Guidebook for Airport Terminal Restroom Planning and Design

DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 130

Guidebook for Airport Terminal Restroom Planning and Design

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AIRPORT COOPERATIVE RESEARCH PROGRAM

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FOREWORD

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ACRP Report 130: Guidebook for Airport Terminal Restroom Planning and Design provides a thoughtful, step-by-step process to help airport practitioners plan, design, and implement terminal restroom projects. The guidebook will be of interest to anyone whose goal is to meet customer expectations for airport restroom facilities. The guidebook effectively uses graphics, icons, and call-outs to help readers quickly find the guidance they need to develop airport restroom facilities that balance cost, aesthetics, space limitations, and day-to-day maintenance requirements.

Some of the most common issues for which airports receive customer comments relate to the convenience, location, design, and cleanliness of terminal restrooms. The unique considerations of airport terminal restrooms include continuous availability and operation, changing passenger demographics, evolving customer expectations, and greater space requirements to accommodate luggage and operational/maintenance needs. Although airports are paying greater attention to restroom facilities, there is a lack of airport-specific guidance for their planning and design. Research was therefore needed to develop guidance for planning and designing airport terminal restroom facilities that can be tailored to accommodate various activity levels and customer profiles.

The research, led by Alliiance, began with a review of current restroom planning and design resources. This was followed by gathering extensive input from key stakeholder groups, including travelers (with specific outreach to those with disabilities), airport staff (including operations managers and restroom cleaners), and product developers. Detailed case studies were conducted at ten airports of different sizes and activity levels to review recent layouts and designs. The research team then used their findings and expertise to develop this guidebook.

This guidebook's recommendations are presented in three sections: planning, design, and implementation. One innovative and broad-ranging recommendation in the planning section (Chapter 2) is for airports to form a "restroom team" consisting of representatives from key stakeholder groups. This team would not only lead restroom projects but also serve as a forum for addressing the occasional stakeholder conflicts that can arise. The design section (Chapter 3) features steps for evaluating options based on considerations for initial cost, life cycle cost, warranty, maintenance, and sustainability. In the implementation section (Chapter 4), the guidebook gives practitioners suggestions for project phasing, delivery methods, and maintaining standards for various products (e.g., fixtures and finishes).

The guidebook's appendixes, contained on the accompanying CD-ROM (except for Appendixes I and J), include the case studies, focus group summaries, helpful templates and forms, a discussion of the restroom of the future as well as a bibliography and glossary.

CONTENTS

SUMMARY

Guidebook for Airport Terminal Restroom Planning and Design

There is a change underway in the aviation industry. It is a grassroots movement and the passengers have spoken—through blogs, media articles, and surveys. Restrooms in airport terminals that have lines or are cramped, dirty, smelly, or ugly are no longer tolerable. A bus station aesthetic will not cut it with the rising cost of airfares. If travelers can have a massage and grab a coffee en route to their gate, they feel it reasonable to expect restrooms with a few touches of hospitality such as soft lighting, warm water, and calming music. Such small conveniences are an easy accommodation. However, the real challenge is for airports to provide space so that restrooms have room for people to move around and provide secure, clean, and dry places for their belongings. These are the most frequent complaints, and the industry is in catch-up mode.

The driving force behind the development of this guidebook is customer service. When people travel, few things dampen their experience more than confronting a barrier to fulfilling their needs. Airport terminal restrooms are used by the full diversity of humanity in terms of mobility, age, gender, and culture. The further an airport goes to accommodate this spectrum, the more likely a traveler will choose one hub over another. The sign graphic on the cover and the essay on the restroom of the future in Appendix I are symbolic of what should be the commitment to inclusive customer service of every airport—large or small, hub or origin and destination—where every person's restroom needs are reasonably satisfied.

This *Guidebook for Airport Terminal Restroom Planning and Design* fills a gap in aviation industry resources, providing airport managers and planning/design professionals the tools to embrace this change utilizing the following:

- Findings regarding the state of the industry based on literature review, surveys, focus groups, and case studies.
- Planning methods for evaluating existing restrooms to determine what is needed and prototypes to guide the development of a restroom master plan.
- Design guidance for different size airports and budgets to compare and prioritize restroom components and features including considerations for new construction/renovation and the benefits of standardization.
- Implementation strategies including construction impacts as well as post-construction review.

As this guidebook will demonstrate, restrooms that are successful find the balance between accommodating the needs and expectations of the traveler, the efficiency of airport operations, and the cost of building and managing these spaces. While aesthetics are important and certainly affect a traveler's perceptions of cleanliness and safety, function still rules. Trends in restroom design focus on touch-free environments, open entryways without doors,

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large-format materials with minimum joints, concealed trash, space for belongings, hand-drying options, and sustainability.

In the development of this guidebook, additional restroom-related scope was uncovered that includes lactation rooms, nursing mother lounges, pet relief areas, and shower facilities. This scope is not included herein but is anticipated to be the focus of a future guidebook.

This guidebook is not intended to provide definitive solutions. Every airport has a unique context and challenging issues. The ideas in this resource often conflict with each other and some will simply not be feasible due to restrictions in space and/or budget. Through research, case studies, focus groups, and surveys, the effort of the researchers has been to collect issues, considerations, and insights to allow the restroom team (representatives from all airport stakeholders and outside experts) to creatively navigate the decisions required to plan and design restrooms that are the best fit for their airport and its travelers.

CHAPTER 1

Introduction

1.1 How to Use This Guidebook

The task of planning and designing traveler-responsive restrooms is complicated. Nearly every expectation or requirement is in conflict with another. Adding enough space to maneuver in the toilet stall with a carry-on bag, for example, takes away potential income-generating square footage for concessions or hold rooms. But compressing the plumbing chase footprint to increase usable restroom area creates a hardship for the plumbers. Piecing together this puzzle requires more than just one or two facilities staff and an architect. It requires a team: the restroom team. Representatives of all airport stakeholders and outside experts must work together to prioritize customer accommodations so that planning and design is fiscally responsible and does not adversely compromise airport operations.

This guidebook is organized chronologically to follow the process that the restroom team navigates, from determining drivers and goals through post-construction evaluation.

Planning is the first of the three primary efforts in a restroom project. It is the walk-before-running stage. It is a big picture view of what the airport has and what it needs in terms of where restrooms should be located, how many fixtures are required, and how much space each location will need. It also considers timing—whether all restrooms will be completed at once or in phases. This is different from the design effort, which focuses on the quality of the components rather than the quantity.

Design balances the character of the spaces with the durability, maintenance of the materials, and facility operations. This requires prioritizing the most impactful components against cost and maintenance requirements. When the scope of the work to be done is finalized and documented, the implementation effort begins.

While relatively straightforward, the implementation, or construction, period is an opportunity to monitor which aspects of the design are difficult to build or obtain as well as refine details both for the project at hand and for future work. With the grand opening of the new restrooms comes the compilation of the restroom standard, which will streamline future restroom initiatives. Figure 1-1 illustrates the restroom development process and, in turn, the organization of this guidebook.

Extensive supporting forms and reference materials are located in the appendixes to streamline the primary content. Throughout this guidebook, the following icons have been used to highlight significant points of interest.

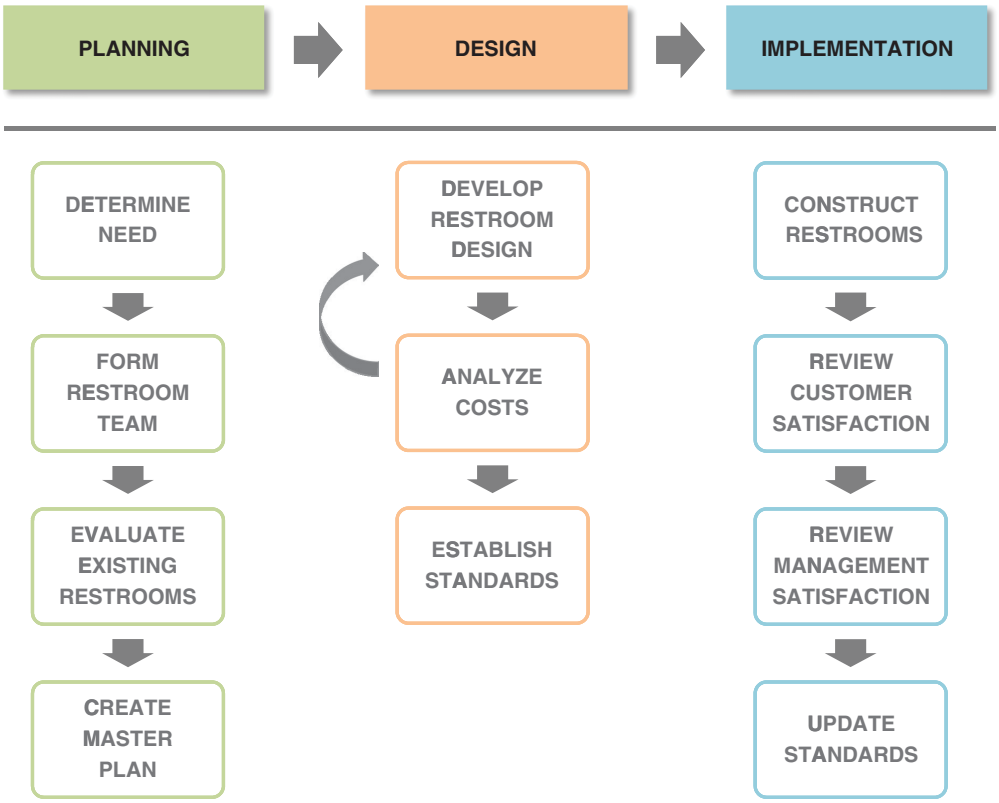

Figure 1-1. Restroom development process.


Significant Customer Service Impact


Accessibility


Sustainability


Product Development Opportunity


Potential Conflict with Other Needs

1.2 Research Approach

The development of this guidebook began with reviewing current resources available for the planning and design of restrooms, soliciting input from significant stakeholders—including the traveler and the airport management perspectives—and conducting case studies at airports of various sizes throughout the United States. In the process of studying the evolution of public restrooms and current trends in airport restroom design, the research team envisioned the Airport Restroom of the Future (Appendix I) to provoke contemplation and discussion.

With an understanding of the state of the industry, the team focused on developing comprehensive methods for evaluating an airport's current restroom facilities to determine an airport's actual needs. Building on this data, formulas and restroom layout prototypes were established to aid the restroom team in their development of a restroom master plan. Considering airports of different sizes, design considerations were developed to guide the process of selecting components by prioritizing such aspects as costs, maintenance, and sustainability. Guidance on the impacts of new construction versus renovations was also created. Finally, a process for evaluating the success of a restroom project was formulated to refine an airport's restroom standards for future projects.

1.3 State of the Industry

In 2008, Airport Interviewing & Research, Inc. conducted an extensive survey of airport travelers' restroom concerns and desires entitled "In Search of the Perfect Restroom." At that time, the top findings were as follows:

1. Concern about cleanliness and germs.
2. Concern about privacy.
3. Concern for security of personal belongings.
4. Expectations for convenience in terms of amenities and proximity.

Other comments included the desire of travelers with disabilities to have a restroom reserved for them so they do not have to wait for the accessible stall to be free, lack of clear signage, too small toilet stalls, intrusion of natural and fixture noises, poor ventilation, preferences for fixture features, inadequate lighting, and preferences for light colors and less or no grout joints that tend to show dirt.

The focus groups and surveys conducted for this guidebook confirmed that these issues remain. It was also confirmed that the airport industry is aware of the customer service issues, although perhaps not to the depth revealed in the above outreach efforts. Aviation industry surveys tend to lack enough detail related to restrooms for airport managers to fully appreciate the extent of their customers' concerns. The aim of this guidebook is to support the airport managers with this level of detail.

1.4 Attributes of Successful Airport Restrooms

Ideally, a visit to a restroom is one of many unremarkable daily tasks. Travelers are thinking about that sunny beach that awaits, the opening words of their big presentation, or seeing their kids after a month at the grandparents. The restroom should not jar travelers from their reverie. At most, they should pause as they enter the restroom and think, "Oh, isn't this pleasant." Public restrooms in airports often give travelers their first and last impression of their destination. No wonder the passenger's experience is so high on customer service surveys. In addition, restrooms are the one space in our built world that everyone has an opinion about, and the opinion is often an emotional one.

As this guidebook will demonstrate, restrooms that are successful find the balance between accommodating the needs and expectations of the traveler, the efficiency of airport operations, and the costs of building and managing these spaces. While aesthetics are important and certainly impact a traveler's perceptions of cleanliness and safety, function still rules. Toilets must work and be clean; dispensers need to have ample paper supply; there needs to be a clean, dry location to place belongings at the sink; and the soap dispensers have to work.

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Trends in restroom design focus on touch-free environments, open entryways without doors, large-format materials with minimal joints, concealed trash, alternative hand-drying options, and of course sustainability. This includes water- and energy-saving flush valves and faucets, energy-efficient lighting, and occupancy sensors. The biggest trend in the last decade has been on customer service, the primary driver for most of these initiatives and the impetus for this guidebook. Nearly every airport has some means of collecting travelers' comments—from old school suggestion boxes to social media. The key is to track the pulse of the airport's heart—its traveling public.

CHAPTER 2

Planning

2.1 Drivers and Goals

For the last five years, complaints to airports have been mounting. The most frequent comments from travelers are that the restrooms look filthy and dated, and there is always a line. Other comments include tiles are chipped and cracked; the grout is mop-water gray; and the toilet stalls are so small that passengers have to tango with their carry-ons to get the door closed, then use the bag to keep the door closed because the latch will not stay closed.

It is time for a change—not just a restroom facelift, but something impactful that will help bring back to airports the luster of air travel. Updating restrooms has become complicated. The rules have changed. ADA, TSA, every organization has a finger in the process. This section will help airport managers, planners, and designers navigate the first step of any restroom project: planning.

As with every capital improvement at an airport, there is a need that drives a project's initiation. These drivers might include the following:

- Change in airport vision/mission
- Customer service complaints
- A related project—new or renovation
- Change in operation (e.g., increased passengers)
- Security/safety issues
- Building code/accessibility compliance
- Sustainability master planning
- Aesthetics (typically dated finishes)
- Standardization
- Failing materials/products

Restroom projects are often incorporated into a larger renovation, expansion, or new building. Occasionally, however, an airport will decide to focus only on restrooms and bring them all to a consistent standard. Regardless, goals need to be developed to generate an architectural program. This document details types and sizes of spaces, quantity of each space and approximate locations, level of material quality, schedule, and budget. To get to this point, however, an assessment is required of the existing facility to understand the starting point.

Two independent efforts are required to assess the airport's existing restrooms. One is a physical survey of each restroom space to evaluate the current state of the restrooms by determining their age, condition, number of fixtures, critical dimensions, etc. This effort will document what the airport has.

A parallel effort is undertaken to calculate what the airport needs. This effort looks at the airport's passenger flow, which in turn quantifies how many fixtures are needed (and their

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distribution throughout the airport) to accommodate the calculated passenger load. Comparing these quantities with the surveyed quantities will determine how many fixtures and restrooms locations will need to be added and/or relocated.

Before either of these efforts is launched, however, a group of stakeholders needs to be assembled: the restroom team.

2.2 The Restroom Team

There is one attribute every member of this group will need for the process to succeed—a sense of humor. Besides the inevitable bathroom jokes, the process of designing airport restrooms brings often-conflicting regulations, must-have lists, and goals. Team members need to be resilient and open to compromise, then support the final program while remaining vigilant for potential future improvements and refinements.

From day one, the team should include every manager with a vested interest in the restroom's planning, implementation, and maintenance. From within the airport, this should include representatives from the following groups:

- Facilities/planning
- Customer service
- Carpentry
- Heating, ventilating, and air conditioning (HVAC)
- Plumbing
- Electrical
- Information systems
- Cleaners
- Airport police

Consulting experts should include the following:

- Aviation planners
- Architects
- Interior designers
- Mechanical engineers
- Electrical engineers
- Technology systems designers

Each individual on the team should be committed to the success of their airport's restrooms. Ideally a core group of members would meet periodically after the project's completion to assess customer service, maintenance, and operational issues and opportunities as these arise continually with changes in the travel market, general use/abuse of the restrooms, and innovations in products and services.

A key aspect of members' commitment is the broadening of their expertise. This involves an awareness of initiatives in restrooms at other airports as well as other public facilities, understanding the range of products and systems while monitoring new developments through relationships with manufacturers, and participating in relevant professional and industry organizations and conferences.

Eventually cost and schedule estimates of the design options will be needed, so one or more of the following (depending on the airport's procurement requirements) also should be involved:

- Cost estimator
- Construction manager

- General contractor
- Primary subcontractors

2.3 Existing Restroom Evaluation

With the restroom team in place, the easiest task to initiate, but also the most time intensive, is determination of the existing state of the airport's restrooms. This process involves going to each restroom and related space—janitor's closets, pipe chases, and associated storage rooms—and documenting the existing conditions for the following:

- Proximity to other airport functions
- Signage
- Surfaces
- Hardware
- Accessories
- Amenities
- Plumbing
- HVAC
- Power
- Lighting
- Technology
- Accessibility

A form for each of these categories is shown in Appendix B: Existing Restroom Evaluation Forms. Use the forms as a guide to create forms specific to the airport's restroom features. Ideally a representative from each of the departments responsible for the management or maintenance of a form's contents will conduct the survey. Forms should be updated over time as modifications are made to any space so there is always a current inventory. In addition to surveying the existing facility, it is suggested that the customer service data collection process is reviewed along with collected data from the last five years. The maintenance process should also be evaluated.

