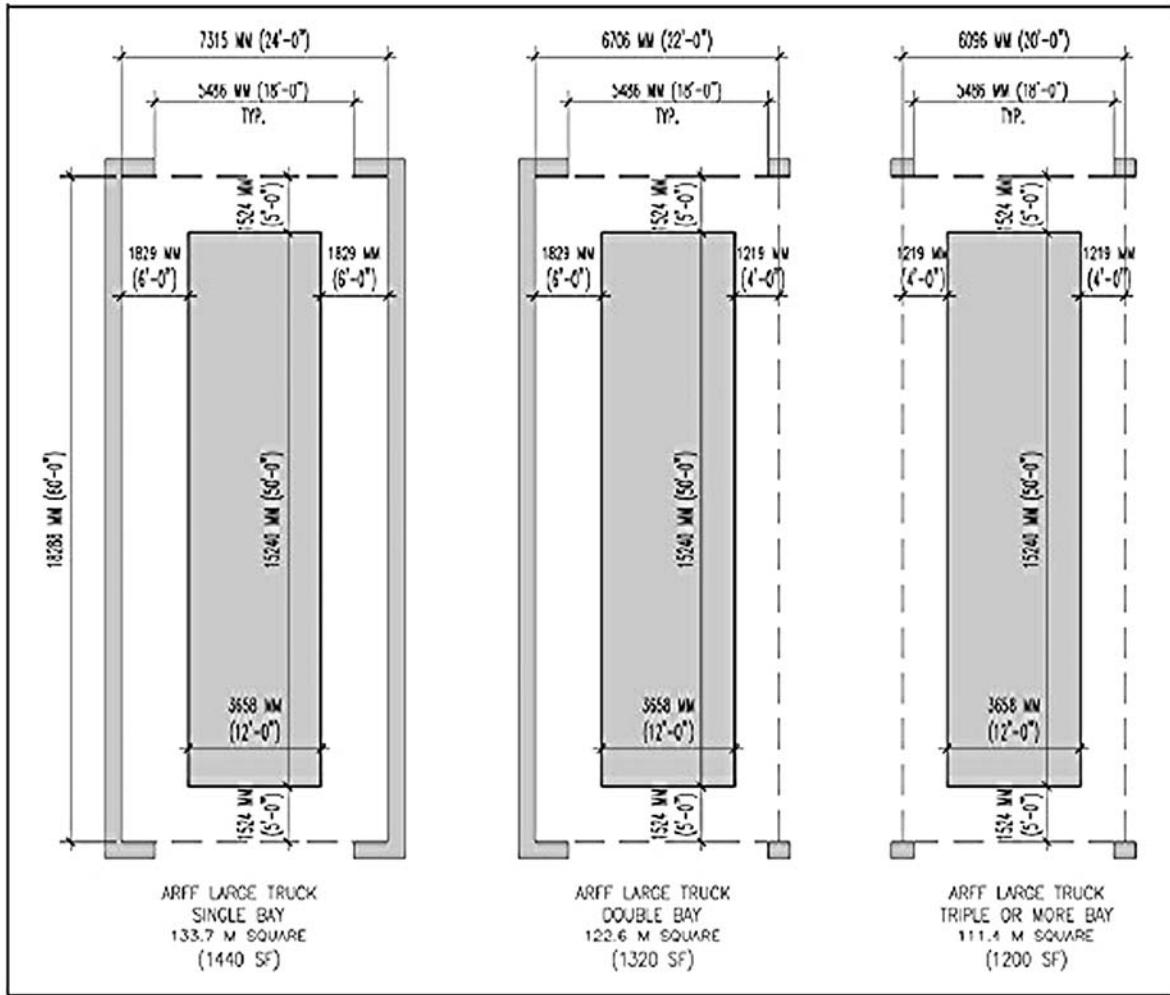
Figure 2-9
Apparatus Bays – Large ARFF (Wide) Vehicle Class
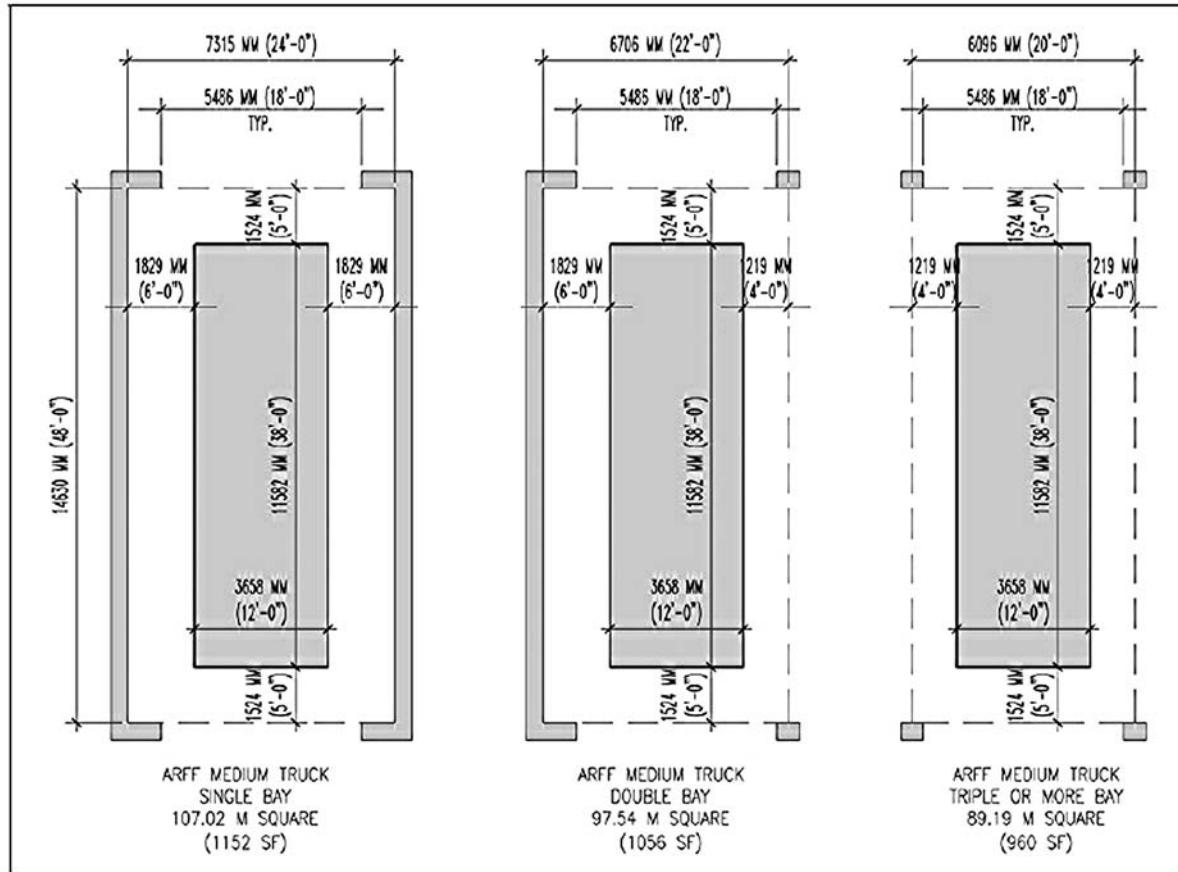
Figure 2-10
Apparatus Bays – Medium ARFF (Wide) Vehicle Class