2.3.1 Customer Service Process

An important means of understanding how well restrooms are operating and being received is to offer travelers a way to communicate their comments. This can be as simple as a rack with comment cards and a box to deposit them. Technologies, however, continue to provide more streamlined and sustainable methods. Numerous airports provide a number to text or twitter comments and new restrooms at Singapore's Changi Airport provide a touch screen with a five-button scale, from happy (excellent) to sad (very poor), to rate the restroom experience.

The data from these sources are typically collected by the airport's customer service staff for monitoring. It is also beneficial to have digital format comments sent directly to the facilities groups so cleaners or maintenance crews can be immediately dispatched to take care of empty paper dispensers or clogged sinks.

There are also airport industry surveys, typically conducted annually, that address customer service issues for restrooms among other aspects of the terminal. Airports Council International (ACI) Airport Service Quality (ASQ) is currently the most broadly used.

If the airport does not implement some form of feedback collection, one or more of the previously mentioned options should be considered. When the need for changes to an airport's restrooms are being contemplated, external feedback is invaluable to confirm customer service

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issues. As the research team's surveys of travelers and airport managers revealed, there is often a disconnect between the perceptions of the two groups.

2.3.2 Maintenance Process

The survey of the existing restrooms provides an invaluable opportunity to interview maintenance crews to determine which products have not met expectations in terms of durability and ease of maintenance, and what procedures have proved to be inefficient or ineffective and should therefore be updated. What is the frequency and procedure for cleaning the restrooms? How do the trades monitor the need for repairs? Is there ample attic stock for quick fixes?

Numerous airports, both large and small, do a periodic walk-around with clip boards in hand to mark down any fixture or surface that needs attention. The Los Angeles International Airport (LAX) case study in Appendix C includes an example of the forms it uses for this purpose. Hartsfield–Jackson Atlanta International Airport (ATL) has a full-time cleaner assigned to each women's restroom to wipe up spills and keep paper stocked. Having a full-time attendant who manages a small number of restrooms eliminates the need to shut down a restroom for basic upkeep. Yet another airport keeps a strike team poised to clean any restroom immediately after a surge.

Regardless of the strategy, the key to an effective maintenance program is to have a restroom standard operating procedure (SOP) in place for all maintenance staff to reference. This helps ensure the expected level of quality control is maintained in areas of cleaning and repairs. The LAX case study in Appendix C includes its SOP for cleaning. SOPs should be reviewed annually to confirm that new products are included and that all customer service issues are being addressed.

2.4 Restroom Fixtures Needed

An important consideration before delving into calculating the size, location, and quantities of restrooms is the concept of level of service (LOS). The original measure of LOS, as developed by the International Air Transport Association (IATA), was to measure passenger flow through an airport. It takes into account the capacities of areas such as check-in, security checkpoints, hold rooms, etc. *ACRP Report 55: Passenger Level of Service and Spatial Planning for Airport Terminals* provides an overview of how LOS is applied to airport planning. Restroom sizes and locations, however, are not specifically addressed.

It is a subjective exercise to correlate LOS with airport restrooms and is outside the scope of this guidebook. Some guidelines can be suggested based on general assumptions. *ACRP Report 25: Airport Passenger Terminal Planning and Design* ventures into how passenger perception can influence LOS through the availability and cleanliness of restrooms. Building on that, it can be inferred that an airport striving for LOS A (excellent) versus LOS D (adequate) should provide well-appointed restrooms that provide most of the amenities recommended herein including adequate space for belongings and circulation, ample circulation space, accommodations for individuals with special needs, and highly maintained facilities.

The planning principles described in this chapter might be equated with LOS B (high). The recommendation is a high level of customer service with room for improvement if an airport strives to provide the highest levels of customer service. In terms of capacity, this means increasing the number of fixtures calculated in the following pages and the frequency of restroom locations.

To meet the projected passenger demand requirements, airport restroom sizes are typically calculated based on the portion of the terminal they serve. Airside, concourse, or secure (post-security) restrooms are calculated based on aircraft seat capacity. Landside, terminal, or non-secure (pre-security) restrooms are based on passenger peak hours and their expected visitors.

Keep in mind that landside and airside restrooms accommodate a different mix of users. While both are visited by travelers and airport employees, landside locations are also frequented by meeters and greeters as well as, in some airports, transportation chauffeurs. Generally speaking, outbound travelers tend to go through security before using the restroom to assess how much time they have before their flight. Likewise, inbound passengers tend to wait until they've landed to avoid the cramped aircraft restrooms. But then they need to go!

Based on comments from the research team's case studies and focus groups, the impact of these scenarios on terminal restrooms is that landside restrooms tend to get more abuse since they are used by a broader spectrum of the non-traveling public. Some comments suggested that these locations are more akin to subway station restrooms. While durability remains paramount, higher-end materials may not be as appreciated landside, thus allowing more of the overall budget to be diverted to the extra amenities of the airside restrooms described later in this chapter.

The following sections describe the fixture count calculation process for airside and landside loads. Note that areas within the airport that are not greatly influenced by passenger flow can rely on building requirements to determine the fixture counts.

2.4.1 Airside Calculations

Calculations for secure restroom locations are typically based on the types of aircraft serving the adjacent concourse. In order to provide reasonable walking distances from the gates, planning standards use the US FAA equivalent aircraft (EQA) factor to convert an existing gate size to an EQA.

1 EQA ≈ 145 Seats (typical narrowbody aircraft)

ACRP Report 25: Airport Passenger Terminal Planning and Design, Volume 1: Guidebook recommends providing one restroom module (one restroom for men and one for women) for every eight EQA. Depending on the fleet mix, this translates to one module centered on a reasonable number of gates (approximately four narrowbody gates on each side of a double-loaded concourse) where the farthest passenger's walk equates to approximately 450 feet.

Historical observations indicate deplaning (arriving) passengers produce the greatest demand for the concourse restroom locations. Because most passengers on short-haul domestic flights will wait to use the restroom facilities until arrival, it is important to provide adequate capacity to serve these arriving passengers. This is especially important where near simultaneous flights arriving on adjacent gates will produce a surge effect on the restrooms located nearby. Taking surges into account, the peak 20-minute arrival period of the peak arrival hour is a good indicator for calculating peak passenger capacity.

Observations also indicate that arriving passengers typically use the first restroom location they pass between their arrival gate and baggage claim or a connecting gate. Passenger behaviors suggest this is true even if queues are present and another location may be only a short distance away (passengers are likely uncertain how far away the next restroom is located). Due to these passenger tendencies, a good planning rule, as stated in *ACRP Report 25*, is to provide fewer restroom locations but with larger capacities. It is also recommended that restroom modules be placed adjacent to major concession nodes within airside concourses.

Today's restrooms should be designed for at least an equal split between women's and men's fixtures (toilets/urinals) as the trend of increasing female travelers continues (refer to Appendix E: Survey Summaries and Appendix H: Bibliography). However, it is recommended to provide 25 to 50 percent more fixtures for women than for men due to longer utilization time

and because female travelers typically bring children into the restroom, as voiced in the focus groups, and do not have the advantage of the quick turn-around provided by urinals for men (refer to Appendix I: Airport Restroom of the Future). A valuable exercise is to conduct usage surveys, especially at restrooms known to have lines, to understand passenger loads unique to concourse configuration, airline practices at gates such as high turn frequency, etc. Results may suggest an even higher female to male ratio at some locations within the airport.

Local building codes should always be consulted as well as airport authorities, who may mandate specific requirements. Keep in mind that building codes provide minimum requirements. To provide exceptional customer service, especially in larger hubs, code minimums have proven to be inadequate.

A family restroom should also be included in each module to provide a space for individuals, companions, or families with special needs (refer to Chapter 3: Design).

The following process can be used to determine the number of airside restroom modules and fixtures needed.

1. **Determine EQA Factor**

   Utilize Table 2-1 to determine the concourse EQA factor by multiplying the number of aircraft in each airplane design group (ADG) by the EQA Index. Sum all resulting EQA values to calculate the total EQA.

   Note: A general planning rule is to utilize the design aircraft for each gate. However it is important to understand wingtip adjacency conflicts, if any. Therefore, utilizing the largest aircraft able to use each gate, while producing no impacts to adjacent gates, will provide a good capacity estimate for the concourse.

   EXAMPLE:
   A concourse contains eight A320, two B757, and two B767. Therefore, based on Table 2-1:

8 (A320) × 1.0	8.0
2 (B757) × 1.3	2.6
2 (B767) × 1.9	3.8
Total EQA	**14.4**

2. **Determine Number of Modules**

   Divide the resulting EQA factor by eight. Generally rounding up will provide the appropriate number of locations. However, careful consideration to the concourse layout should be studied when determining the number of modules (e.g., single- vs. double-loaded concourses—see Figure 2-1).

Table 2-1. Equivalent aircraft index.

FAA AIRPLANE DESIGN GROUP (ADG)		TYPICAL SEATS	TYPICAL AIRCRAFT	EQA INDEX
I	Small Regional	25	Metro	0.2
II	Medium Regional	50	SF340/CRJ	0.4
III	Large Regional	75	DHC8/E175	0.5
III	Narrowbody	145	A320/B377/MD80	1.0
IIIa	B757 (winglets)	185	B757	1.3
IV	Widebody	280	B767/MD11	1.9
V	Jumbo	400	B747,777,787/A330,340	2.8
VI	Super Jumbo	525	A380/B747-8	3.6

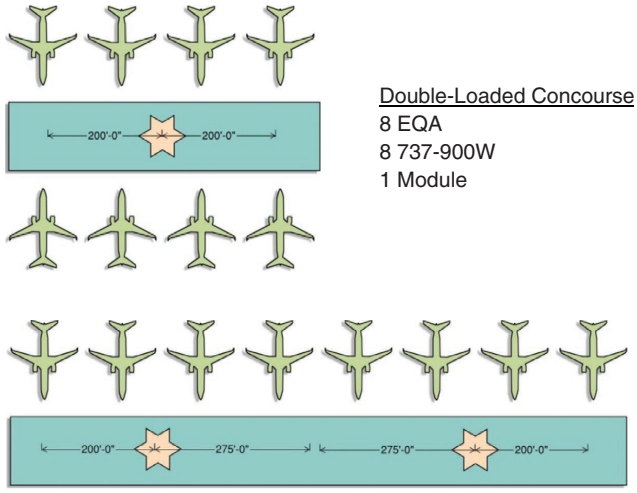

Figure 2-1. Locations based on concourse type.

3. **Determine Peak Passenger Capacity**

Peak passenger capacity (design passengers) is calculated using the following formula:

Design Passengers = EQA (value from Step 1) **× 145 Seats** (1.0 EQA) **× 90%** (load factor)

Note: Utilizing EQA seats will typically produce the greatest capacity scenario (all gates in use). However, this value should be compared and in some cases balanced against the design peak hour (typically calculated by the airport's planning consultant) to gauge effects on total calculated fixtures. It may be appropriate to adjust EQA seat values based on the expected fleet mix in use for each given airport.

For example, if the ADG III fleet mix expected to use the terminal is only 737-800 aircraft, seat capacity, depending on class configuration, can range from 160 to 185 seats. Load factor (LF) is based on latest industry planning standards and should be compared with factors unique to each airport.

Now use the design passenger capacity to determine passenger demand:

Peak 20-Minute Passenger Demand = Design Passengers × Peak 20-Minute %

Note: The following peak 20-minute % values are recommended:

- *Concourses with hub activity = 60%*
- *Concourses with origin and destination (O&D) activity = 50%*

In some cases an O&D airport's passenger activity may exhibit peaks consistent with hub-type operations. Therefore, the above values should be used as guidelines. It is recommended that peaking characteristics unique to each airport be utilized (typically obtained from the airport's master plan forecast data) and compared to these values.

Last, calculate the design factor, which will be used to determine the required fixture count.

Design Factor = Peak 20-Minute Passenger Demand × % Using Restrooms (utilization)

Note: The general utilization rate planning standard = 50% to 60%.

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4. **Determine Total Number of Men's and Women's Fixtures**

Since the quantity of women's fixtures can fluctuate, with a suggested minimum being equal to men's fixtures but potentially increasing based on the airport's customer service philosophy, the men's fixture count is used for base calculations. The men's recommended fixture count is determined as follows:

Men's Fixtures = Design Factor (from above) **× Male % ÷ 13**
(peak 20-minute male passengers per fixture ratio)

Note: When the passenger gender mix is unknown, assume a 50%/50% ratio. The peak 20-minute male passenger ratio is based on previous factors (load factor, gender split, peak 20-minute percentage, utilization percentage) and includes an average 1.5-minute male and 2-minute female dwell time at a fixture.

The women's recommended fixture count is determined as follows:

Women's Fixtures = Male Fixtures × Female Increase Factor

Note: Table 2-2 illustrates the resulting male/female ratios for typical female increase factors.

Table 2-2. Female increase factors for fixtures.

FEMALE INCREASE FACTOR	FEMALE/MALE FIXTURE % RATIO
1.25 (25%)	56%/44%
1.50 (50%)	60%/40%
2.00 (100%)	67%/33%

Finally the number of fixtures per module (determined in Step 2) is calculated. Each module is equivalent to a typical restroom set.

Fixtures/Module = Total Fixtures ÷ Total # of Locations

Table 2-3 lists typical *male* fixture ranges for EQA factors categorized by O&D or hub-type facilities, passenger utilization rates, and peak 20-minute percentage factors. Female increase factors can be utilized with this table to calculate the number of *female* fixtures.

Important: A fixture count of six per gender is the minimum recommendation to use for any facility type.

For non-hub facilities or concourses with limited activity, the fixture count should be compared against local building codes.

Table 2-3. Total number of male fixtures per EQA based on 50%/50% gender mix, 1.5-minute dwell (male), 2.0-minute dwell (female), 90% LF. Minimum six male fixtures for all airport classifications. Number of fixtures rounded.

		TOTAL MALE FIXTURES BY EQA			
		O&D		Hub	
Pax Utilization		50%	60%	50%	60%
Peak 20 min %		33% to 50%	33% to 50%	60%+	60%+
EQA	3.0	6	6	6	6-7
	4.0	6	6	6-8	7-9
	5.0	6	6-7	7-10	9-12
	6.0	6-7	6-9	9-12	11-14
	7.0	6-9	7-10	10-14	12-16
	8.0	**7-10**	**8-12**	**12-16**	**14-19**
	9.0	7-11	9-13	13-18	16-21
	10.0	8-12	10-15	15-20	18-24
	11.0	9-14	11-16	16-22	19-26
	12.0	10-15	12-18	18-24	21-28
	13.0	11-16	13-19	19-25	23-31
	14.0	11-17	14-21	21-27	25-33
	15.0	12-18	15-22	22-29	26-35
	16.0	13-20	16-24	24-31	28-38

2.4.2 Landside Calculations

Landside restrooms are typically located within the major terminal areas such as check-in, baggage claim, and concessions areas. Calculations are based on the total peak-hour O&D passenger demand (PHP) and the visitors of those passengers. One approach, as stated in *ACRP Report 25*, is to provide one fixture per gender for every 100 individuals; however, this factor is only one approach because many variables such as the terminal layout can influence this factor. Local building codes should be consulted as well as airport authorities who may mandate specific requirements.

Visitor ratios are typically provided with airport survey data, compiled by the airport or its planning consultant, and should be used to calculate the total visitor demand when available. However, if this information is unknown, an increase factor of 20 percent for well-wishers (WW) and 30 percent for meeters and greeters (M&G) is a typical industry-wide planning standard.

For terminal facilities with enplaning/deplaning passenger processing functions (such as check-in/baggage claim, respectively) on separate levels, utilizing the associated visitor ratios with their respective passenger processing functions is appropriate:

WW + enplaning passengers

and

M&G + deplaning passengers

For terminal facilities with both check-in and baggage claim functions on a single level, a visitor ratio, comprising the average of the WW and M&G ratios, may be more appropriate.

1. **Determine Design Passenger Demand**

   Multi-level Facility:

   Check-in:
   Design Demand = Total Enplaning (departing) **Peak-Hour O&D Passengers**
   × WW Ratio (e.g., 1.20)

   Baggage Claim:
   Design Demand = Total Deplaning (arriving) **Peak-Hour O&D Passengers**
   × M&G Ratio (e.g., 1.30)

   Single-Level Facility:

   Design Demand = Total O&D (enplaning/deplaning) **Peak-Hour Passengers**
   × Visitor Ratio (e.g., 1.25)

2. **Determine Number of Fixtures**

   Once the quantity of fixtures for males is determined, use the female increase factor used in the airside calculations.

   Total Male Fixtures = Design Demand ÷ Ratio

   Note: Ratio = 1 fixture per 70 PHP for first 400 passengers + 1 fixture per 200 PHP in excess of 400 passengers

   Total Women Fixtures = Total Male Fixtures × Female Increase Factor

Fixtures per location per level should then be distributed. One method is to distribute the required fixtures in direct proportion to each existing location's percentage of the total terminal fixture count (for a single-level facility) or each level's total fixture count (for a multi-level facility).

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However, this should be studied carefully as some locations may exhibit lines during peak passenger demand. As a result a higher percentage distribution for those areas may be required.

For terminals with integrated multi-modal ground transportation centers (GTCs)—such as taxi, limousine, rail—a ground access or curb-front survey would provide valuable passenger modal splits. This information could then be used to identify the appropriate passenger demand for those enplaning passengers that are dropped off at the curb thereby reducing the actual demand placed on the restroom facilities located in the check-in hall. Enplaning passengers utilizing the GTC, depending on location, should have access to restroom facilities prior to arriving in the check-in hall.

Restrooms should be located in proximity to the major passenger processing functions such as check-in, baggage claim, security screening, meeter/greeter areas, GTC locations, and major landside concessions nodes. Locations should also be visible from the major passenger flows.

2.5 Prototypes

Whether for new construction or renovation, prototypes provide building blocks that allow the airport's restroom team to develop a master plan for locating public restroom modules throughout an airport terminal over a specific period of time. In the preceding process of evaluating the airport's restroom needs, the planning formulas provided the number of fixtures needed to accommodate the anticipated passenger demand. How do those numbers translate into actual physical space requirements?

In traditional airport planning, restroom blocks were assigned a square footage based on broad planning formulas and rules of thumb. Also by tradition, restrooms have been near the bottom of the priority list. Thus, a 1,500-square-foot rectangle would likely be stretched or compressed to fit the odd-sized spaces leftover from the primary terminal planning exercise. As airport designers and managers routinely discover in their renovations, these spaces rarely function well with today's toilet stall or circulation space requirements. The result is cramped restrooms spaces that have inconvenient columns, impractical utility chases, etc.

Sections 2.5.2 and 2.5.3 provide not just a base square footage for two prototype restroom plans, but also appropriate dimensions to efficiently streamline the planning process. Through case studies and professional experience, the research team has observed that nearly all public airport restrooms are based on one of two layout plans—the room plan (Section 2.5.2), which has the sink and toilet areas distinctly separated, or the galley plan (Section 2.5.3), which lines up toilets and urinals on one side of the circulation aisle and sinks on the other. Both are relatively equal in size, though each has particular advantages and disadvantages that will be highlighted in the coming pages. These two prototypes work for any size hub or O&D airport and can be modified to accommodate any airport's unique terminal layouts though space proportions may dictate one prototype plan over the other. It is not uncommon for a restroom team to develop two or three basic prototype variations for their airport.

Sections 2.5.2 and 2.5.3 show the basic plan layout of the room and galley prototypes, respectively, with three-dimensional images to illustrate how the proposed components might appear in practice.

To enable complete understanding of the space requirements of the restroom components, Section 2.5.1 studies each of the following spatial components to provide recommended sizing and configurations:

- Entry area
- Sink area

- Baby diaper changing area
- Toilet stall
- Wheelchair-accessible stall
- Urinal area
- Family room
- Plumbing chase
- Janitor's closet/storage

Section 2.5.5 presents additional diagrams that indicate locations of the following restroom elements:

- Spatial components
- Amenities
- Signage
- Accessories
- HVAC
- Lighting
- Power
- Technology

2.5.1 Spatial Components

Entry Area

The entry, as with other circulation within the restroom, needs to accommodate two-way traffic for passengers with luggage, in wheelchairs, pushing strollers, etc. A clear width of six feet six inches is a reasonable minimum. Seven feet is preferred. Avoid locating anything in the entry corridor that will cause a bottleneck such as information signs and drinking fountains. Designers should ensure that there are no sightlines into the restroom from the external public spaces, paying special attention to reflective surfaces and materials.

Sink Area

The most functional arrangement of sinks is a pair separated by a drying station that consists of a paper towel dispenser, a hand dryer (if used), and a trash receptacle. This locates each sink position next to a place to dry, thus eliminating dripping water across the floor to a remote station. While a drying station may be flanked by a sink on each side, drying time is comparably shorter than washing so conflicts should be minimal.

It is desirable to have a shelf behind the sink to place belongings while washing and drying. The shelf should be slightly higher than the sink top to remain dry but no higher than the bottom of the mirror, which ANSI A117.1-2003 requires to be 40 inches from the floor to the reflective surface. The depth should be 8 to 12 inches deep for purses, bags, hats, folders, etc.

Traditionally, sinks and sink tops have been approximately 24 inches deep. This seems to be a standard based on residential kitchen counters and commercial break room millwork that uses up valuable floor space without benefit. If a shelf is provided, as recommended previously, a reach beyond the 24-inch sink depth is not possible for persons with mobility impairments. Even reaching a faucet with this sink depth can be difficult for children much less travelers with impaired reach.

Child-steps have become more common, especially in older restrooms where the typical counter is 36 inches high and 24 inches deep. Typical child-steps are fold-down models, which while well-intentioned, make those sink positions non-accessible and the floor-bolted mounting creates a cleaning obstacle.

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Paper Towels vs. Hand Dryers

A clear outcome from the focus groups and surveys (see Appendixes D and E) is that people are not enamored with hand dryers: they are loud, especially in a restroom with several, and can have issues with bacteria and dripping water; some users are reluctant to insert their hands into a narrow slot; they are awkward to reach for the mobility impaired and have been known to seize hearing-aids at certain frequencies leaving the user "deaf" for several minutes afterwards. Research mentioned in Appendix H also questions the "green" advantage of hand dryers over paper towels.

A current trend is the development of a variety of hand dryer styles with lower sound levels, more open hand access, easier maintenance, and other features that are attempting to address customer concerns. Clearly this is a technology in transition. Whether hand dryers are at a stage of development that meets customer and maintenance needs is something the restroom team will have to decide.

ANSI A117.1-2003 requires that in restrooms with six or more sinks, at least one sink is to have an "enhanced reach range." This means that the point where controls or sensors for water and soap are activated cannot be more than 11 inches back from the front edge of the counter and/or sink. The recommended sink depth to accommodate these requirements is 20 inches from the face of the raised shelf.

The drying station should have a paper towel dispenser and trash receptacle. For the time being, paper towels will always be needed to wipe chocolate off a child's (or adult's!) face, clean up spills, etc. Hand dryers are an optional add-on, though their desirability is currently in question (see sidebar). If used, hand dryers should also be located next to the sink. This presents a design challenge in that these three components vie for the same space. The recent innovation of providing the hand dryer on the sink, either as part of the faucet or as a stand-alone device alongside the faucet and soap dispenser, is a promising trend in that it simplifies the dispenser–hand dryer–trash configuration. If trash is collected in containers hidden from view, allow space for access to empty the trash. While it may seem desirable to empty trash from the pipe chase, the cleaners do not favor this since it requires entry into another space, which reduces their efficiency.

Baby Diaper Changing Area

The changing table should be located in a private corner of the restroom, out of the primary circulation path if possible. Locating the changing table in the entry area is to be avoided so the person changing the infant is not on display and people entering the restroom are not greeted with an unpleasant sensory experience. Also the changing table should not be located in the accessible stall as the use of the changing table would preclude use of the toilet and vice versa. Future codes appear poised to not allow this arrangement. It is recommended that the changing station have its own sink or be within easy reach.

Toilet Stall

With an in-swinging stall door, travelers have to maneuver around their carry-on, the open door, and the toilet to enter the stall and operate the door. While out-swinging stall doors allow the possibility of stall doors being opened into passersby, their benefits outweigh this hazard by

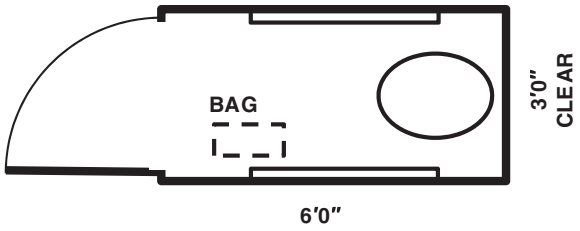


Figure 2-2. Typical (ambulatory) stall layout.

providing a clear space for individuals to maneuver themselves and their belongings with the door in any position. Having the resting position of stall doors be a position that is a few inches open allows users to readily see if the stall is occupied. Such a practice would eliminate the need for "occupied/vacant" indicators, many of which are problematic because they use the colors red and green, respectively, which prohibits those who are color-blind from deciphering the indicator.

With the growth of our aging population, it is recommended that every typical stall is set up as an ambulatory stall (Figure 2-2). The International Building Code requires that, in any restroom with six or more toilets/urinals (both prototypes herein fall under this requirement), one shall be an ambulatory stall in addition to the required wheelchair-accessible compartment. An ambulatory stall has grab bars on both sides to provide assistance for those with impaired mobility such as the elderly, someone with a broken leg, stroke victims, etc. It is also recommended that a vertical grab bar, similar to that required in the accessible stall, be provided on both sides to help a person pull themselves up or ease themselves down.

ANSI A117.1 requires an ambulatory stall to have a clear width of three feet and clear length of five feet. With an extra foot in length for a carry-on, this is a perfect size for airport stalls. In addition, this is the same depth as the accessible stall (see Figure 2-3), which simplifies restroom layouts.

Wheelchair-Accessible Stall

The International Building Code requires every public restroom to have a wheelchair-accessible compartment. This compartment requires a space large enough for a person in a wheelchair to turn completely around, typically a five-foot-diameter circle. The code has allowances for overlap

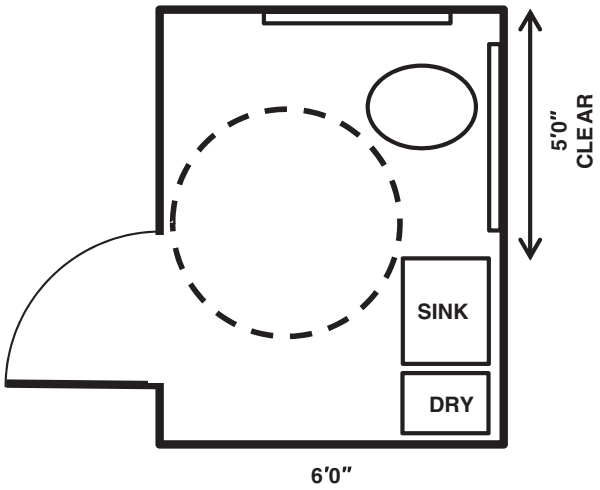


Figure 2-3. Wheelchair-accessible stall layout.

with fixtures (but usually not doors) and some jurisdictions have a modification if there is an open gap below the stall partition versus a partition to the floor.

The prototype shows a sink area within the wheelchair-accessible stall. In the prevalent arrangement where the person has to leave the accessible stall to wash and dry their hands, the wheelchair user has to touch their wheels and the door hardware on the way. This creates a potentially humiliating experience that is unhygienic both for the user and future occupants of the stall.

Urinal Area

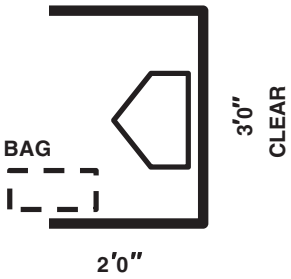


Figure 2-4. Typical urinal layout.

Security and privacy are a primary consideration for urinals. It is recommended to provide a three-feet-wide space at the urinal to match the width of the recommended toilet stall to provide a common fixture module for laying out restrooms. More important, it provides floor space for travelers' carry-ons so they are to the side rather than behind the person (Figure 2-4).

For wall-hung urinal screens, the maximum depth recommended by partition manufacturers is 18 inches. However, a minimum 24-inch depth is recommended to keep carry-ons within users' peripheral view. Deeper is better. End support pilasters that match the stall pilasters should be provided to support this depth. The height of the urinal screen should match the height of the stall side panels, both for aesthetic continuity and additional privacy.

Family Room

The family room is similar in layout to the wheelchair-accessible stall except that a divider is placed between the toilet and sink area. This provides privacy for the person using the toilet if traveling with a companion, children, etc. (See "room" and "galley" prototypes in Sections 2.5.2 and 2.5.3). There should also be space for baby diaper changing. As indicated previously, the changing area should be located adjacent to the sink and paper towels. Providing a fold-down child seat is an option appreciated by those traveling with energetic toddlers, especially if sightlines are blocked for privacy.

Plumbing Chase

For a plumbing chase to be usable, it needs to be at least wide enough for a person to comfortably move around and work. It is recommended that the chase (and access door) is wide enough to wheel in the plumber's tool cart after the installation of the pipes. The TSA does not permit tools to be left unsupervised in public areas. With narrow plumbing chases, additional maintenance staff is required to unproductively watch the tools while another works within the chase.

Larger chases should be considered when piping is on both sides. Organize piping and conduits in the chase as tight to walls as possible. Access to pipe chases should be from public corridors or concourses so that maintenance staff of the opposite gender of the restroom does not encounter an awkward situation.

Janitor's Closet/Storage

A janitor's closet should provide space for a mop sink, hose bibb, and related tools. This is also a good location for soap reservoirs if this type of soap dispensing system is utilized. Some airports provide a central storage space for paper stock and cleaning supplies. In larger airports the travel distance can become inefficient so verify with the cleaning managers their preference and the size and quantity of shelving required for storage if located within the restroom block. If janitorial and storage functions are co-located, verify also with the plumbing and cleaning managers if there is a need to provide a segregated and locked space for each trade. This is typically done with chain-link fencing.

2.5.2 Room Prototype

The room prototype layout separates the toilet and washing functions into "rooms" (see Figure 2-5). It requires a little more space than the galley prototype (Section 2.5.3) but tends to feel less congested because occupants are not traversing the main circulation path when moving between the toilets and sinks. For this reason, this prototype is preferred over the galley plan whenever feasible. This layout expands easily by adding opposing pairs of stalls and sink pairs.

Another feature of this layout is the potential for a "grooming" area that greets travelers as they turn into the restroom proper from the entry (Figures 2-6 through 2-8). This buffer adds a welcoming, hospitable feel to the space and works well for people who just need to quickly wash their hands. Other options for this space are an art wall or another sink grouping. A baby diaper changing table is discouraged here as noted previously.

Variations of the room prototype are used at ATL, Dallas/Fort Worth International Airport (DFW), Long Beach Airport (LGB), and Jackson Hole Airport (JAC) as discussed in Appendix C: Case Studies.

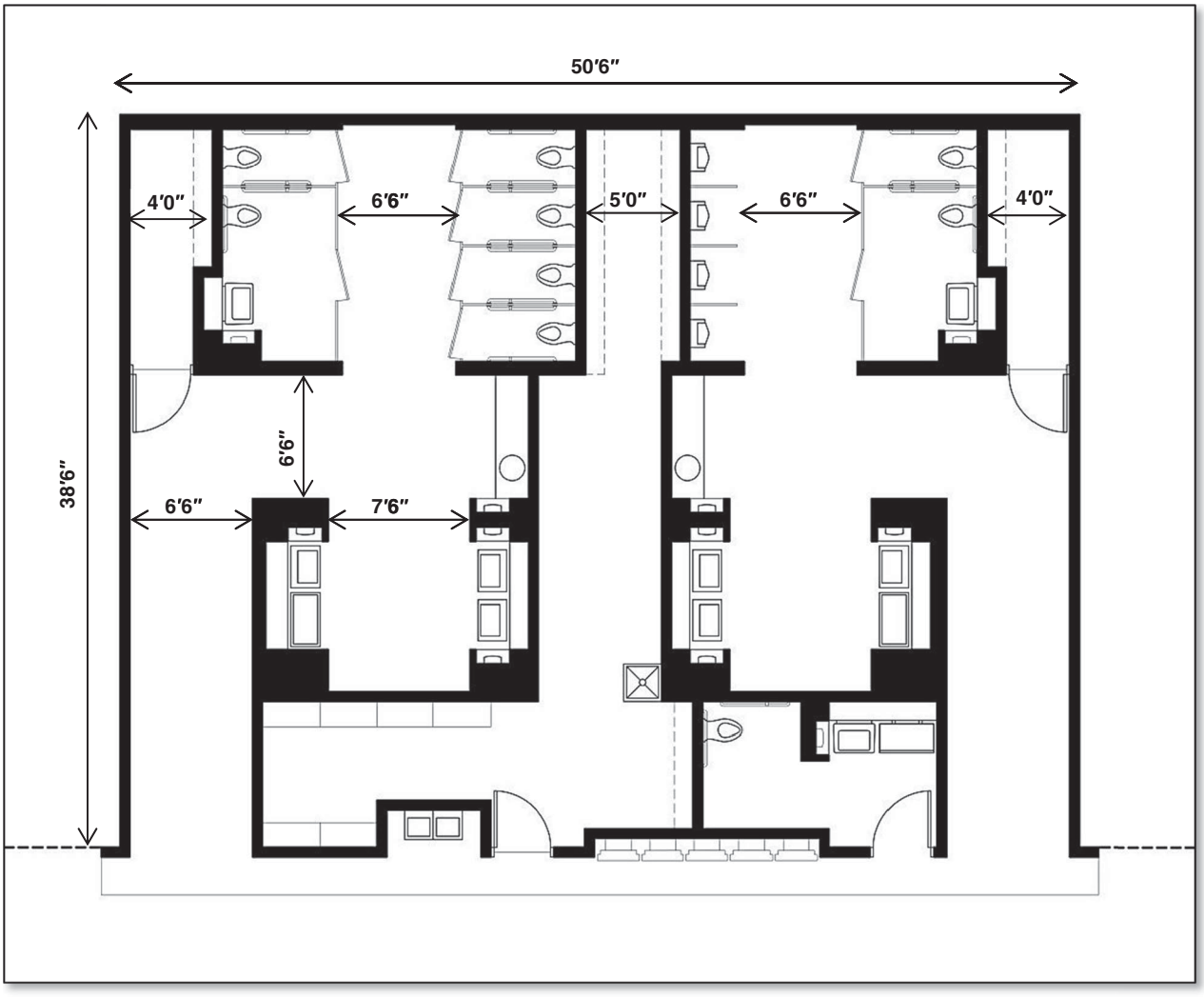


Figure 2-5. Room prototype layout—1,950 square feet (approximately 160 square feet per fixture).

Figure 2-6. Room prototype—view toward entry.

Figure 2-7. Room prototype—view toward grooming area.

Figure 2-8. Room prototype—view toward entry.