4572 mm (15'-0")

7315 mm (24'-0")

1824 mm (6'-0")
CLEAR CIRCULATION AREA

1 - DESK 1828 mm
(6'-0")

2 - DESK CHAIR
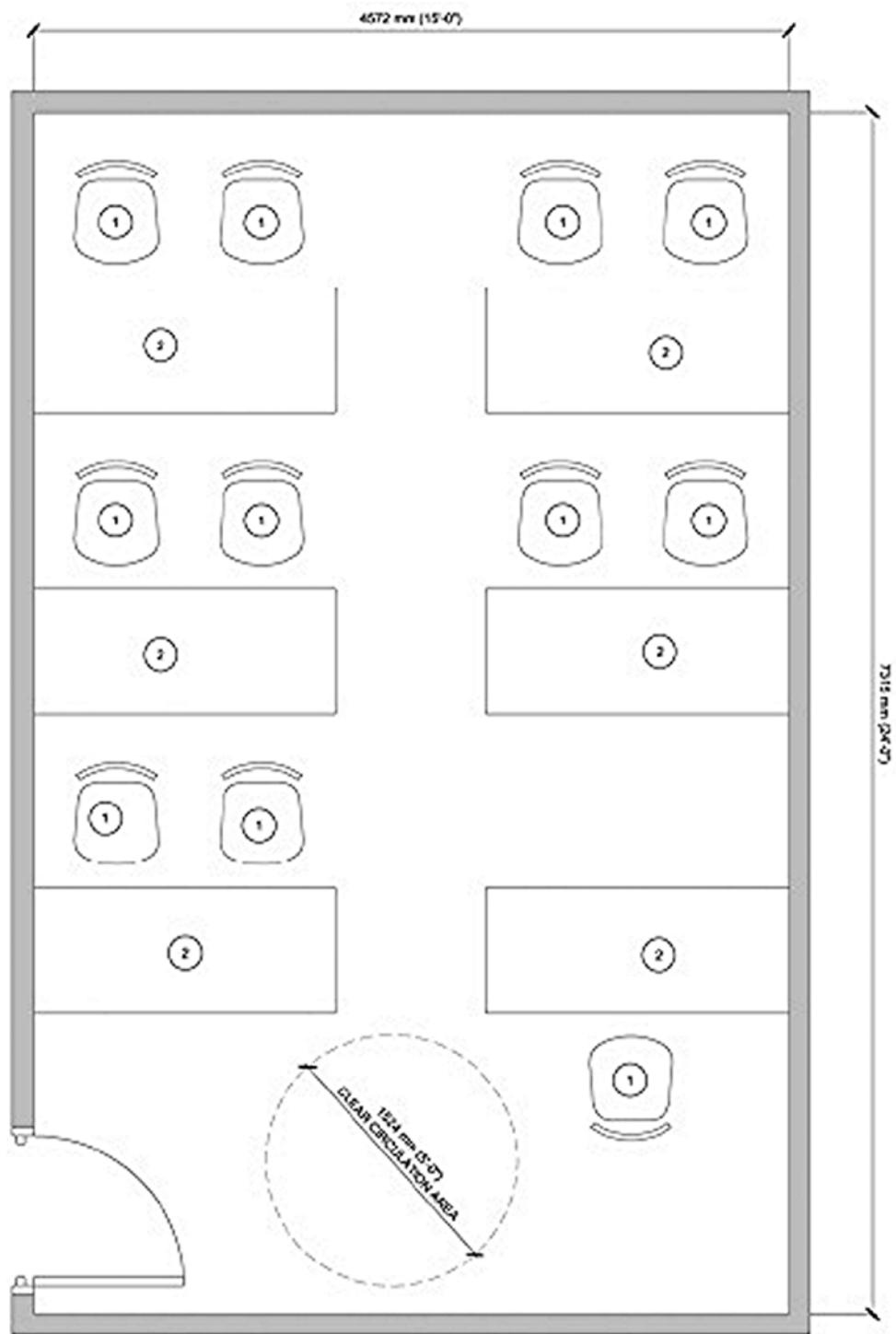
Figure 2-11
Department Training Room
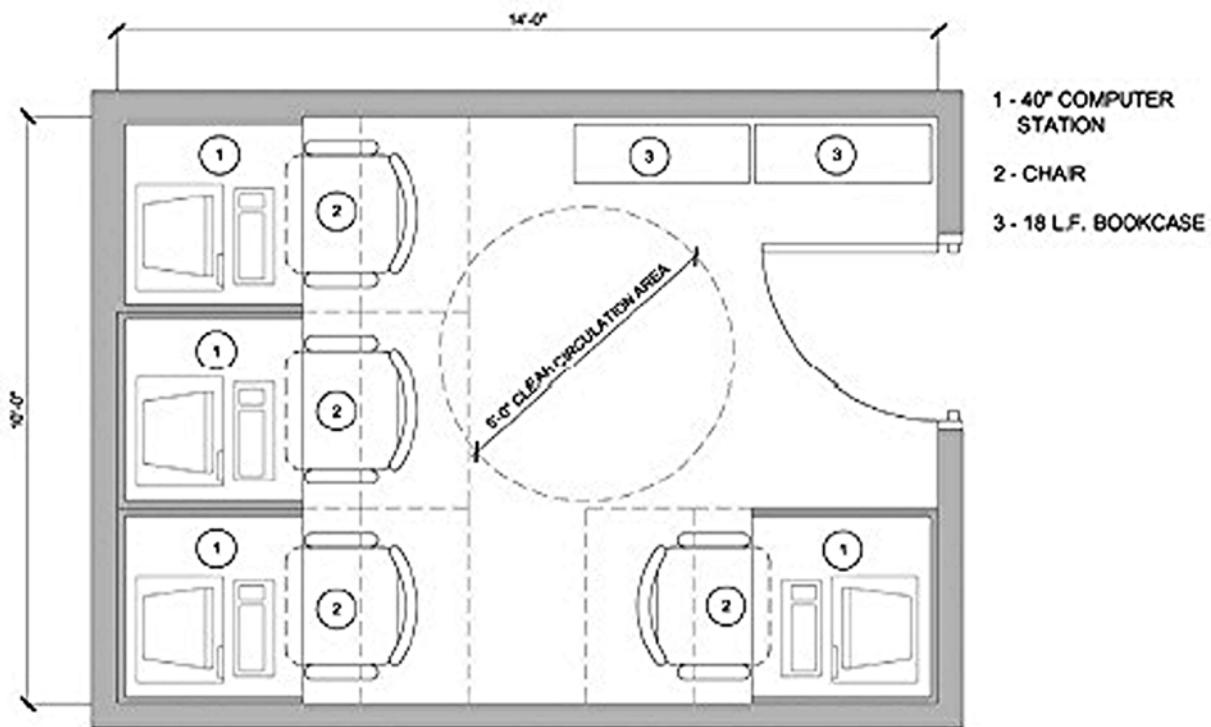
Figure 2-12
Testing/Individual Study Area
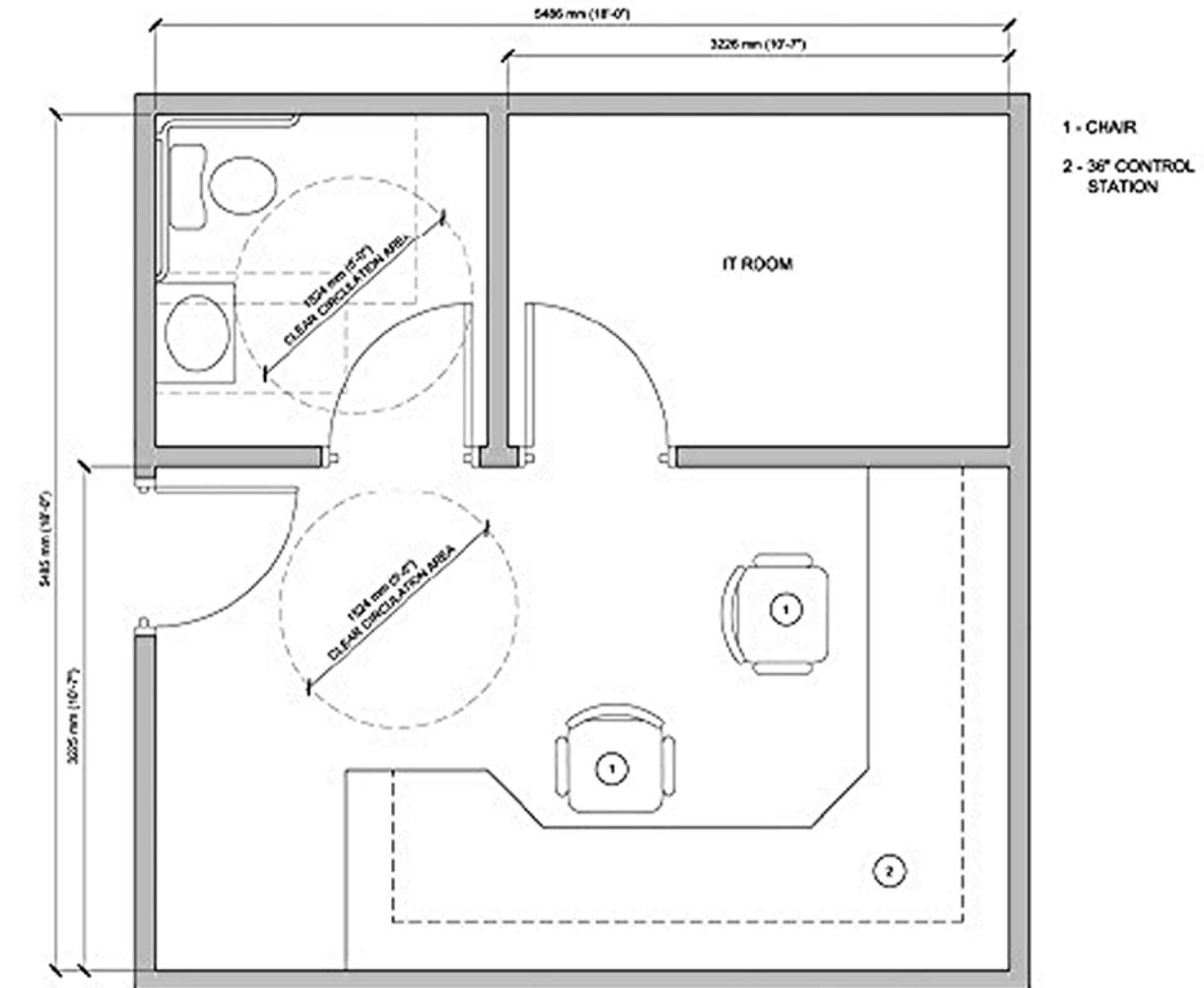
Figure 2-13
Small Dispatch Room