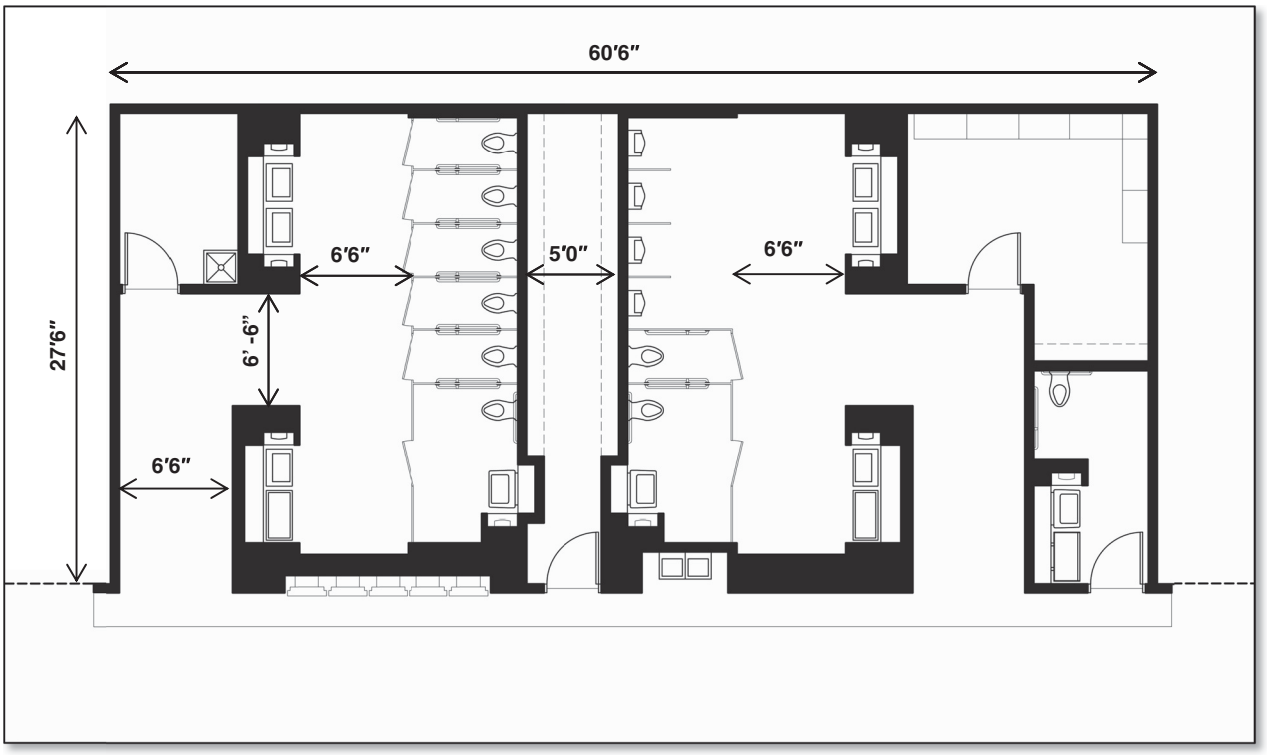


Figure 2-9. Galley prototype layout—1,650 square feet (approximately 138 square feet per fixture).

2.5.3 Galley Prototype

The "galley" layout is a more efficient plan, spatially (Figures 2-9 through 2-11). The toilets and urinals stretch along one side of the circulation space and the sinks line the other. A set of men's and women's restrooms can share a single plumbing chase. As the restroom expands to more than two sink groups and a baby diaper changing table group, the width of circulation space should be increased to seven feet six inches to accommodate the extra traffic. The accessible stall and changing table remain on the shorter, quieter end of the restroom in expanded versions.

Figure 2-10. Galley prototype—view toward entry.

Figure 2-11. Galley prototype—view toward grooming area.

One drawback with this type of layout is that entry is directly into the stalls and urinals. This condition can be remedied by eliminating two or three stalls and creating a blank wall for art or grooming alcove similar to the room prototype. This enhancement requires more floor area, however, using slightly more floor area than the preferred room prototype.

Variations of the galley prototype are used at LAX, Minneapolis–Saint Paul International Airport (MSP), Sacramento International Airport (SMF), John Wayne Airport (SNA), Blue Grass Airport (LEX), and Duluth International Airport (DLH) as discussed in Appendix C: Case Studies.

2.5.4 Prototype Expansion

The room and galley prototypes in Figures 2-12 and 2-13 are shown with the preferred minimum restroom size and gender mix of six fixtures per gender determined in Section 2.4. Figures 2-14 and 2-15 show how both prototypes can expand for larger fixture counts. The dashed stalls and sinks show the recommended expansion grouping to keep the fixtures/sink balance. The recommended mix is two stalls or urinals for each sink station.

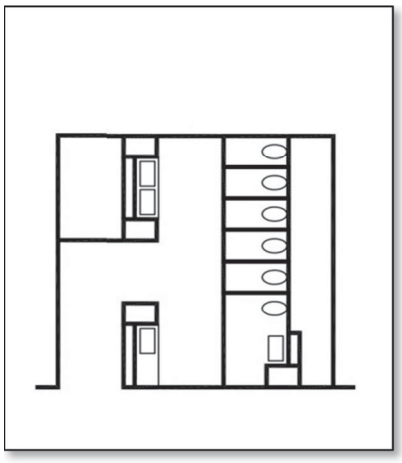


Figure 2-12. Basic galley prototype.

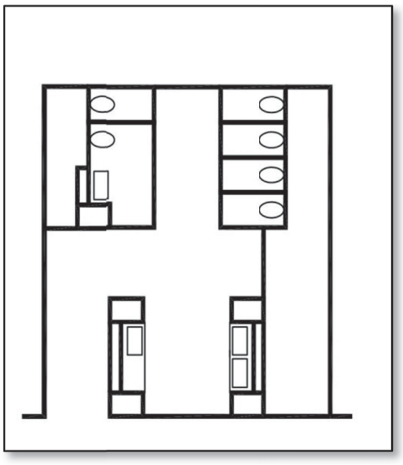


Figure 2-13. Basic room prototype.

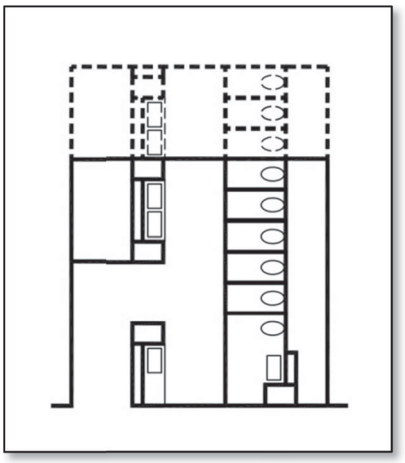


Figure 2-14. Expanded galley prototype.

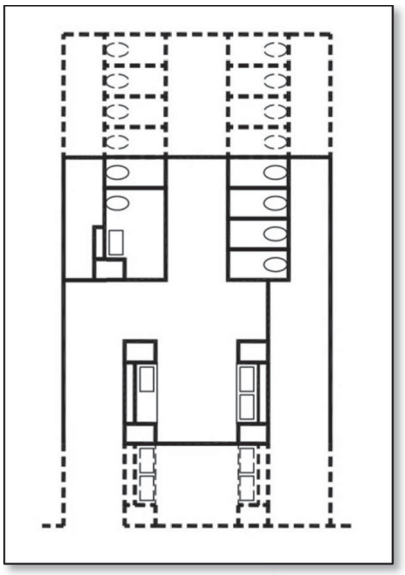


Figure 2-15. Expanded room prototype.

Many airports have a column bay spacing of approximately 30 × 30 feet so a typical concourse might be three bays wide. This limits expansion outward. However, a variation of the prototype might expand the restroom along the concourse length. Alternatively, a larger restroom block might have a pair of women's and men's restrooms grouped together. This arrangement facilitates cleaning by closing down only half a gender's restroom in a given location. The drawback is that if both gender sets are open it may be unclear if one is full. This can lead to customer frustration. A technology that monitors and indicates stall occupancy with an electronic sign at the restroom entry would alleviate this.

2.5.5 Restroom Elements

The placement of the following restroom elements needs careful consideration to maximize their effectiveness by providing travelers what they need in intuitive locations:

- Spatial components from Section 2.5.1
- Amenities
- Signage
- Accessories
- HVAC
- Lighting
- Power
- Technology

Figures 2-16 through 2-24 diagram the recommended placement for each of these elements as well as provide considerations unique to the components. The diagrams are based on the room prototype. However, the placement would apply similarly to the galley prototype as well.

2.6 Master Planning

With the count of existing restroom fixtures and locations in hand along with the required counts and locations calculated in the previous section for both current passenger loads and future projections, a master plan can be developed. The master plan document is an effective

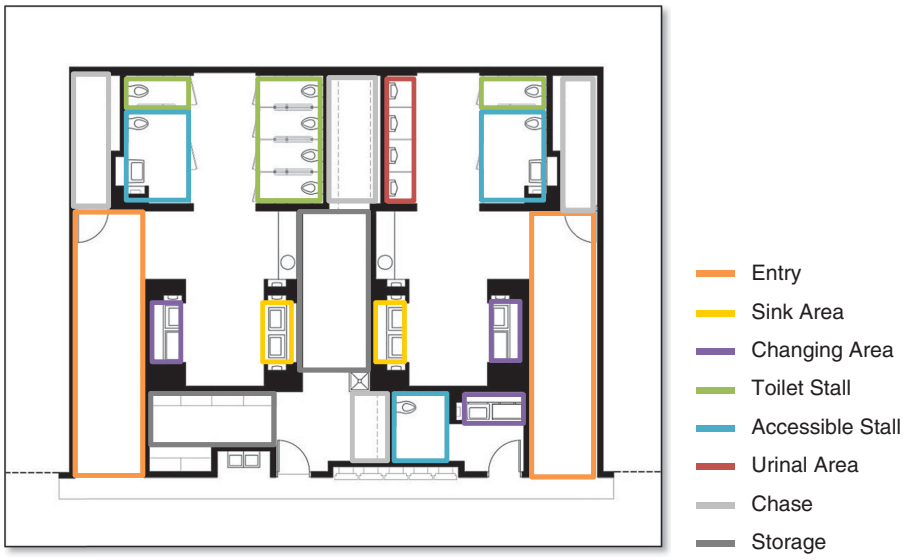
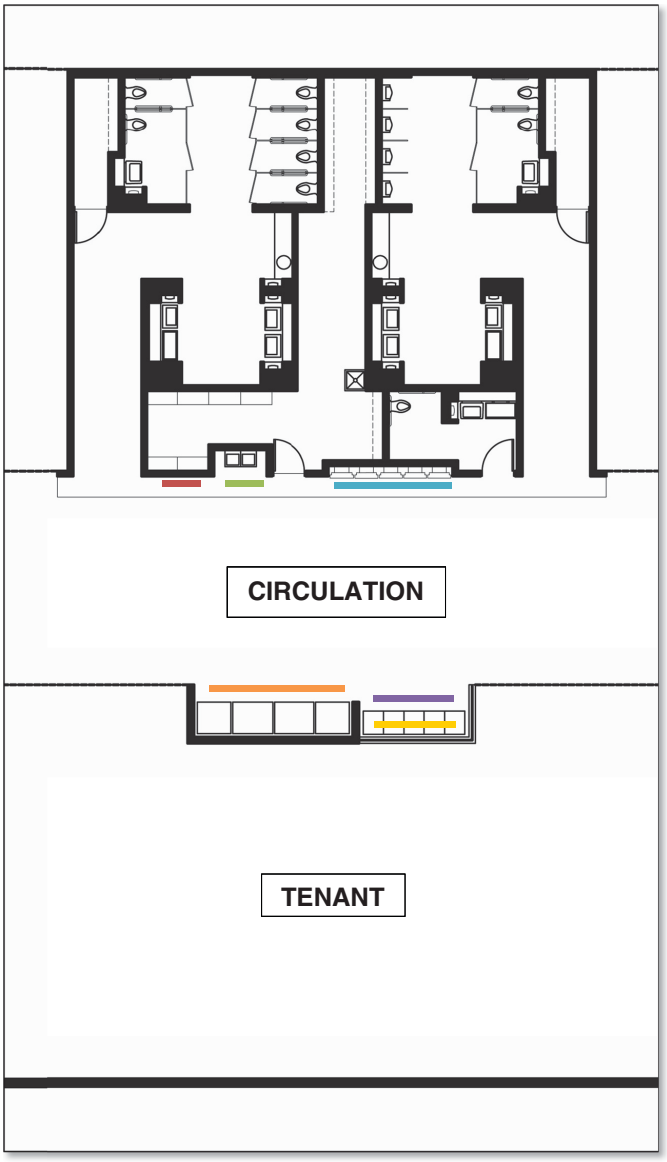


Figure 2-16. Spatial components arrangement.



Co-locate common-use items, like a flight information display system (FIDS) and automated external defibrillator (AED), with restrooms to create an amenity and information hub. Items can be grouped together or separated depending on wall/space availability on both sides of the circulation area. Tenant space might be used for a holdroom, retail, office spaces, etc.

Vending
Power / Charging Station
Waiting
Drinking Fountain
FIDS
AED / Fire Extinguisher / Emergency Phone

Figure 2-17. External amenity locations.

Figure 2-18. Internal amenity locations.

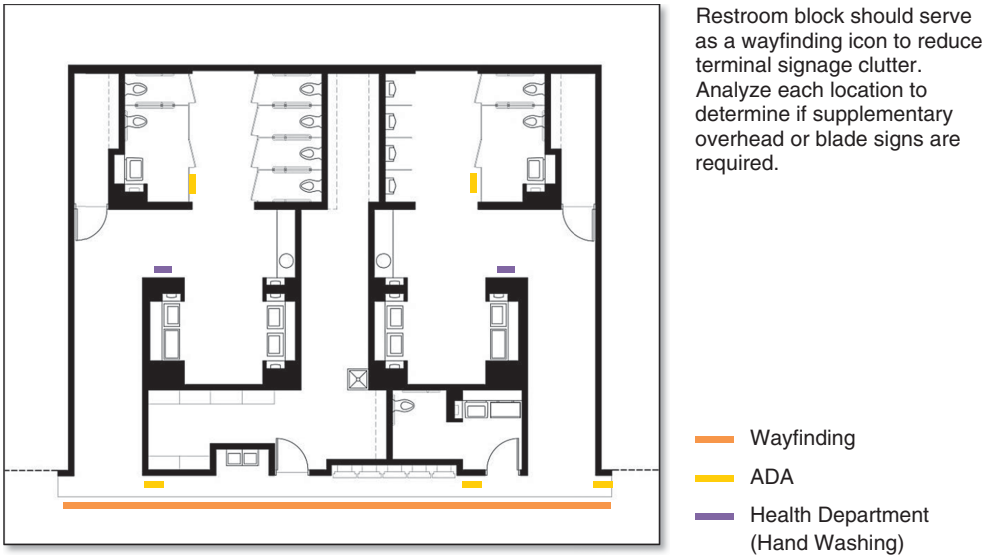
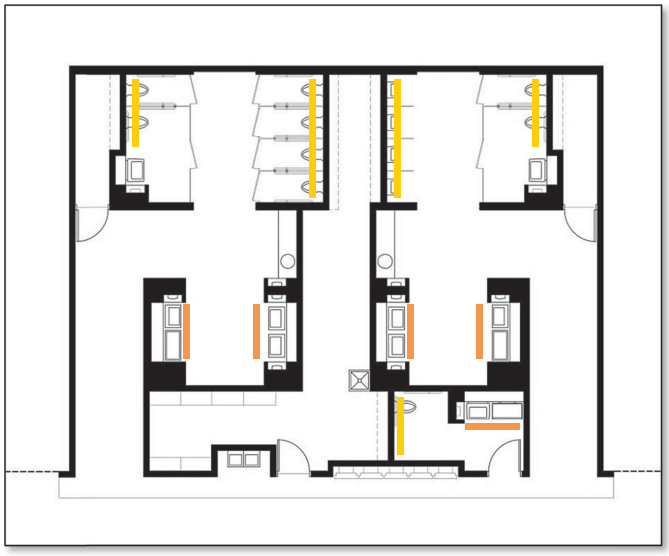


Figure 2-19. Signage locations.

Provide recessed accessories wherever possible to reduce surfaces requiring cleaning, to minimize potential corners to bump into, and to streamline restroom appearance.

- Mirror
- Toilet Paper / Disposal
- Seat Paper Dispenser
- Paper Towels / Trash
- Biohazard Disposal
- Sanitary Products Vendor
- Utility Shelf / Rack

Figure 2-20. Accessory locations.



Supplying warm air from vents under sinks helps to dry wet floors quickly. Locating exhaust vents above toilets will draw out air supplied from low vents and quickly pull out odors.

Note: Providing supply air under sinks requires a thicker wall to accommodate insulated ductwork.

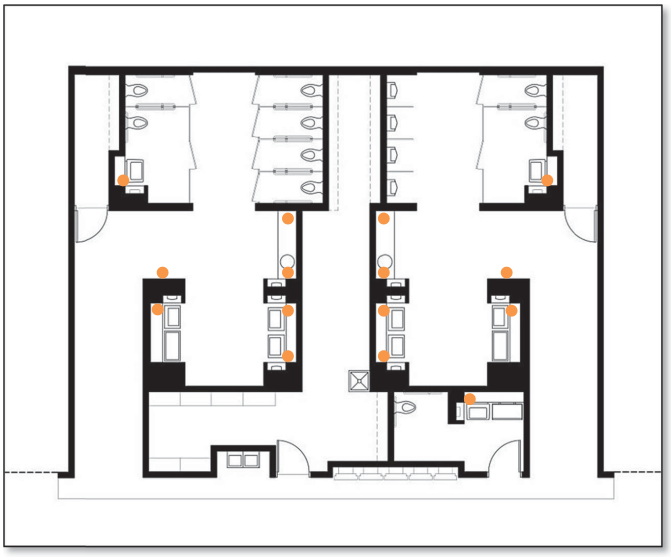
- Air Supply (Low)
- Exhaust (High)

Figure 2-21. HVAC locations.