1 - CHAIR

2 - 36" CONTROL
    STATION
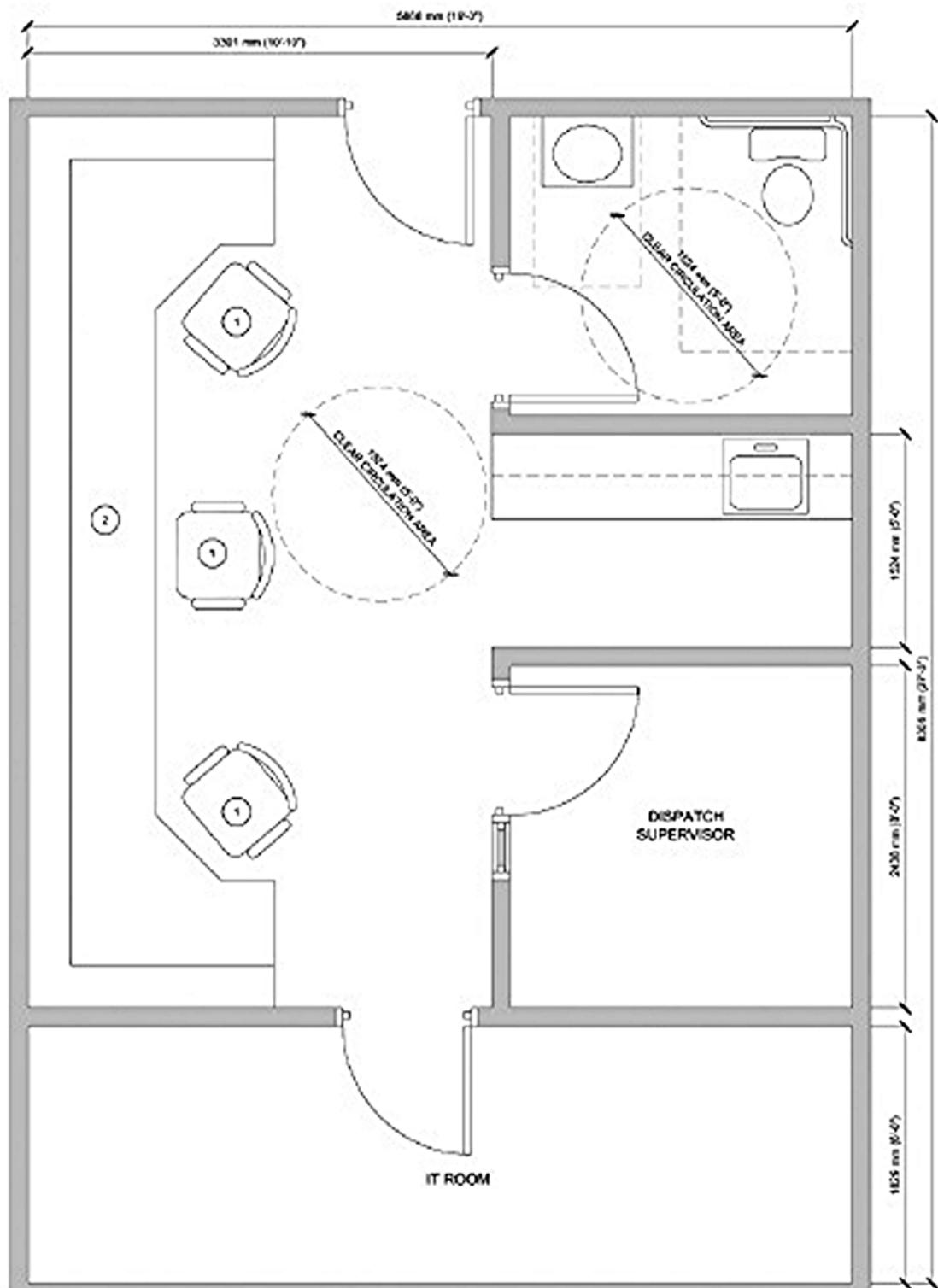
Figure 2-14
Larger Dispatch Room

LIVING ROOM
DINING ROOM

DINING ROOM
KITCHEN

Figure 2-15
Day Room

3048 mm (10'-0")

4267mm (14'-0")

1524 mm (5'-0")
CLEAR CIRCULATION AREA

1 - REFRIGERATOR   3 - DISHWASHER   5 - HOOD

2 - RANGE   4 - PANTRY
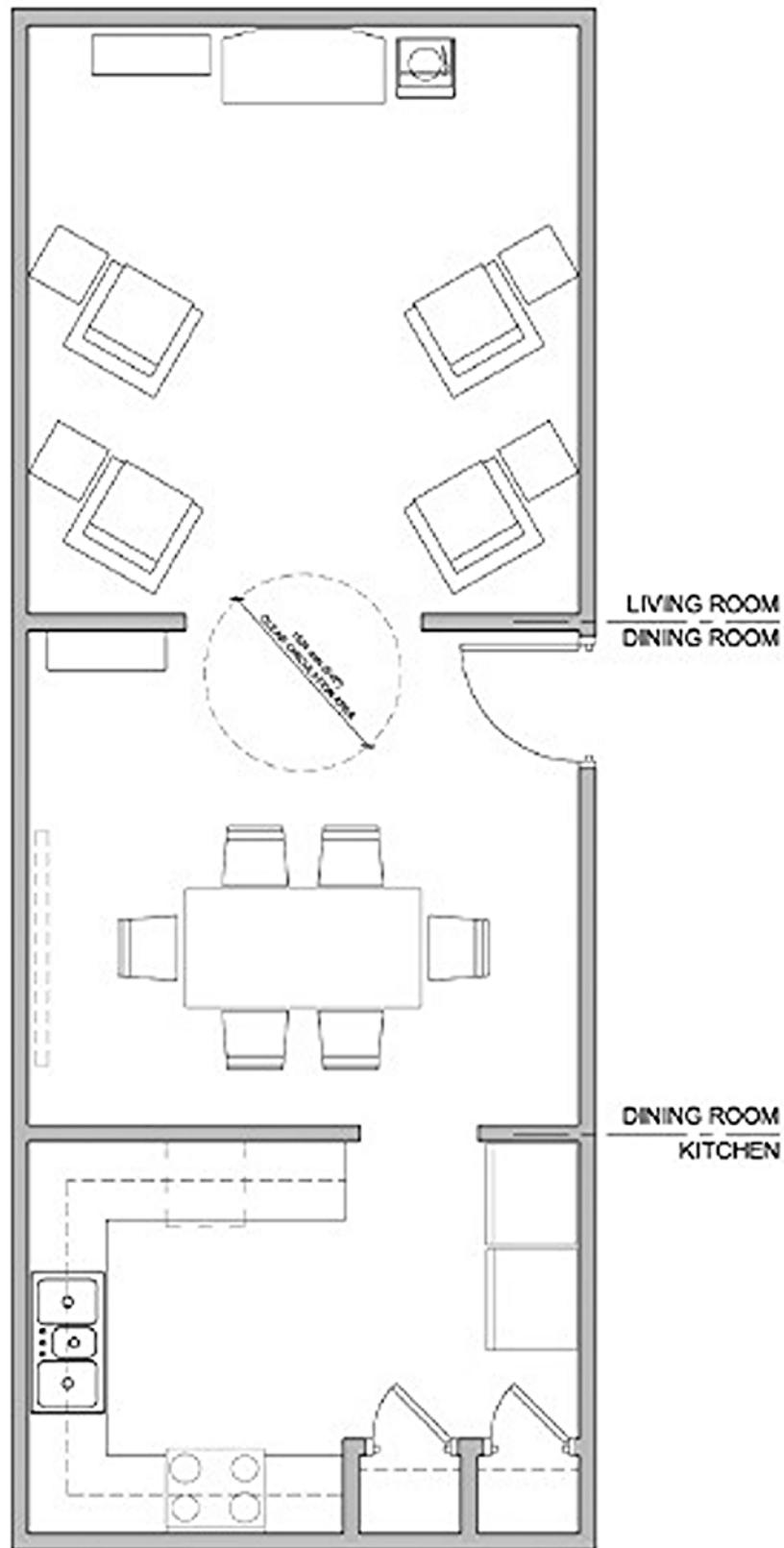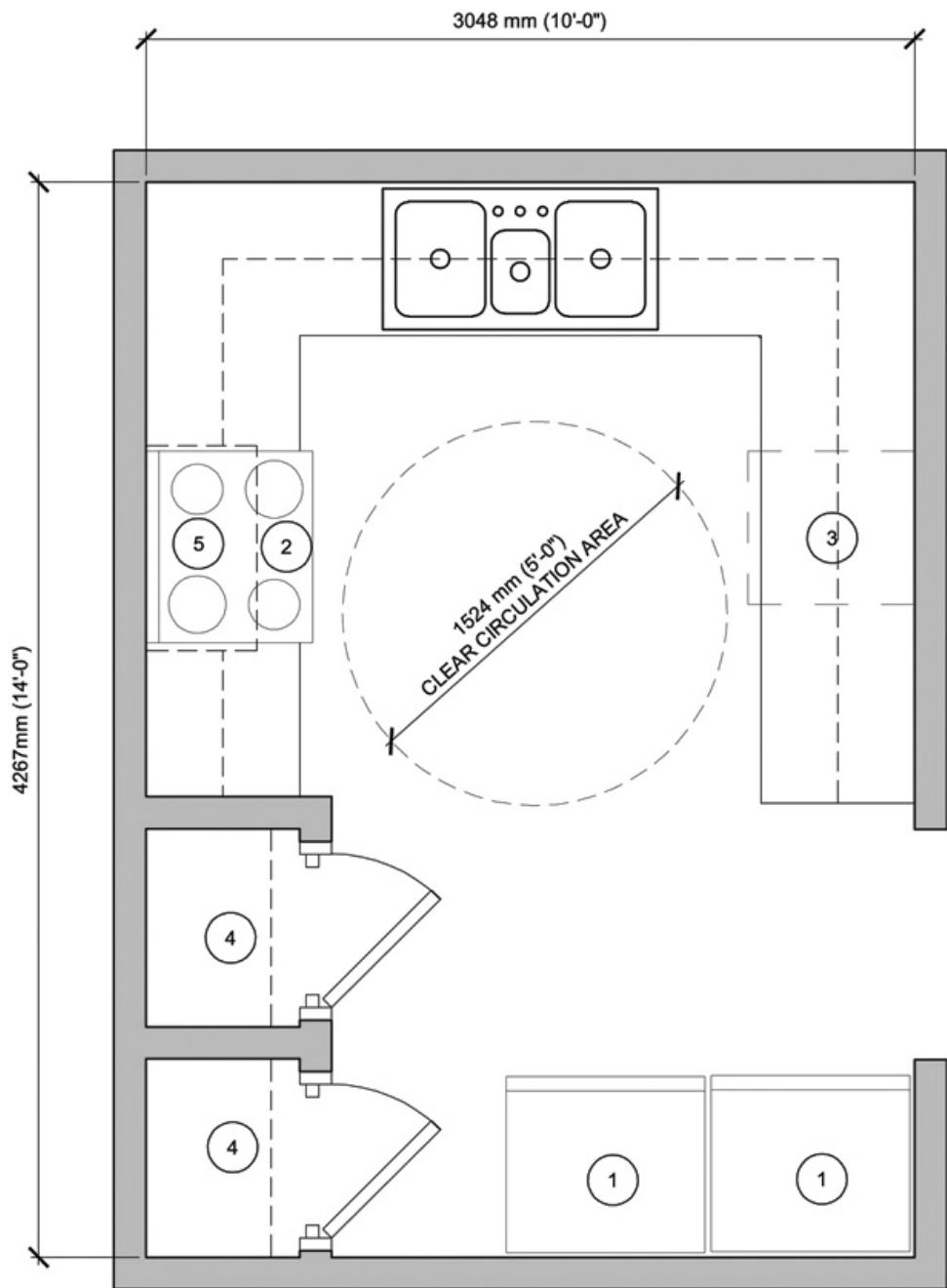
Figure 2-16
Day Room - Kitchen
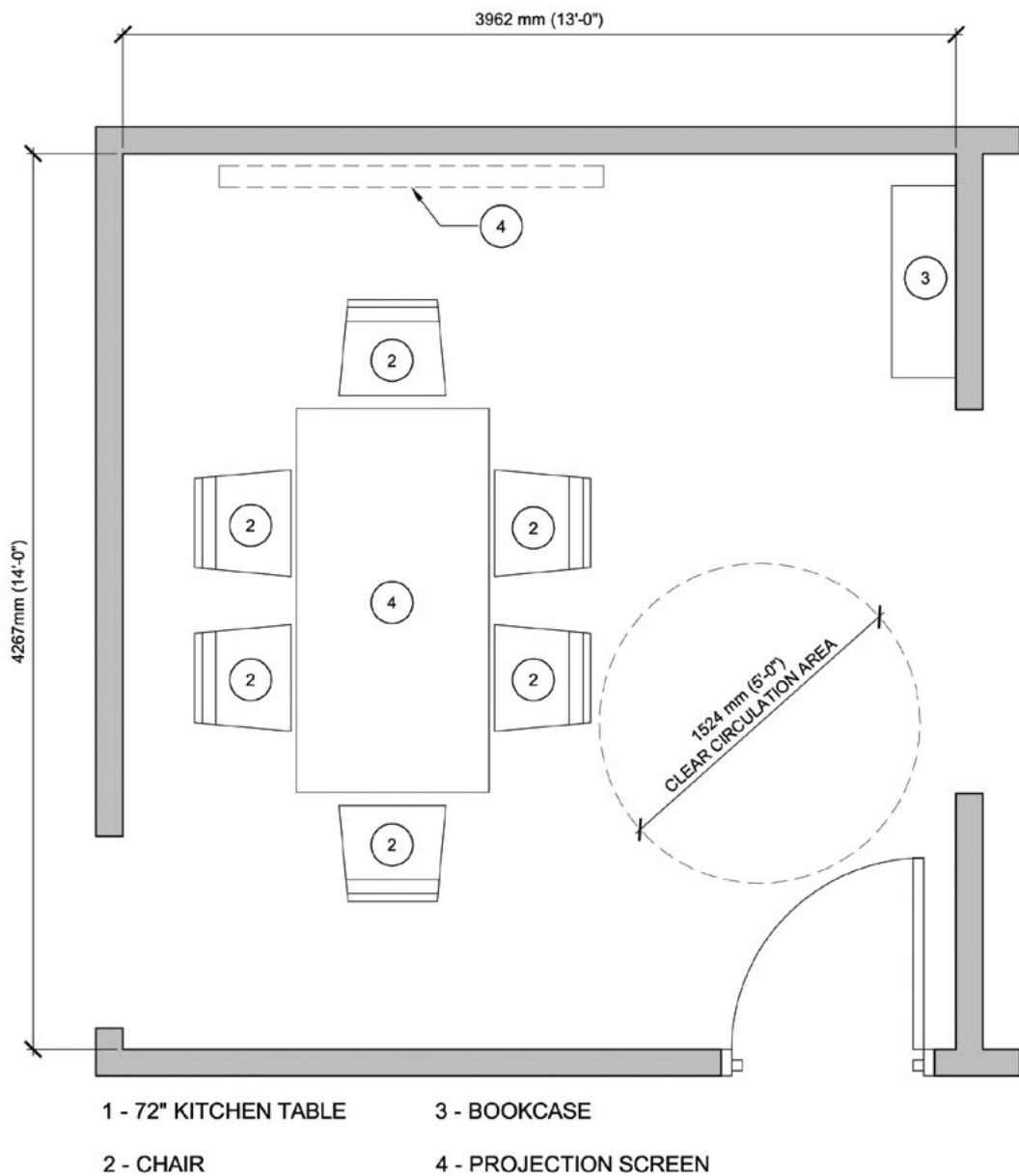
Figure 2-17
Day Room – Dining/Training Area

4572 mm (15'-0")

4267mm (14'-0")