Wall lights provide even ambient light and minimize fixture clutter on ceilings. Side-lighting at mirrors illuminates faces without shadows. A downlight in each stall eliminates shadows from light panels behind occupants. Lighting at restroom exterior should complement lighting concept of the surrounding public space.

- Lighted Panels
- Recessed Downlight
- Mirror Light
- Utility Light
- Motion Detector

Figure 2-22. Lighting locations.



A receptacle at each sink allows use of a shaver or hair dryer. Provide central receptacle for cleaning equipment. Coordinate power requirements in chase and storage spaces with equipment and airport needs.

- Duplex Receptacle

Figure 2-23. Power locations.

Figure 2-24. Technology locations.

communication tool for a variety of audiences from airport executives and authorities to the public. It is a living document that is expected to be modified over the years as air travel is an ever changing industry. At minimum, the document should be updated with the completion of every restroom project. Otherwise, following the updating schedule of the overall airport master plan is good practice. Although not a requirement, airport master plans are typically updated every five to ten years or as needs warrant.

2.6.1 Catchment Zones

An important relationship to understand when developing a master plan is the zone each restroom serves. Figure 2-25 shows the exterior catchment zone that each restroom location, represented by a red star, serves. The exterior zones consist of the number of gates for each location. This relates directly to the airside calculations in Section 2.4.1. These zones will likely change in ten years or more as the fleet mix changes or the concourse is modified. Both of these scenarios would be known from the airport's master plan and the restroom locations should be planned to ultimately serve the projected conditions.

The interior catchment zones are equally important to delineate. It is more complex because other amenities are added to the mix such as stores, food courts, rental car desks, etc. Interior zones occur on both the airside and landside as seen in Figure 2-26. In this example, the zones and corresponding restrooms are given a number. Zones served by multiple restrooms use a letter suffix to indicate this.

Because some areas of airports have convoluted passenger flows, periods of on-site observation may be required to see which restrooms travelers typically go to from these points. Here too, restroom locations should be planned with an eye toward future zones.

2.6.2 Master Plan

For renovations, a useful master plan superimposes the proposed restroom locations over the existing restroom distribution. Figure 2-27 shows a page from an airport-wide master plan document. In the center it lists the existing, required, and proposed fixture counts for the entire concourse.

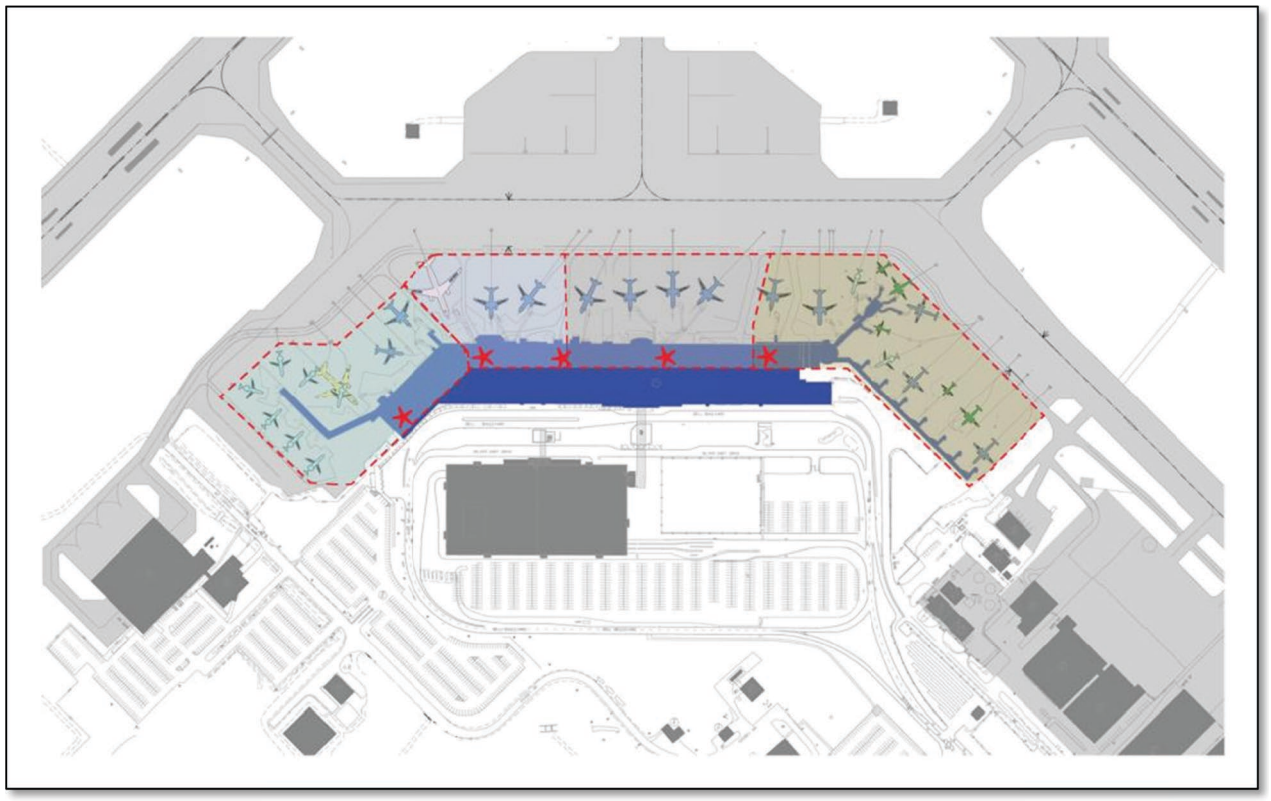


Figure 2-25. Exterior catchment zones. Red stars represent restroom locations.

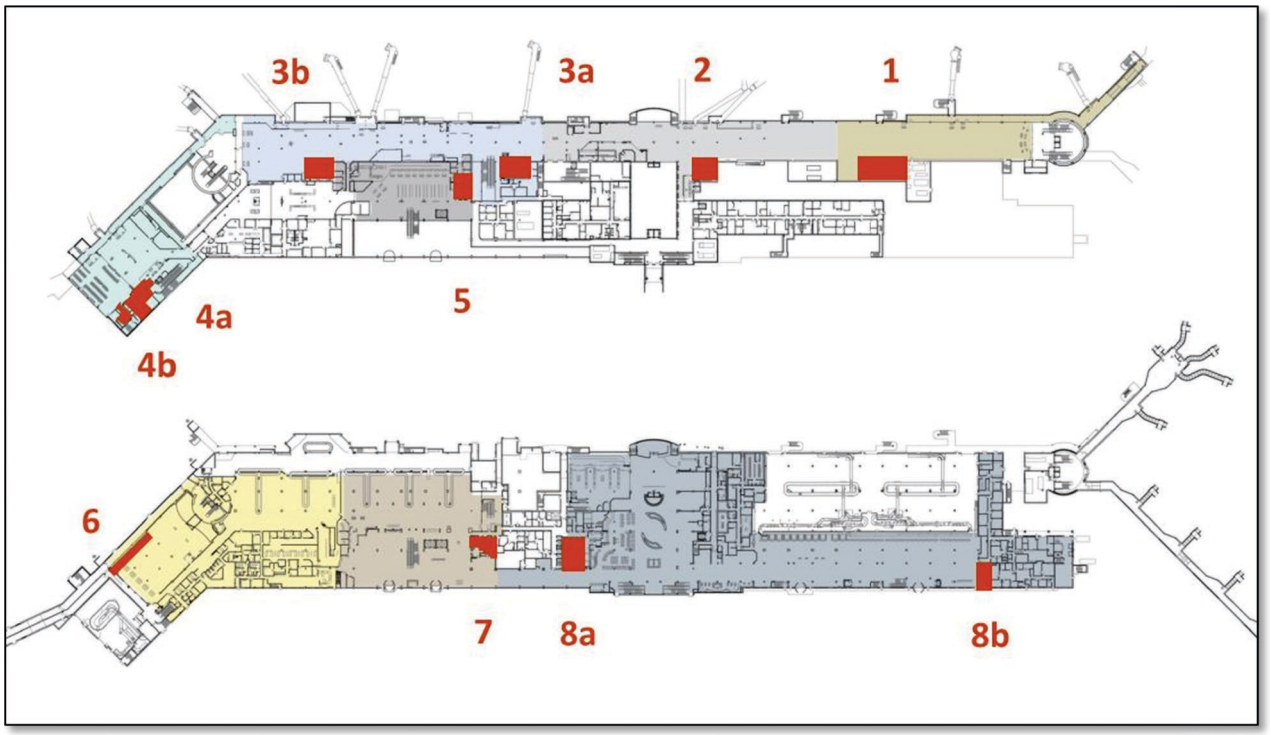


Figure 2-26. Interior catchment zones. Restroom sets shown as red blocks.

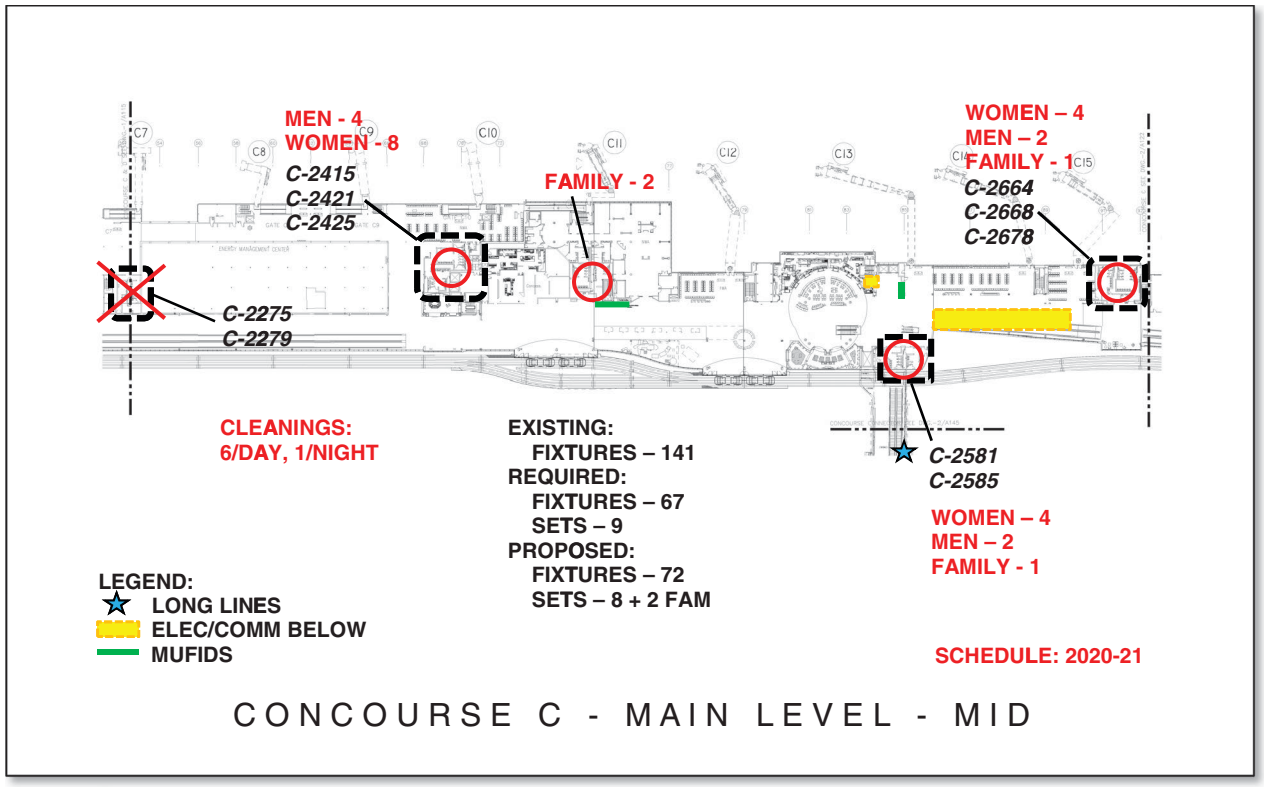


Figure 2-27. Partial concourse master plan.

For this section of the concourse, the plan shows a dashed black box around the existing restroom locations along with the room numbers, which ties in to the evaluation forms described in Section 2.3 of this guidebook. The red circles indicate the proposed restroom locations with the fixture counts in red. Most of the locations are renovations, but there is one new location and one that is being eliminated. The plan also shows the proposed timing of the restroom projects in this area. This part of the concourse is relatively new so the restroom work is about five years into the future.

The document also captures particular issues of interest for the airport, including locations that typically have long lines (there is one here) and the frequency of cleaning throughout the day. Compared to other areas of the airport, this number is high so this is a comparatively busy concourse. The airport has concerns about restrooms located over electrical and communication rooms in the event of leaks in the restrooms. This plan indicates the location of these spaces on the level below.

The restroom team at this airport developed the concept of creating an information hub at each restroom so travelers will learn over time that certain amenities are co-located. One aspect of this hub is the multi-user flight information display system (MUFIDS), which persons can peruse while waiting for traveling companion(s) using the restrooms. This plan shows where existing MUFIDSs are located that would ultimately be relocated to new restroom locations.

One planning strategy to consider when the number of women's fixtures is greater than the men's is to locate the family room in front of the men's restroom to balance out the two sides. Also consider, for larger restroom blocks, dividing the restroom into two halves so one-half can be closed down at a time. This eliminates losing an entire gender's restroom in an area. Note that it is difficult for maintenance staff to shut down one side of the restroom without actually entering the restroom. This can be an issue if staff is of the opposite gender.

2.7 Renovation Versus New

An important consideration in the master planning process is to evaluate the pros and cons of renovating a restroom versus relocating it, or building new. The last option is easy. If a new concourse or terminal is planned, the restrooms will obviously be constructed with it. The benefit of new construction is that there is no disruption to existing restrooms or the adjacent spaces. There is also more planning freedom so the restrooms can meet most, if not all, of the restroom team's design criteria. If new restrooms are constructed, consideration should be given to bringing existing restrooms up to the same or a similar standard. This provides consistency throughout the airport, which is important for travelers from a wayfinding and LOS perspective and for maintenance by keeping attic stock to a minimum.

Renovating an existing restroom is by far the easiest option, especially if it simply involves updating fixtures and/or materials. Phased renovation can occur over time to minimize disruption. Note that the cost of the extended construction period should be analyzed as piecemeal construction can cost considerably more than a more aggressive schedule that renovates more restroom sets at a time.

Sometimes, however, there are bigger issues that a simple renovation cannot fix. Perhaps the restroom would be more effective farther down the concourse or the space is too small in its current location for the number of fixtures required to accommodate increased deplanements. Relocating a restroom is a logistical puzzle that everyone on the restroom team has to be involved in solving. The biggest considerations are as follows:

- How long will construction take?
- What utility shutdowns will be required and for how long?
- Can the existing restroom remain operational until the new location is complete?
- What spaces will be affected at the new location? Will the overall project cover the cost of modifications to the affected spaces? If the affected spaces are that of a tenant, will this affect the tenant's lease?

CHAPTER 3

Design

3.1 Considerations

Once the proposed locations are determined and the first project is identified, the next step is to develop the design. The prototype plan has presumably been massaged and shaped to fit the location(s) but may require fine-tuning as the components are finalized. The design stage is the ultimate tug of war between functionality, space requirements, initial costs, and long-term costs (maintenance, resource usage, etc.). Everything that goes into and around the restroom needs to be researched, discussed, prioritized, priced, selected, and located within the space.

This chapter steps through this process. The intent of this guidebook is not to recommend design solutions but rather offer suggestions and considerations as the design is pulled together by the restroom team. Section 3.3 looks at each of the primary components in the restroom and associated pipe chases, and janitorial and storage spaces including the following:

- Signage
- Amenities
- Surfaces
- Accessories
- Plumbing
- HVAC
- Electrical
- Lighting
- Technology

For products that have a number of attributes to compare, a matrix is provided in Appendix A that compares:

- Initial cost
- Life cycle cost
- Warranty
- Maintenance
- Sustainability
- Pros
- Cons

Before jumping into that level of detail, however, it is important to consider the impacts of maintenance, sustainability, and universal design.

3.1.1 Maintenance

Every material and product will require frequent cleaning and occasional repair or replacement. A component installed in the restroom of an office building may last ten to fifteen years, in a large

hub airport restroom, maybe two to five years. This is in part due to the 24/7 operations, especially in larger airports, but also the constant bumping of carry-ons and, unfortunately, vandalism.

Durability is a key aspect of every item that is included in an airport restroom and typically comes with a higher price tag than most of the other options. The high price is not necessarily extravagant. A material that will hold up for twenty years instead of five may be worth paying double the cost per square foot.

A key feature of surfaces that are easier to clean and are ultimately more durable is minimal joints. Large-format tiles, for example, are gaining prevalence as new innovations in manufacturing provide wall panels up to four feet by ten feet with butt joints sealed with adhesive. Eliminating grout joints, which over time discolor—often to the shade of mop-water gray—and can develop cracks that let moisture seep into the wall or floor cavities, will give restrooms a fresh, clean appearance.