1524 mm (5'-0")
CLEAR CIRCULATION AREA

1 - ARM CHAIR   3 - ENTERTAINMENT CENTER

2 - SIDE TABLE   4 - BOOKCASE
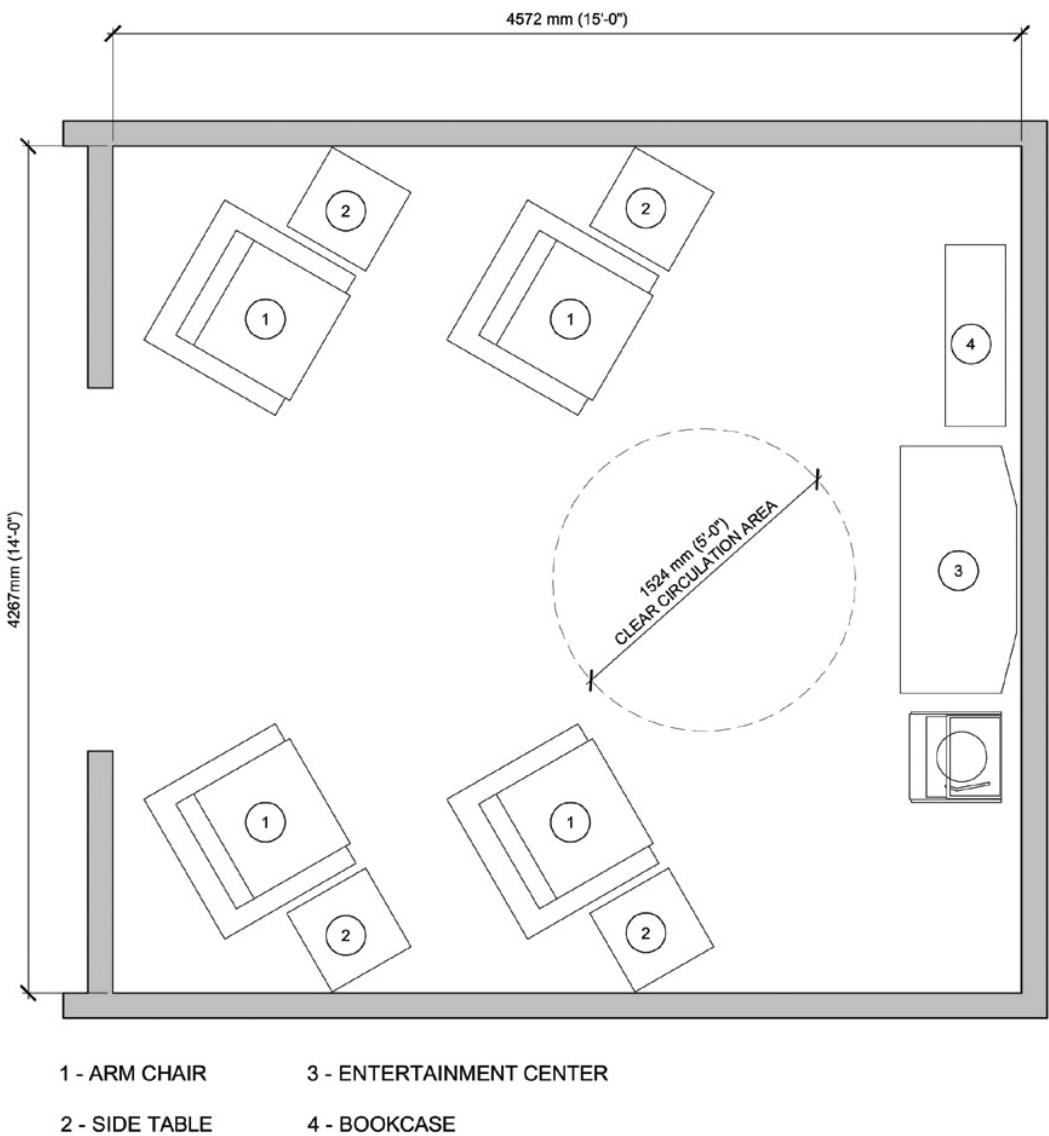
Figure 2-18
Day Room – Living Room Area
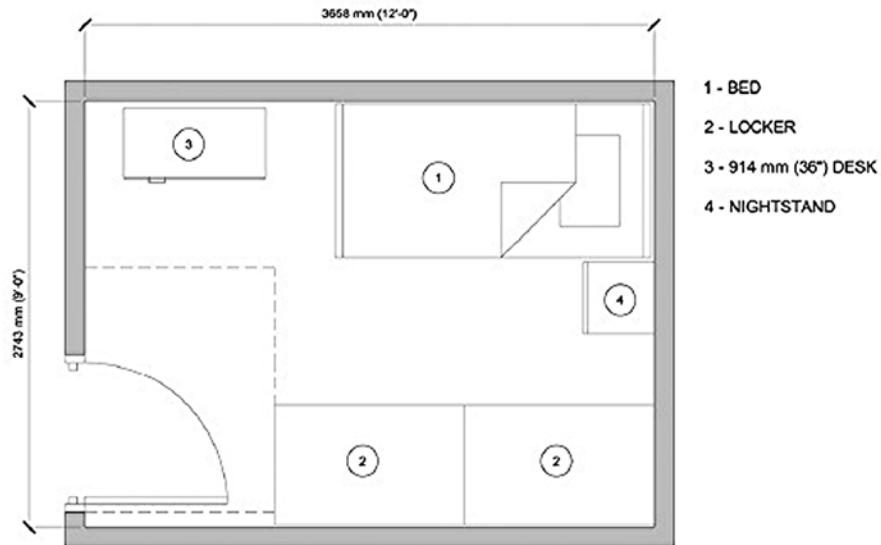
Figure 2-19
Dorm Room – One Bed
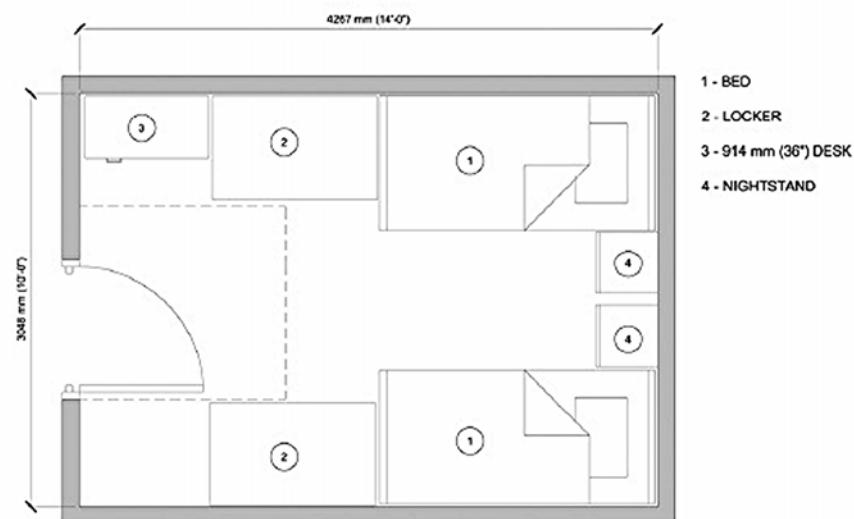
Figure 2-20
Dorm Room – Two Beds
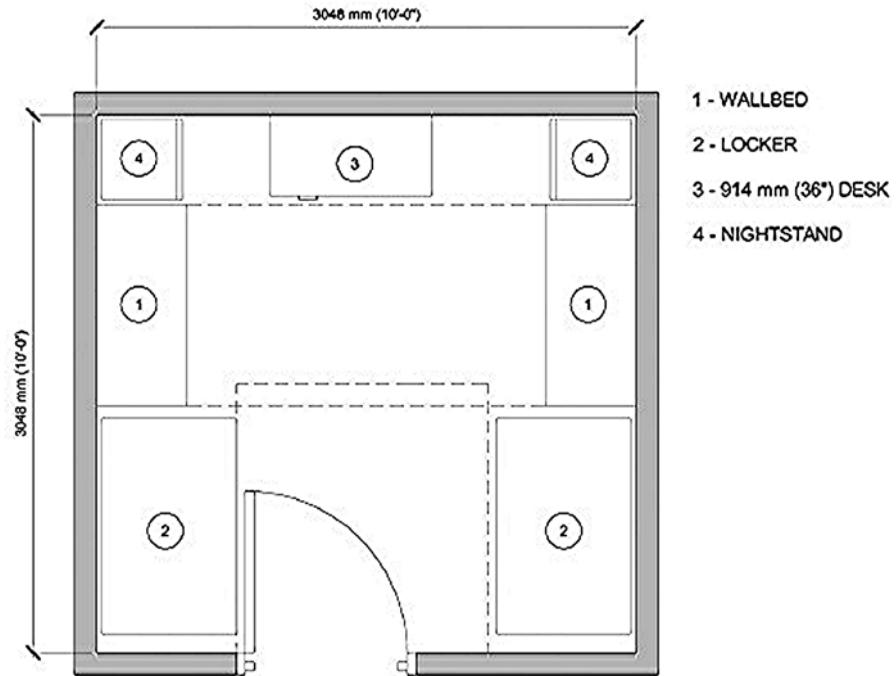
Figure 2-21
Dorm Room with Two Foldup Beds
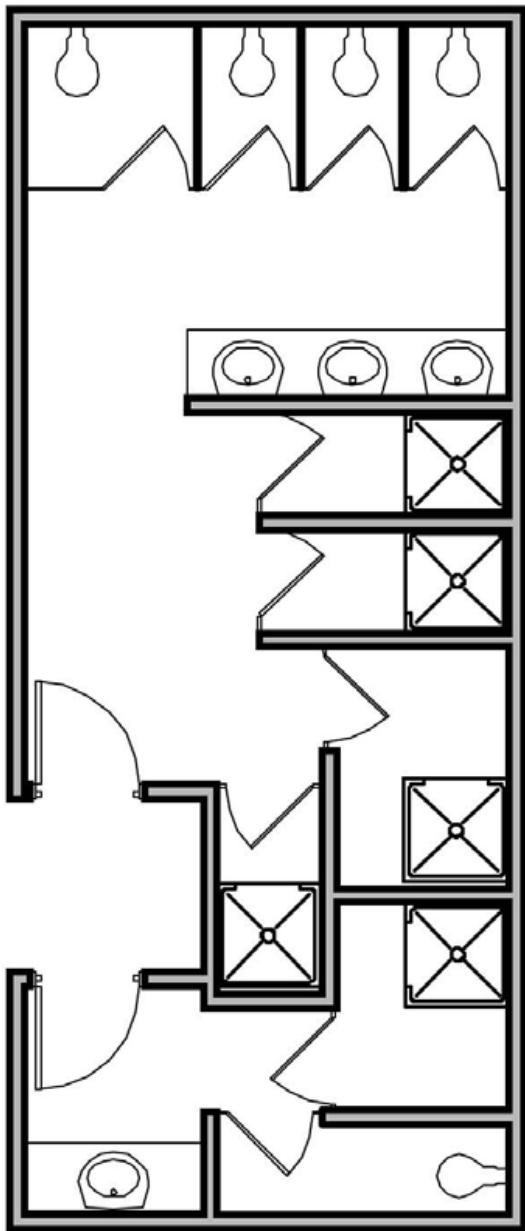
Figure 2-22
Bathroom, Showers, Changing

1 - FREE WEIGHTS

2 - UNIVERSAL STRENGTH
    TRAINING MACHINE

3 - PHYSICAL FITNESS
    MACHINES
    A - NATURAL RUNNER
    B - TREADMILL
    C - BIKE
   D - STAIR CLIMBER

4 - WATER COOLER
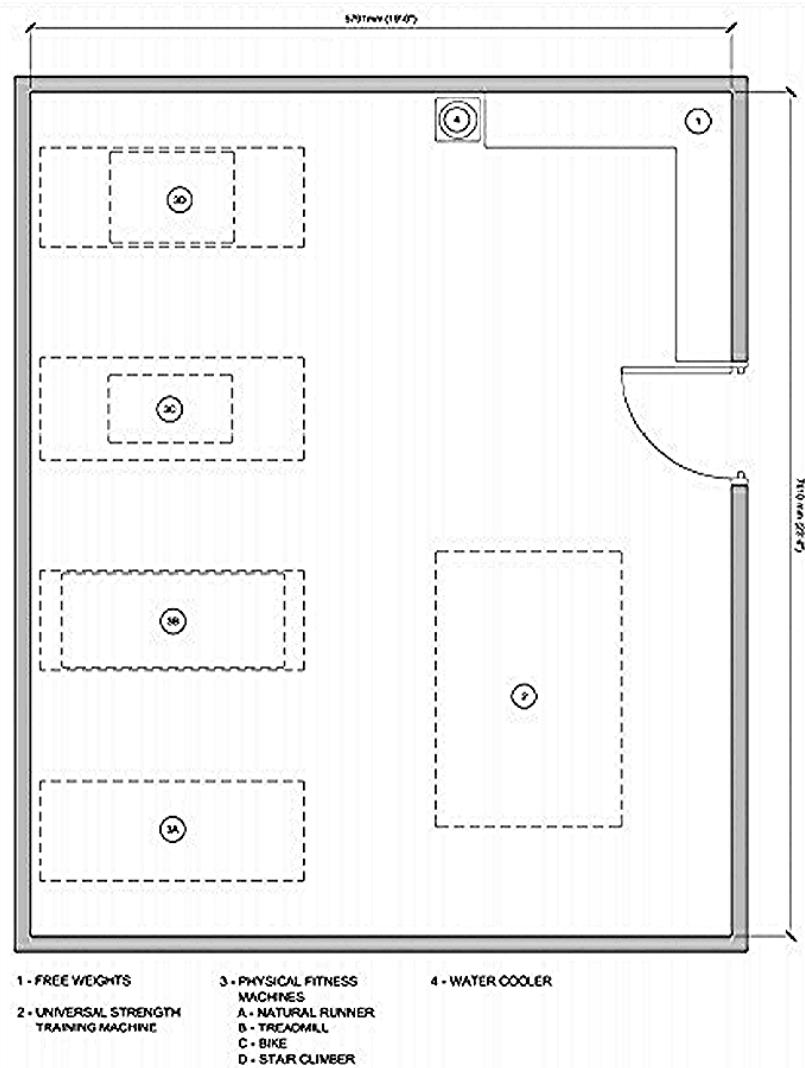
Figure 2-23
Fitness Room