Of course, with innovations come additional considerations. In the example of the large-format panels, it is critical to understand wall and floor movement to avoid stress cracks. Such deflection can be significant in older airports. The key is that the entire restroom team participates in researching and evaluating products, which is an ongoing process. New materials, products, and technologies are introduced every day. Most will not pass muster, but occasionally one will fulfill a need or provide an enhancement that will benefit customer service or operations.

International airports are visited by travelers from other cultures that may have never experienced a Western restroom. In their attempts to figure out a stall full of unfamiliar fixtures, they at times will cause damage. Then there is intentional damage from disgruntled travelers, unruly youth, and others—every airport has its share of stories. While some airports make efforts to minimize damage such as providing instructional signage or frequent monitoring by staff, at the end of the day replacing or repairing broken fixtures and extra cleaning is part of operating an airport.

That being said, it is imperative that selected materials and products are easily repaired or replaced. While a light fixture from Italy may provide gorgeous lighting at the sink mirrors, when the replacement takes four weeks to arrive, it has a significant impact on a traveler's experience. Try to select products that have locally available stock or at least an attentive local representative. For those products that do have long lead times, specify a supply of attic stock with the project.

3.1.2 Sustainability

Any opportunity an airport can find to reduce waste of natural resources should be explored. Some may not be economically feasible, but airport restrooms have several aspects that can have significant impact on resource-waste with relatively low impact to the project's long-term costs. Most obvious is water usage. Low-flow fixtures can substantially conserve the amount of water consumed. Toilets, urinals, sink faucets, and drinking fountains all have sustainable features available that are noted in Appendix A: Component Comparison Matrix. A strategy that should be considered for every product is the LEED 500-mile maximum radius from extraction and manufacture to the project site.

Note that these products and technologies are still in development and some current products actually end up having adverse effects. The sensors on some automatic flush valves are activated by the slightest movement of a person in a stall. This may cause the toilet to flush several times during one visit. Reflective stall materials can also confuse the sensors. Some waterless urinals have issues with odors depending on the model and the maintenance procedures. Several of the case study airports visited by the research team had tried them with mixed results. Some had great success with them, others replaced the fixture not long after the project was completed.

Some products have sustainable effects in collateral areas. Drinking fountains can have a water bottle filler attachment that allows travelers to bring their own (empty) water bottle through security and fill it before boarding. This reduces the amount of plastic bottles that would need disposal. Another innovation is faucets and flush valves with small turbines that power the fixtures' automatic sensors via water flowing through the spout. This eliminates the need for batteries or connecting to building power. Note that automated toilets are required to have emergency backup power. These requirements may also apply to self-powered and battery-powered models.

3.1.3 Universal Design

The concept of universal design has been around for decades. It goes beyond providing accessibility for persons with disabilities, primarily enforced by ADA and translated to architecture through ANSI A117.1. The intent of universal design is to create spaces and components that everyone can use, regardless of mobility, age, status in life, and most recently gender identification. So far, in the United States at least, cultural diversity has not been a major thrust of universal design (e.g., provision of squat toilets common to Asian and African travelers), but it may come.

In the focus group for travelers with disabilities (Appendix D: Focus Group Summaries), the comment was made by a person with limited vision that universal design should also mean that fixtures are always in the same relative location. For example, the toilet paper dispenser could always be on the right side of a stall. For this person, every visit to a restroom was a searching expedition.

Given that the traveling public comes from all walks of life and all corners of the globe, it is important to consider universal design, especially from the perspective of providing excellent customer service. With our increasing elderly population, for example, accommodation for limited mobility, visual and hearing impairments, and slower movement is no longer just the realm of the accessible stall (see Appendix I: Airport Restroom of the Future). In addition, small children and persons of short stature need to reach the faucet and transgender persons need restrooms that are welcoming where they can feel comfortable. In fact, comfort is the key. When a person is uncomfortable, for whatever reason, it is a distraction and degrades their experience; exactly the situation this guidebook endeavors to eliminate.

Accommodating universal design, however, is not an easy task. Almost every opportunity is in conflict with another. For example, the accessible, 18-inch-high toilet seat works well for transferring from and to a wheelchair. This height, however, can create problems with bowel movements. The elderly, for example, often need to assume a squat position. An expert on disabilities is an invaluable individual to have on-call for the restroom team.

Responding to Disability

As members of the restroom team interact with people with disabilities, they may feel tongue-tied as they try to communicate without using words that may sound insensitive or offensive. The Minnesota State Council on Disability has a helpful booklet, "Responding to Disability: A Question of Attitude," that provides guidance to navigate interactions for those who haven't had the opportunity to get to know people with disabilities. It is also available online at: www.reachable.org/content/responding-disability-question-attitude-9.

3.2 Standardization

It is in the best interests of the airport to develop a standard for restroom design. This will provide consistency throughout the airport, which will help with wayfinding, streamline the design and construction process, and make the maintenance process more efficient. The standard should include the following:

- Prototype layouts
- Products
- Finishes and colors

A sample standard from one of the airports that participated in the Airport Managers Survey and Case Studies is included in Appendix F: Restroom Design Guidelines/Standards Sample. Like the master plan, this is a living document—products are discontinued, new innovations come to market, etc. It should be updated with each project and reviewed every five years in periods without restroom work.

3.3 Components

The components are the heart of the design—the materials and products that fit out the space. This section provides guidance in the initial selection of each of these. Research needs to be undertaken by the restroom team to understand what components fit best within the airport's customer service, operations, and fiscal philosophies.

Because of the extreme wear and tear on components in airport restrooms, it can be difficult to find products that are durable while not looking utilitarian. Given the quantities needed in an airport, customization of existing products is a viable option as is engaging manufacturers to develop new products to fulfill a specific need. See the product development focus group in Appendix D for guidance through this process.

3.3.1 Signage

Concourse Wayfinding

When a traveler deplanes, often the first priority is finding the restroom. Likewise, after a long drive to the airport and facing lines at both the ticket counter and security checkpoint, a quick stop at the restroom is in order. If restrooms are not readily visible from gates and after checkpoints, clear directions to the nearest restrooms are critical (see Figure 3-1).

Figure 3-1. Wayfinding sign.

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Wayfinding signage for restrooms often consists of the international men/women symbol on an overhead sign with an arrow. It can be useful for travelers unfamiliar with the airport to indicate the distance in feet, especially if there are restrooms in different directions. While locations are typically shown on directories, providing a phone app with the restrooms highlighted, especially in relation to a person's current location, is a great customer service feature.

Location Sign

Airports have become as cluttered as highways with signs of every size, shape, and color cluttering the visual field, making it is easy for travelers to miss the restroom sign. Therefore, it is the recommendation of this guidebook to forgo the ubiquitous blade sign and let the restroom speak for itself.

Using an iconic façade and entry on restrooms throughout the airport would help travelers to recognize them and thus eliminate the need for identifying signs. That said, some indication will be needed, from a distance of about 50 feet, to identify which entry is for which gender. Airports are beginning to use bold colors, text, or graphics to draw attention, sometimes with a playful sense of humor.

Room Name and Number

Accessibility and building codes typically require that a sign be provided that identifies the name and the number of the room. Specific requirements for size and location should be verified. Room signs also allow the facilities staff to locate doors or openings for maintenance and emergencies. The aesthetic of the room sign is often an afterthought and the airport's standard room signage—often a basic, primary-colored plastic plate adhered to the frame head—is installed; however, consideration should be given to integrating the sign into the overall design by, at minimum, using a color and/or material that complements the design palette.

Room names should be brief so they can be quickly read. There is no need to use the word "room" on the sign, because it is commonly understood that the sign is for a room. So, use "family" instead of "family room."

What's in a Name?

A lot more than one may realize. The current names used to identify a single-toilet restroom carry the perception of exclusion. Family, companion care, special needs, unisex—each of these names imply the space is intended for a specific group. Unlike an accessible stall or room, which is specifically designed and reserved for persons with disabilities, these rooms are for multiple occupants with a variety of needs that are difficult to manage in a typical restroom. As the room names convey, the users might be a parent with child(ren), a person assisting a companion with mobility impairment, or a transgender person who finds both male and female restrooms uncomfortable. Despite the different names, however, all of these rooms have the same components.

So what is the right name? That is a challenge that from a universal design standpoint is in need of resolution. It may even be a springboard for a broader social revolution regarding restrooms. See Appendix I: Airport Restroom of the Future.

Accessible Stall

In larger restrooms, it can be beneficial to provide a symbol graphic identifying the accessible stall(s). This can be on the door or on the wall next to the door, as long as it is clear which door is to the stall. Rather than the symbol being applied as a sticker or other applied signage material, which is vulnerable to damage in a high-use area such as this, the symbol can be integrated into the surface material. Stainless steel, for example, could have the symbol etched into the surface (make sure there is enough contrast for the visually impaired).

The FAA Office of Civil Rights requires indication on the exterior of a restroom if it has an ambulatory stall(s). It is also helpful to identify the ambulatory stall within the restroom. In a typical restroom, the ambulatory stall is the one with the slightly wider door. That is a subtle difference for wayfinding. Unfortunately, there is not a standard symbol for ambulatory stalls. Following this guidebook's recommendations, the typical stalls would all be ambulatory, although this would not be known until the doors are opened. The FAA does waive the external indication requirement if all the typical stalls are ambulatory.

Employees Wash Hands

This is another type of sign that is often an afterthought. The project is finished and a variety of informational signs are attached to the walls with double-sided tape or screws. Anything applied to the walls becomes a cleaning obstacle. If possible, the sign should be recessed with the wall material so the surface remains flush and smooth.

A simple technique to recess signage is to print the sign graphic on the back surface of a one-quarter-inch sheet of tempered glass. Affix the glass to the substrate with double-sided tape for easy future replacement. Make the opening in the surface one-eighth inch larger than the glass on all sides and seal the gap with clear sealant.

Like the toilet accessories, signs within the restroom should be deliberately organized on the wall to create simple composition.

Advertising

An ad or flat screen above the urinal or on the inside of the stall door seems like an ideal place to generate extra revenue with the captive audience. Resist the temptation, however. As mentioned previously, travelers are already overstimulated moving through the airport and tired from the processes of air travel. "Rest" is an important syllable in the room name. To optimize customer service, keep the space calm and free of unnecessary distractions.

3.3.2 Amenities

Waiting Area/Seating

Many travelers fly with a companion or family. Providing seating by the restroom for those finished early or waiting is a welcome accommodation, especially for the elderly or those traveling with children. It can be as simple as a bench or a small sitting group. The debate is whether to provide power and USB. This is becoming commonplace at most new airport seating. The drawback is that it invites persons to camp out with their laptops, thus negating the waiting area.

Full-Length Mirror

Travelers appreciate an opportunity to check that all their clothes are back in place before rejoining the public. Locate a tall mirror where it can be viewed when exiting the restroom (but not where it can provide a sightline into the restroom) and ideally out of the flow of traffic. Like

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the hand-washing type signs, the mirror should be recessed in the finish material so that it is flush and sealed around the perimeter. This protects the edges from damage and the silvering from moisture. Keep the bottom of the mirror about eight inches off the floor, clear of cleaning equipment. Consider setting the top in line with the top of door frames to help compose the wall elements and ensure that tall travelers also have a full-height view.

Make-up/Grooming Area

Some airports opt to eliminate mirrors at the sinks to minimize dwell time. Whether or not this strategy is employed, a separate make-up/grooming area can help with traffic flow. A small shelf should be provided for a purse or bag and an outlet for shavers and the like. Side-lighting is important to avoid facial shadows. A small hand sink is a nice accommodation but not necessary if there are mirrors at the typical sinks. This amenity can be combined with the full-length mirror and, like that feature, should be located on the exit path but out of the way of traffic.

Dressing Room

Having a small space to change clothes with room to open a suitcase was identified as a desired amenity a number of times on the research team's focus groups and surveys. A toilet stall is not quite big enough although a designated stall without a toilet and with a bench would work well.

Adult Changing Table

Similar to a baby changing station, the adult version is also intended for changing diapers. Persons with mobility impairments will likely need to be changed during the travel time when flying. Usually they have a traveling companion to change them. At present, the common option is to lie on the floor in the accessible stall—far from desirable or customer-friendly.

This type of room is an emerging trend. Other public institutions, the University of Minnesota, for example, require this in new projects. An adult changing table is typically freestanding. Some have height adjustability, important for the companion doing the changing. There are no regulations at this time, but it seems a reasonable accommodation, like lactation rooms for traveling mothers, is to provide a room at each concourse and other key nodes.

Severe Weather Shelter

A restroom block is an intuitive place to provide a shelter for severe weather such as tornadoes, hurricanes, etc. Restroom blocks are rigid with a network of pipes and conduit and are often constructed with concrete block partitions. Note that terminology is important. "Safe rooms" and "storm shelters" have specific requirements by the Federal Emergency Management Agency (FEMA) and the International Code Council (ICC) that need to be met to use those identifiers.

Severe weather shelters are the most common type of shelter used in airports. The Metropolitan Emergency Managers Association has a useful checklist to determine the best spaces for shelters within the facility.

If the restroom has windows, security film should be installed to protect against airborne projectiles. Again, signage should ideally be incorporated into the material palette (Figure 3-2).

Amenity Node

A restroom block is a great location for an adjacent FIDS. It can be checked by travelers while waiting for a companion and can be essential in creating one-stop "amenity nodes" throughout

Figure 3-2. Sign for severe weather shelter integrated into finishes.

the airport that travelers will come to recognize and seek out. The following components also should be considered for location in the restroom amenity node:

- Automated external defibrillator
- Fire extinguisher
- Manual fire alarm pull station
- Airport phone
- Vending machines
- Shipping drop boxes
- Lockers

Another adjacency is the service center (typically carrels where travelers with long layovers can plug in and work). Shortening the distance to the restroom is a welcome convenience. Note that the amenities in the node are ideally recessed in the wall or alcoves so as not to compromise circulation.

Art/Display

Some airports have an art program where a percentage of every project's cost is set aside for public art. Restrooms are an ideal place to incorporate art. It might be integrated into the iconic image or can be housed in display cases for revolving exhibits.

Storage

Whether the mop sink is located in the pipe chase or a dedicated janitor's closet, accessories for organizing maintenance tools and supplies should be provided. This typically includes wall racks and rack-shelving. Note that the shelves should be on wheels so they can be moved to clean up leaks or spills. The cleaning and plumbing managers should be consulted to confirm what needs to be stored at each location.

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3.3.3 Surfaces

Partition Structure

See Appendix A for component comparisons.

The floors and ceiling/roof structure is a given. The restrooms are constructed between the concrete and steel that supports the entire building. The perimeter interior partitions, however, have options. Note that "partitions" do not support weight from above as opposed to "walls" which are part of the building structure.

There are two basic partition types: concrete masonry units (CMU) and metal studs. CMU are more durable and should always be used at plumbing walls as metal will rust from leaks. CMU are heavy and some older airports do not have the structural capacity in the deck to carry such a concentration of heavy walls. If metals studs need to be used for structural or budgetary reasons, a concrete curb provided under the studs will keep them off the floor in case of large spills. This is especially critical in pipe chases.

Floor

See Appendix A for component comparisons.

The use of large-format porcelain tiles with thin one-sixteenth-inch maximum grout joints, thin porcelain stoneware slabs with adhered butt joints, or seamless terrazzo is recommended for the restroom floors. A seamless surface eliminates the clicking sound of rolling luggage, which adds to the din already common in restrooms. Note that comments were made in the research team's focus groups that for people with visual disabilities, the clicking sound helps them discern if others are around. Seamless floors also avoid mold and bacteria build-up that can happen with grout.

The slip-resistance of floor materials should conform to building code requirements so as not to create a hazardous condition if the floor is wet. Note that glossy floors are not necessarily more slippery. Water can collect in textured surfaces creating a highly perilous surface.

Grout should be a medium gray as stains and the cleaning process over time result in a mop-water gray color. The colors of dirt vary in different regions of the country so one technique is to match the dust color found in the airport.

It is recommended that flooring in pipe chases and janitor's closets have a waterproof traffic coating that continues up the wall four inches to contain leaks in the space. Storage rooms without plumbing fixtures can simply have sealed concrete.

Effects of Uric Acid

Splashed urine on floors and walls is a prevalent maintenance issue in high-use restrooms. Over time, the materials become stained then break down while the urine odor pervades the space. The key to mitigation is not the material but rather how well it is sealed. It is not enough to have seamless flooring or wall finishes. If there are tiny holes in the surface, uric acid–borne bacteria will find its way under the sealer and propagate, turning into mold and mildew and the associated stains and smells. There are numerous commercial cleaners available to tackle urine spills, but the first line of defense is completely sealed antimicrobial flooring.

Wall Base

See Appendix A for component comparisons.

Often the wall base is the same material as the wall surface. Consider using a different base color from the wall and floor to aid low-vision customers trace their way through the space. The National Institute of Building Sciences recommends that the value contrast of floors/doors to walls have a light reflectance value difference of 30 to define space and passageways.

Design trends are moving away from a cove base to a right-angle base. Cleaning crews find the right-angle transition easier to clean because the equipment can get tight to the walls. Cove bases can also be expensive if there are many corners (e.g., niches) and are less flexible for future expansions or modifications

Wall

See Appendix A for component comparisons.

Large-format porcelain with tiles one-sixteenth-inch grout joints are the current trend for wall surfaces in airports; however, new wall materials in much larger sizes have been developed that should be considered. Wide floor-to-ceiling porcelain stoneware (one-eighth-inch thick) or quartz wall panels (three-eighths-inch to one-half-inch thick) create an elegant, monolithic appearance. Edges are butted together and sealed with hairline-thin epoxy resin sealant.