Functional Component	Space Allocation Standard			Notes
	m²	ft²	Standard	
Apparatus, Equip, & Maintenance				
Apparatus Bay - Extra Large	108.69	1,170	per truck	Station
Apparatus Bay - Large	86.95	936	per truck	Station
Apparatus Bay - ARFF	122.63	1,320	per ARFF truck	Station
PPE Gear Storage	0.93	10	per person	Station
Hose Storage	5.02	54	per 52-Hose storage unit	Department
SCBA Maintenance Room	13.38	144	per four staffed vehicles	Department
SCBA Compressor Room	4.65	50	per four staffed vehicles	Department
Protective Clothing Laundry	9.29	100	per staffed vehicle	Station
Equipment Wash/Disinfection	13.94	150	per room	Station
Work Room/Equipment Maint.	11.15	120	per room	Station
Vehicle Maint. Equipment Storage	37.16	400	per station	As dictated by installation mission requirements
EMT Storage (incl. locked Meds stor.)	1.11	12	per station	Station
HAZMAT/CBRNE Equip. Storage	11.15	120	Tech. level / Tier 3 req.	Department
Spare PPE Gear Storage	5.95	64	per person	Department - storage for 30% total crew gear
Fire Extinguisher Inspection	2.23	24	per inspection station	Dept. - dictated by installation mission requirements
Non-FL Fire Exting. Maint. & Storage	11.15	120	per room	Dept. - dictated by installation mission requirements
Flightline Fire Exting. Maintenance	14.86	160	per station	Dept. - dictated by installation mission requirements
Flightline Fire Exting. Tank Recovery Exterior Covered Storage	3.72	40	per room	Dept. - dictated by installation mission requirements
Spare FL Fire Exting. Tank Exterior Covered Storage	16.72	180	9 sf/tank x 10% of total tanks	As dictated by installation mission requirements
Vehicle Maintenance/Storage Bay	111.48	1,200	per station	Department - AF only
Vehicle Maintenance Office	13.94	150	per office	Tied to Vehicle Maintenance Bay
Administrative and Training				
Station Officer's Office/ Watch Desk	11.15	120	per office	Station
Fire Chief's Office	32.05	345	per office	Department
Chief's Conf. Room	11.15	120	per room	Department - tied to chief & deputy chief
Deputy Chief's Office	11.15	120	per office	Dept. - dictated by installation mission requirements
Lobby Area	9.29	100	per lobby	Department - tied to chief & deputy chief
Admin. Asst.	5.95	64	per office	Department - tied to chief & deputy chief
Asst. Chief/ Shift Supervisor	11.15	120	per office	Dept. - dictated by installation mission requirements
Asst. Chief of Fire Prevention	11.15	120	per office	Dept. - dictated by installation mission requirements
Inspector(s) Offices	4.46	48	per workstations	Department (may be spread-out over several stations)
EMS Office	7.43	80	per office	Station - dictated by installation mission requirements
HAZMAT/ Safety Office	11.15	120	per office	Dept. - dictated by installation mission requirements
Logistics Office	7.43	80	per office	Dept. - dictated by installation mission requirements
Dept. Training Room	2.60	28	per person	Department - total on-duty Fire Department Staff
Training Room Storage	7.43	80	per training room	Tied to Department Training Room
Training Officer Office	9.29	100	per office	Department
Satellite Computer Training/Testing Room	13.01	140	per four testing stations	Satellite Station
HQ Computer Training/Testing Room	17.65	190	per six testing stations	HQ Station
General Admin Storage	7.43	80	per station	Station
IT Room	1.86	20	per room	Station
Dispatch	17.84	192	per dispatcher	Department - either fire or consolidated
Dispatch Supervisor	5.95	64	per workstation	Department - tied to dispatch
Dispatch Bathroom	4.46	48	per fixture (ADA)	Department - tied to dispatch
Dispatch Kitchenette	1.86	20	per kitchenette	Department - tied to dispatch
Additional IT Room Space	5.57	60	per room	Tied to dispatch
Residential and Living				
Day/Training Room	60.20	648	per staffed vehicle	Station = kitchen + dining/training + lounge
Dorm Room with one bed	10.03	108	per room	Station = staffed vehicle count + 1/company
Dorm Room with two beds	13.01	140	per room	Station = staffed vehicle count + 1/company
Dorm Room with two fold-up beds	9.29	100	per room	Station = staffed vehicle count + 1/company
Bathrooms/Showers/Changing	23.23	250	per staffed vehicle	Station
Fitness Room	40.60	437	per station	Station - to accommodate 4 working out at one time
Laundry Room	7.43	80	per staffed vehicle	Station - 1 washer, 2 dryers, sink, folding table
Physical Therapy/Sauna	18.58	200	per station	Station - dictated by installation mission requirements
Recreation Room	33.44	360	per station	Optional - station = one or two "game units"
Vending	1.86	20	per vending machine	Station
Other Spaces				
Reserve Offices	11.15	120	per office	AF only - dictated by installation mission requirements
Reserve and Active Duty Mobility/ Deployment Gear Storage	18.58	200	per station	AF only - dictated by installation mission requirements
Reserve Firefighter PPE Gear	0.93	10	per person	AF only - dictated by installation mission requirements
EOC Situation Room*	29.73	320	per room	Dept. - dictated by installation mission requirements
Public toilet (ADA-compliant, unisex)	4.18	45	per room	Station

Table 2-3
Space Program Data – Building

Functional Component	Space Allocation Standard			Notes
	m²	ft.²	Standard	
Staff Parking	41.81	450	per space (incl. circ.)	Station
Visitor Parking	41.81	450	per space (incl. circ.)	Station
Bicycle Rack Area	14.86	160	per 10-bike Rack	Station
Site Approach to Apparatus Bays	185.80	2,000	per bay	Station
Agent Storage (ARFF)	6.97	75	per ARFF truck	Station or Department - Foam + 2nd agent
Agent Storage (Structural)	4.46	48	per Station (Struct. trucks)	Station - Class A Foam
Patio	13.94	150	Min. (1 to 2 companies)	Station - add 100 sf for 3-4 cos, add 100 sf for > 4 cos.

Table 2-4
Space Program Data - Site