Another design feature of these monolithic panels are the ease of inserting flush graphics and text with contrasting colored material using water jet cutting. Graphics are flush with the wall panel surface so are easily cleaned. Metallic braille can also be countersunk into the wall panels.

Accent wall tiles of various types and sizes offer design opportunities to add punches of color, reflectance, and/or texture. Avoid placing less durable tiles in locations that are susceptible to wear and tear from luggage and other personal belongings. Consider again grout color (lighter tones stain and become dirty) along with cleaning implications. Last, be aware that most tiles bow slightly in the middle in one of the directions. A running bond pattern can show this slight differential between the tile faces. Instead use a stack bond or one-third running bond pattern.

Ceiling

See Appendix A for component comparisons.

Ceilings in restrooms serve multiple utilitarian functions. They reflect light, can dampen sound, and provide access to mechanical and electrical equipment above. From an aesthetic perspective, ceilings help organize the rooms and influence how cramped or open a space feels.

Lighter colors, usually white, provide the greatest light reflectance and feel the most open. Higher ceilings in the traffic areas can make this crowded area feel less claustrophobic, while low soffits or ceilings over the stalls add to the sense of privacy. In the room prototype described in Chapter 2, articulated ceilings and soffits can be used to visually group the stalls or sinks together to reinforce the "room" concept.

With all the hard surfaces on the floors, walls, stall partitions, and fixtures, the ceiling is really the only opportunity for noise mitigation. Materials should be carefully considered as some airports have periodic hose-downs of the restrooms in their cleaning cycle. Perforated metal ceiling panels have essentially replaced linear metal ceilings commonly used in airports in the past. They are more durable and perform very well acoustically. They also come in larger sizes, which minimize the joints. A variety of hinge and sliding mechanisms make even large panels (up to ten feet long) easy to move for access without damaging the panels.

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Painted gypsum board is among the most prevalently used materials, especially on soffits, due to its simple aesthetic, ease of repair, and relatively low cost. Acoustically it is not very good and if access is required above the ceiling, access panels will need to be provided. These clutter the ceiling plane and over time, the finish tends to get chipped and fingerprinted.

Stall Partitions/Urinal Screens

See Appendix A for component comparisons.

Stall partitions are often the largest surface area in a restroom so the durability, design detailing, aesthetics, and ease of maintenance are important considerations. A wide range of materials are available for different intensities of use. Softer stones such as marble and limestone are not recommended because of their inherent nature to crack, chip, break, and absorb moisture and stains. Consider lower and moderately priced partition systems for less public areas (employee areas, etc.) in the airport and moderately to higher priced partition systems for greater performance and aesthetics for the most public airport restrooms.

Partitions should not be mounted less than six inches up from the finished floor to allow floor cleaning equipment to get underneath. ANSI A117.1-2003 requires a nine-inch-high toe clearance in accessible stalls for wheelchair maneuvering. This requirement is waived if the stall is six inches larger in both directions. Manufacturers often recommend a space at the bottom of 12 to 14 inches. This makes personal belongings on the floor extremely vulnerable to theft and can also compromise privacy. Most standard partition panels are 58 inches high. Per standard recommendations, this puts the top of the panel at 70 inches above the floor. Increasing the panel height and lowering the mounting height of the panel provides better security and privacy.

There are several partition system types to choose from. Cleaners prefer ceiling-hung systems, but their primary drawback is that there is no lateral stiffness. When stall doors swing open, the stall system moves; sometimes to the point of disengaging the door latch in adjacent stalls so those doors pop open. If a ceiling-hung system is chosen, it is recommended by manufacturers that a floor-to-ceiling pilaster be dropped at every three stalls maximum. Structural support is required above the ceiling. Note this system is not feasible with heavier partition materials.

Floor-and-ceiling-mounted systems are recommended by manufacturers for busy restrooms, like airports, that are susceptible to abusive treatment (from luggage) and vandalism. These systems also require structural support above the ceiling but are far more rigid and durable.

Two other system options include floor mounted and floor mounted/overhead braced. The first requires a two-inch penetration into the concrete deck/slab for anchoring and is also less rigid than floor and ceiling mounted. The last variation of floor mounting has a continuous overhead metal brace at approximately seven feet off the ground. While this system is also quite rigid, a common issue is vandalism from a person hanging from the metal bar, although anti-grip profiles are available.

Urinal screens should be the same height as the stall partition panels for visual continuity and privacy [Paruresis (i.e., shy bladder syndrome) impedes the quick turnover of restroom occupants]. If the recommended floor-and-ceiling-mounted stall partition system is being used, the same pilasters should be used at the urinal screens for extra strength and design consistency.

Partition hardware often comes as part of a manufacturer's package. Aesthetically, hardware has been the weak link in stall systems. Further development is needed to address a number of issues. A big one is the gap between panels that can be up to an inch wide. This essentially leaves the occupant on display from the front and the sides. Continuous brackets are available that cover the length of the gap, but they tend to look industrial. Latches typically have small knobs

that are difficult to operate for the mobility impaired. Ideally, a person should be able to unlatch the door with their wrist.

Occupancy indicators are available but should not be necessary if the doors swing out. Adjustable hinges are available so that, when not latched, a door can close to a position a few inches from completely shut. This allows potential users to see that the stall is unoccupied. Also, the standard colors of occupancy sensors (red for occupied, green for vacant) are indistinguishable for the color blind.

Stall Doors

Similar to stall partition materials, a variety of materials for stall doors are available for different intensities of use. These are typically the same materials as the stall partition panels. However, partition materials like quartz and granite should not be used for stall doors because they are too heavy for commercially available hardware and a swinging door made from these materials could cause bodily harm to a person hit by one. For these partition materials, stainless steel doors are recommended. Stainless steel is available in a variety of finishes and textures. Careful review by the restroom team is important as some finishes hide fingerprints well but may be more time-consuming to maintain.

Counters/Backsplash

See Appendix A for component comparisons.

Few surface materials are recommended for counters and backsplashes due to their heavy use, potential graffiti, and chemical reaction with water and various liquids such as fingernail polish and remover. Stone, quartz, and solid surface materials are the most durable for these restroom conditions. Softer stones such as marble and limestone are not recommended due to their inherent nature to crack, chip, break, and absorb moisture and stains.

Historically, restrooms have been planned with countertops with cutouts for the sinks below. A common complaint by travelers is that the countertops are always wet from dripped water leading to the hand-drying station. This leaves no place for their belongings. A better configuration is to eliminate the counter (one less surface to clean) and provide wall-mounted sinks. A shelf behind the sink (as described in Section 3.3.4: Accessories) offers a dry place for belongings.

Room Doors

See Appendix A for component comparisons.

It is rare that airport restrooms have entrance doors anymore. The constant opening and closing wears out the doors and hardware quickly and impedes traffic flow. An open, labyrinth-type configuration with efficient two-way traffic is more common now. Doors are used on smaller rooms, however, like family rooms and pipe chases. Finishes for these doors should be durable. To prevent collisions, doors should not swing into public corridors.

Stainless steel doors and frames hold up well for the family room and visible doors within the restroom. This finish ties in well with the stainless steel accessories in the space. Less visible doors and adjacent doors to utility spaces are typically painted steel. Most airports have a standard for their construction. A consideration is that the paint tends to get chipped and marked, especially from cart traffic and so will need periodic refinishing. A kick plate adds protection but has a utilitarian feel.

Wood doors are also common. The pattern of the grain is more forgiving to scratches and marks than a solid-color-painted door. They also add a spot of natural visual warmth in what can otherwise be a sterile environment with all the hard surfaces. A kick plate should also be used on the push side.

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The airport's standard hardware should be used for these doors with the exception of the family room. Access to the family room should be touchless like everything else within the space. This requires a complex hardware configuration that ideally includes the following:

- An automatic door opener and closer on both sides
- An automatic locking button on the inside (the interior door opener unlocks the door as does manually turning the lever)
- Two light-emitting diode (LED) indicators ("open" and "in use") on both sides of the door

Wall Protection

Corners are vulnerable to damage in airports from traveler's belongings, maintenance carts and equipment, etc., especially in restrooms where it is crowded and space is limited for maneuvering. Even the hardest stone materials are susceptible to damage along the edges. Manufactured stainless steel profiles are available for most thicknesses of tile; however, once materials get thicker than three-eighths inch, these trim pieces can also be easily dented. For thicker materials, consider custom corner guards made of thicker walled stainless steel tubing with tabs welded to the non-visible side for securing to the substrate.

3.3.4 Accessories

The majority of accessories are dispensers or receptacles. Larger manufacturers of restroom accessories have models for most of the functions discussed in this section. Ideally, accessories are from the same manufacturer in the same style (see Section 4.1.3). This provides aesthetic continuity throughout the space and streamlines long-term maintenance on the units. It also typically provides a single key for the various dispenser locks, which streamlines the maintenance process.

With so many separate accessories scattered throughout the restroom, careful consideration should be given to organizing them on the walls to avoid visual clutter. Grouping the accessories within the stalls on one wall is one strategy that has the added benefit of through-bolting the same accessories in the adjacent stall on the opposite side of the partition, providing a more durable installation. Accessories in restrooms should be located consistently throughout the airport. This is particularly helpful for the visually impaired.

Mirror

To reduce dwell time, some airports have opted not to place mirrors at the sinks and instead provide a mirror or two on a blank wall for grooming and last-minute clothing checks.

Regardless of the location, mirrors should ideally be tempered so that if broken they do not result in sharp shards that could be used as weapons. The downside is that the current manufacturing process distorts the clarity of larger-size mirrors. This issue will likely disappear in the coming years as the process is improved.

The silvering behind mirrors is vulnerable to damage by cleaning solvents that contain ammonia so the edges and back should be sealed and protected from any moisture penetration.

ANSI A117.1-2003 requires that the bottom of the reflective surface must be no higher than 40 inches above the finished floor for mirrors above sinks and counters (check local codes for modifications) and 35 inches in other locations. A frequent design-to-construction error is that the opening height for the bottom of the mirror (the backsplash typically) is at 40 inches. Therefore the reflective surface is slightly higher and thus non-compliant.

See Section 3.3.8 for information on mirrors with integral lighting.

Paper Towel Dispenser

See Appendix A for component comparisons.

Airports have been moving away from folded paper towels toward more economical and eco-friendly paper towel rolls. Touchless models are the most sanitary. Note that touchless does not necessarily mean powered; if only the paper pulled out is touched, the model is hygienically sound. Sensor-operated dispensers, however, are usable by persons with almost any mobility impairment.

More models are being offered with a stainless steel finish, which is more durable than other materials and blends well with other accessories in the restroom that are typically stainless steel. Stainless steel enclosures that cover the plastic dispenser are also available; however, they may cover the sensor on automatic models.

Paper

Curiously, one of the big drivers in airport restroom design is paper, primarily the stock for paper towel and toilet paper dispensers. There are many variables to consider—paper thickness, number of plies, folded or rolls, regular or jumbo. There can be significant long-term cost savings with adjustments to any of these variables. Focusing on the cost factor alone, however, can ultimately compromise customer service and maintenance.

The vendors that supply the paper typically provide the dispensers at no or low cost, which are often plastic and not the most durable product. While the vendor will replace broken dispensers, until that happens, travelers encounter a dispenser that does not work or perhaps has a big crack in the face. That experience within the short time that travelers are in the airport will leave a long-lasting impression that may affect their future choices in layovers and destinations.

The governing authorities of some airports require that bidding occur as frequently as every year for vendors. This can create a maintenance nightmare for the airport if the vendors change every year or two. One airport interviewed in the case studies, whose vendors did not provide dispensers, complained that every new vendor had a "new and improved" paper delivery system resulting in a half-dozen dispenser models throughout the airport that required their own sets of spare parts and required more space to stock the different types of paper.

Restrooms are among the most expensive spaces per square foot. The restroom team spends months planning and designing a space that is welcoming, calming, and memorable. So why leave the intended experience to chance by waiting to see which vendor is awarded the annual bid and what dispenser they will provide. What are the odds that the red plastic cover on the paper towel dispensers will complement the elegant restroom interior?

One-ply toilet paper versus two-ply is an ongoing debate in the industry. Some say that people will use less toilet paper with more plies. Others counter that people pull out their preferred amount regardless of waste, so the thinner product may as well be provided. The answer is elusive, but a clue lies in an encountered airport where the airport staff restrooms provide two-ply paper while those for the customers are one-ply.

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Sink Area Waste Receptacle

See Appendix A for component comparisons.

The waste receptacle is one of the primary contributors to the perception of a restroom as "unclean." This is due to both overflowing trash—typically paper towels, but also food, diapers, etc.—and large, visually dominating receptacles. To eliminate both of these conditions, the common waste disposal method in recent airport restrooms consists of an opening in the counter with a trash container underneath in a secured enclosure. Typically there is one waste opening between each pair of sinks. Locating the trash under the counter efficiently takes advantage of otherwise unused space. It also creates an opportunity for additional storage for soap refills, cleaning supplies, paper products, etc.

Traditional surface-mounted and recessed waste units are also available combined with a paper towel dispenser above, which saves wall space and eliminates wall clutter. Stainless steel waste containers should be lined to make cleaning easy and prevent corrosion. Note that while a flipper door helps conceal the trash inside, the door becomes a germ farm and, depending on what has smeared on the door as it was deposited, can be quite repelling.

Hand Dryer

See Appendix A for component comparisons.

Hand dryers have evolved significantly in recent years. Attention to the disposition of water blown off hands, energy use, accessibility, noise, and hygiene has fostered design innovation in mounting methods, air movement, and refinements to improve the user's experience. All hand dryer styles are available touchless and these should be used. Most hand dryers are separate units although there are sink units available with integral hand dryers.

Issues remain regarding the noise levels, which can be especially troublesome for some hearing aid users. One participant in the research team's focus groups commented that the noise frequency can leave her "deaf" for several minutes. See the sidebar in Section 2.5.1 for further information on hand dryers versus paper towels.

Biohazard Disposal

See Appendix A for component comparisons.

The familiar red plastic disposal for needles is a mainstay of airport restrooms. For those requiring regular injections, such as diabetics, the receptacles are vital for safe disposal. In some airports, however, primarily on the landside (non-secure) side of the terminal, these disposals are also a target of vandalism as needles are stolen for further use. Thus, durability is as important as visibility and location with stainless steel enclosures being preferred to plastic. The full container is typically replaced by maintenance with an empty one and collected by the airport's biohazard vendor.

Toilet Paper Dispenser

See Appendix A for component comparisons.

Like paper towel dispensers, toilet paper dispensers are often provided by the paper vendor. Within the stall, however, plastic models are especially vulnerable to damage from carry-ons, etc. Stainless steel models are available for both standard and jumbo rolls.

The larger rolls reduce refill frequency but take up more space. To alleviate this, the rolls are often turned sideways. This arrangement, however, can be difficult for those with limited motion in their hands or arms. Also, when mounted below grab bars, the toilet paper comes out uncomfortably low.

Multiple-roll models are commonplace and highly recommended. Coreless rolls are available that reduce waste but can be difficult to install correctly.

Combination units that combine the toilet paper dispenser with a waste receptacle or a seat paper dispenser help reduce the clutter of accessories within the stall. Through-partition dispensers that have access from adjacent stalls reduce the projection of the dispenser into the stall. Recessed models achieve this better but require thickened partitions instead of panels.

The location of the paper outlet is narrowly defined in ANSI A117.1-2003 as are other accessories found in combination units. Be sure to check for modifications in the local code.

Stall Waste Receptacle

See Appendix A for component comparisons.

Traditionally, waste disposals have been provided only in women's stalls for sanitary products. With the increase of elderly travelers and people with disabilities, providing a disposal for adult diapers allows more dignity to the user than the alternative and provides a receptacle for general trash instead of the toilet. Disposals that are big enough to accommodate an extra-large men's diaper should be used.

Seat Paper Dispenser

See Appendix A for component comparisons.

No matter how well a restroom is maintained, some people are simply wary of unseen germs and are uncomfortable sitting, exposed, on a surface where only a minute before someone else sat. And sometimes, the toilet seat is visibly soiled and no other stalls are available. Seat paper dispensers provide a flushable cover for users to sit on rather than hover. The dispenser should be installed either behind or to the side of the toilet. This unit is also available combined with a toilet paper dispenser. Again, a stainless steel enclosure is more durable than plastic.

There are also automatic models available. When activated, a continuous clear plastic covering slides around the toilet seat. The used portion is automatically spooled in a container for later disposal.

Shelf

See Appendix A for component comparisons.

Travelers are always carrying something—a bag, jacket, food. Even airport employees often have a planner, folders, etc. in hand. There needs to be a clean, dry place to put them in the restrooms. Counters are typically wet from splashing and from drips to the hand-drying station and floors are usually suspect. Shelves at the sink, in the stalls, and at the urinals have become a mandatory customer expectation.

Preferred are built-in shelves integrated with the wall materials. These may be a recessed niche at the toilets and urinals or a continuous shelf behind the sinks. The shelves should be eight to twelve inches deep and above wet surfaces. Accessibility is important, even for the agile. Shelves behind sinks should be within easy reach (see Chapter 2 for recommended counter depths). Shelves in stalls at and near urinals should not be placed behind toilets and urinals. Such locations are typically awkward to reach and there is the hazard of dropping something into the fixture.

Where budget is limited, shelves can be surface mounted but not where they would create a projection that someone may bump against. For space-constrained locations, stainless steel fold-down shelves are an option.

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Hooks

Hooks are useful both in the toilet stall, at urinals, and at sinks. Travelers often have a coat, bag, or purse they would rather not set on the floor due to concerns about cleanliness, theft, or both. Typically two hooks are provided, one above the other. The lower hook, at four feet off the floor, meets accessible reach requirements and a higher one at five feet or more will accommodate a long coat.

Within stalls, hooks should never be mounted on the back side of the door as a common theft technique is to reach over the top while passing by and lifting a purse. Closer to the toilet is preferred too for access to sanitary products or injection materials for diabetics. A higher urinal screen allows for hooks there as well. At the sinks, hooks on a side wall or hand-drying column are convenient.

Hooks should be a strong metal with secure mounting. There should be no sharp edges. They should project enough for a wide bag strap and hook upward to hold a garment.

Sanitary Products Vendor

This coin-operated dispenser can be set for different denominations. Newer models have a push button rather than a lever so it is accessible as well as less likely to break. These can be recessed (preferred) or surface mounted. One unit within a restroom is typically sufficient. More may be required in larger restrooms or if the restroom is divided into separate areas.

Baby Diaper Changing Table

See Appendix A for component comparisons.

Durability is a key requirement for the changing table to ensure the safety of infants and to hold unintended loads like luggage or sitting adults. Changing tables can be purchased as a manufactured unit that is mounted to the wall and folds down or can be custom made as part of the counters. There are also hybrid models that consist of a manufactured changing platform that is secured to the countertop.

Materials used should be easy to clean and antibacterial. Stone materials tend to be cold to the touch, so using a solid surface material under the pad can be more comfortable for babies. Most users will have a changing pad in their diaper bag, so providing a low enclosure with a strap that will keep the baby and pad in place is a sufficient accommodation.

Baby Diaper Kit Vendor

Most people traveling with babies are stocked with diapers, wipes, changing pad, etc.; however, sometimes a convenient dispenser can save the day. Providing one dispenser outside each restroom block, ideally near the family room, should be sufficient although one can also be installed at each changing table. The dispensers are coin operated and typically provide a diaper, wipes, a paper liner, and a disposable bag.

3.3.5 Plumbing

Plumbing design is critical to the restroom. It needs to be well thought out, organized, clean, and functional. Each restroom should have its own set of shut-off valves to isolate the restroom block.

In a new airport, a dedicated tempered water system should be used that can serve all of the hand sinks in the building. This system will allow for warm water at all times at the sinks; the comfortable water temperature for hand washing is 105 degrees Fahrenheit.

When piping within the pipe chase is being designed, the pipe elevations should be drawn and organized to all fit into the chase. Ideally the waste piping should slope toward the chase door and a cleanout should be provided above the spill line to allow for easy access and the ability to clean out that piping as needed. If the cleanout is in the back, the maintenance staff must take their equipment all the way to the back of the chase. Enough space should be provided at the chase entry to allow the door to close when someone is working at that end. This conceals maintenance personnel from public view.

In existing buildings, the slope of the existing sanitary mains will be critical in selecting fixtures. The slope in older plumbing systems is minimal and thus it is more advantageous to have more water running through the piping. Low-flow fixtures should be evaluated before installing.

Sink

See Appendix A for component comparisons.

There are two options for hanging a sink: a concealed arm carrier or safety clips. A concealed arm carrier is much sturdier and safer and therefore requires a structural wall behind the sink to secure the carrier and piping. The clip option requires the proper backing to be on the wall to ensure structural integrity.

Each sink should have a shroud that is easily removed, ideally by simply lifting (screws and fasteners should be avoided). Provide a trap and tailpiece of 17-gauge piping. If a shroud is not provided, trap and piping guards should be installed per the local accessible building code.

Sink strainers should be made of stainless steel to prevent corrosion and discoloration. They should also have larger holes to prevent clogging.

Providing a cleanout above the spill line of the sink will allow the maintenance staff to clean the piping without causing an overflow. Note this cleanout is only possible when a sink has a chase behind it. Even without a chase, a cleanout should be provided below each sink.

For wall-mounted sinks, it is recommended to have a gap between the sink and the wall. This makes for one less maintenance-prone sealant joint and allows another option for spills to drain off surfaces that users want to place their belongings on.

Faucet

See Appendix A for component comparisons.

Today's market has ever-changing faucet designs and features to consider. First and foremost are water capacity and power consumption. Given the usage in airport restrooms, it is important that enough water, especially hot water, gets to the faucet.

Energy savings are achievable with innovations like solar- and turbine-powered faucet sensors. Touchless faucets are both more hygienic and are preferred for accessibility. A recent innovation, proximity sensors, turns on the faucet by sensing the heat from a person's hands rather than motion from fingers placed near the faucet. This prevents accidental activation.

The spout shape should allow water to flow high and far enough out over the basin so the user's hands do not touch the sink bowl. If possible, a mock-up of the sinks and faucets being considered should be set up to test for ease of activation, comfort, and unexpected splashing.

Passengers expect warm water right away at the sink. The system design should bring the hot water main as close to the sink as possible.

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Braided supply lines used in the installation of faucets can collect dirt and dust over time. Chrome-plated brass supply tubes should be used to avoid build-up. Also provide quarter-turn ball valves under the sinks instead of the multi-turn type for shut-off directly below the sink. If no shroud is provided on the sink, provide loose key quarter-turn ball valves to help prevent users from shutting off the water.

Soap Dispenser

See Appendix A for component comparisons.

One of two types of soap are typically used in restrooms: foam soap or liquid soap. Both are available in bulk and usually bought in bulk through vendors. However, the advantages to foam soap are that smaller amounts are used, it washes through piping easier, and it removes bacteria from hands as effectively as, if not better than, liquid soap.

Maintenance staff is typically stretched thin to keep up with the busyness of airport restrooms. Utilizing a bulk soap-dispensing system that is accessible for refill from the plumbing chase is ideal because it extends the period between refills. An advantage of a bulk soap system is that it can feed multiple dispensers. Use conduit to run the tubes to make sure they are not inadvertently cut. Run the tubes no higher than the dispenser output height to avoid drips.

Traditional bottle dispensers are often stolen from underneath sinks if they are visible, which they unfortunately are. The half-empty plastic bottles of pink liquid hanging below the counters are an unsightly visual distraction.

Toilet

See Appendix A for component comparisons.

The main difference in toilet designs is the flushing system: siphon jet versus blowout. The siphon jet utilizes a jet of water in the trapway to pull water out of the bowl. The blowout method displaces all the liquid (and its contents) in the toilet bowl. It is a more aggressive means of flushing but is more effective at removing solids, important for high-use restrooms like those found in airports. Their drawback is that they are startling loud.

A wall-hung toilet is the best choice for an airport; however, with the increasing weight of travelers, it is important to be aware of the load limits toilets can carry. The average toilet is rated to hold 1,000 pounds of dead load. For this kind of weight, it is critical that the carrier and associated wall structure also be able to accommodate it. More than one story was shared in the research team's case studies of a person sitting on a toilet that shared a back-to-back carrier with the toilet on the opposite side of the wall and being lifted into the air like on a seesaw when a heavy person sat on the opposite toilet.

Provide cleanouts on the waste piping above the toilet spill line to allow for ease of maintenance. Install the carriers as flush to the chase wall as possible to allow for more space in the restroom. Provide water hammer arrestors for each restroom and make them accessible. All toilet seats should have all-stainless-steel bolts and springs (no plastic or zinc parts). Provide toilet seats with a soft close to prevent seats from slamming down and potentially breaking. Note that plumbing codes typically do not permit solid lids over the seat.

Today, especially in certain parts of the country, water conservation is a critical function of a smart building. Capturing gray water (water from sinks or rain water) and reusing it in toilets and urinals is a great way to conserve and reuse relatively clean water. These systems are complex. The water needs to be properly processed as well as maintained and cleaned to prevent bacteria from traveling through the systems. The system will also need separate drainage to collect it and

a separate distribution system to supply it to the necessary fixtures. Gray water can be cleaned both naturally and chemically.

Urinal

See Appendix A for component comparisons.

Urinals are a staple in the American men's restroom. They are very functional and are expedient in getting users in and out. When selecting a urinal, consider the aesthetics as this fixture is very visible. Their appearance should complement the design of the room.

Within the urinal, it is important to consider flow. Waterless urinals have not been extremely successful, primarily due to installation and maintenance issues. For pint or other low-flow urinals, make sure that a sink or toilet is upstream on the waste piping of this fixture. This will help keep water flowing and help resist deterioration of the pipes from uric acid.

Also consider the trap discharge. Many urinals have a lip at the discharge of the trap that can make them difficult to clean. Most urinals today are mounted on factory-provided mounting brackets that seem to work well to hang the units securely. Last, consider the space around the urinal.

A long overdue development in urinal design is taller urinal options. Floor-mounted urinals that are set in the slab are a thing of the past due to sanitary issues. However, there is no reason urinals cannot all be low enough to accommodate persons of short stature and those with disabilities as well as those of tall stature. The typical men's restroom has a row of urinals mounted at "standard" height and one urinal on the end that mounted at a lower height. From a universal design perspective, they should all be the same so that one is not highlighted as a fixture for those with special needs.

Some airports are using targets in the urinals to prevent extra cleaning related to aiming, or lack thereof. There are small, printed stickers that can be applied with a variety of playful images. Custom designs are also possible. An embedded stainless steel ball and an image applied to the porcelain prior to glazing are other options some manufacturers provide.

Toilet and Urinal Flush Valves

See Appendix A for component comparisons.

Flush valve selection decisions should consider type, location, and utility savings. Most travelers are looking for a touchless environment so an automatic flush valve is recommended. Low-flow water solutions as well as solar- and turbine-powered valves are available for water and power savings.

Based on the restroom layout, a decision needs to be made whether to use a concealed or exposed flush valve. This decision will likely be driven by chase access for maintenance. If there is a chase behind the fixtures, a concealed flush valve has a much simpler look and can be accessed without the maintenance staff needing to be inside of the restroom. This design is also easier to clean than the exposed pipe and fittings.

Drinking Fountain

See Appendix A for component comparisons.

Long days of traveling can be dehydrating so providing drinking fountains is important for the well-being of travelers. While the International Building Code requires only one drinking fountain per 1,000 occupants in a passenger terminal, it is good practice to provide one at each restroom set, in part because people generally associate drinking fountains with restrooms.

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There are numerous aesthetic options for drinking fountains. Look for models that are accessible, easy to clean, and complement the aesthetics of the restroom façade. It is recommended that the drinking fountain(s) be located in an alcove off the hallway. This avoids having the person at the fountain bent out into the traffic flow. It also keeps their bags more protected if temporarily set on the floor.

Drinking fountains are not permitted to project more than four inches past the primary corridor wall per ANSI A117.1-2003. This protects persons with a visual disability who use a cane from walking into the side of the fixture. For locations where space is not available to adequately recess the drinking fountain or for retrofits, most manufacturers make cane-guards for recent models that are inexpensive and easily attached under the high fountain to bring the fixture bottom down to the 27-inch maximum height off the floor.

Filtration on drinking fountains is recommended to provide clean and safe drinking water. The filters require maintenance in addition to the regular cleaning of the drinking fountain to remove debris collected in the drain.

Bottle-Filling Station

See Appendix A for component comparisons.

Given the current restrictions on the amount of fluids allowed to be brought through airport security, the growing awareness of the public to recycling, and the cost of drinks within an airport, many travelers are looking to fill their personal water bottles during their travel instead. Bottle-filling stations mounted on drinking fountains have filled these needs and have become quite popular.

Filtration on bottle fillers is recommended to provide clean and safe drinking water. Filters will require replacement. Automatic bottle fillers need to be cleaned regularly to help keep them dry and from growing mildew. Follow the manufacturer's recommendations on reach for accessibility.

Mop Sink

Mop sinks are a well-used, abused, and integral part of restroom maintenance. These should be placed in easy-to-access locations in pipe chases. Provide one mop sink per set of restrooms. There should be at least 24 inches clear on two sides to allow for both a mop bucket and a person to fill the bucket.

Given the use and abuse of mop sinks, they should be made of impact-resistant composite poly with an integrally molded drain along with a factory gasket and a removable stainless steel strainer. A stainless steel strainer will help prevent corrosion over time and unwanted material from getting down the piping.

Bumper guards (vinyl) on the edges will help prevent chipping and wear. A splash guard made of stainless steel stretching 18 inches up the back wall of the mop sink will prevent dirty and corrosive water from getting on the wall.

Provision of a hose, hose hanger, and mop hanger will help keep the area surrounding the mop sink organized and clean.

If the mop sink is at the end of a branch, provide a cleanout per the local plumbing code dedicated to the mop sink. The trap of the mop sink is not considered a removable trap and thus the cleanout is needed. Ideally the cleanout is a wall cleanout on the back wall behind the mop sink. If this is not possible, provide a floor cleanout in the same room as the mop sink. The cleanout needs to be a full-size cleanout. Consider making the back wall six inches thick to allow enough room for the cleanout.

Mop Sink Faucet

While a faucet may seem like a simple, necessary accessory to the mop sink, there are many considerations to take into account. The faucet should have both a hot water and cold water supply. On each of those there should be check valves (whether integral or separate). Other must-haves include a support arm, atmospheric vacuum breaker, integral shut-offs, pail hook, chrome finish, and lever handles.

Typically the faucet is installed approximately 48 inches above the finished floor or as called for in the manufacturer's recommendations.

If a third-party chemical dispenser is used, which is often an aftermarket item, a pressure bleeding device should be provided on the hose connection and the dispenser should be tested to ASSE 1052. Otherwise there is a risk over time of back-leaking soap into the water system.

Hose-Bibb

A hose-bibb is a necessary convenience for maintenance of airport restrooms. Whether a pipe needs to be flushed, a janitor needs additional water somewhere, or the cleaning process includes a periodic hose-down of the entire restroom, having a hose-bibb in an adjacent pipe chase or janitor's closet is vital. Locate the hose-bibb near the chase door. Make sure the hose-bib has an atmospheric vacuum breaker (either integral or separate) to prevent back flow into the system.

3.3.6 Heating, Ventilating, and Air Conditioning

Providing HVAC to the restroom is critical to perceived cleanliness and odor. With the right amount of ventilation, restrooms will smell better and users will enjoy the experience more. It will also allow for the elimination of air fresheners, which can often be overpowering, bothersome to people with allergies, and a maintenance hassle.

Radiation

Finned-tube radiation is a passive heating method used along exterior walls for both heating and reduction of condensation forming on windows and cold surfaces. Radiation covers should complement the overall restroom aesthetic. Stainless steel is a common choice as it is durable, easy to form, and matches other stainless steel elements in the space. Painted metal scratches easily and is not recommended.

Covers with flat tops are to be avoided because people tend to sit, place luggage, or step on them. Consider a pointed or sloped top to provide additional strength and prevent dust collection. Make sure the surface is easy to clean if textured.

Air Supply

Supply air is not required in restrooms by most building codes because they are, ironically, not occupied spaces (they are considered transient). Providing supply air, however, is good practice. Given that the area surrounding the sinks is often wet, provide supply air below the sink. This will help dry the wet surfaces and will keep the area around the sinks a comfortable temperature.

The space under the counter or sink is conducive to a linear diffuser for this purpose. For a clean look, run the diffuser from wall to wall. This will also allow for an equal distribution of air throughout the space. The ductwork will be located in the chase behind the sink and will need to be coordinated with the piping to ensure both have enough space. Coordinate with the plan layout as the chase will need a clear vertical run behind the sink and mirrors for the insulated duct, usually a minimum of eight inches, and space for the elbow from the diffuser to the duct.

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If space is limited, at the very least provide supply air above the sinks to promote air mixing and eliminate short cycling of the air. Short cycling is when the air comes directly out of the supply diffuser and is sucked right back out through the exhaust without having time to condition the space.

In single-fixture restrooms, like family rooms, it is also recommended to provide supply air. Where supplying air below the sink is not feasible, an overhead diffuser will still work well.

Exhaust

Without restroom exhaust, restrooms would be unpleasant places. Each restroom should have a dedicated restroom exhaust system with exhaust located directly above the stalls. Also provide a distributed diffuser system above each stall. This could be either a diffuser dedicated to each stall or one linear diffuser that runs above all of the stalls. Without exhaust above each stall, the air will take the path of least resistance and the stalls without exhaust may become stuffy.

At least, the code-required exhaust should be provided in the restroom. Where possible, provide an occupied and unoccupied setting by using the spaces' occupancy sensor and modulation of the fan. The code-required minimum should be the unoccupied setting; the occupied setting should be one and one-half times that. If the restroom has a restroom management system (RMS) as described in Section 3.3.9, the exhaust can be connected to provide a cleaning cycle that would be another one and one-half times the occupied setting. The cleaning cycle would allow for more air changes to occur in the space to remove cleaning chemical smells and help to dry floors wet from cleaning more quickly. This can be accomplished with either a standard exhaust fan with a variable frequency drive or an electronically commutated motor.

Providing access panels on both sides of the exhaust fan will allow for duct cleaning because, over time, toilet paper dust builds up substantially in ducts and fans.

Diffusers

The aesthetic and layout of the space should be considered when selecting diffusers. Verify the diffuser finish with the architect. Placement of diffusers is explained in the exhaust and supply sections. Noise criterion level is not a major concern in restrooms since there are so many noises that a little white noise is often welcome. Squealing or fan noise, however, should be dampened.

Thermostat

Locate the restroom thermostat in an inconspicuous location to avoid tampering. A ceiling-mounted thermostat or a wall thermostat with no display would be the best type. This can only be installed in spaces with a building automation system, common in larger airports.

3.3.7 Electrical

Aside from a receptacle for maintenance or cleaning, power is often overlooked in restrooms. Outlets for convenience power are a great amenity for travelers. Best locations are at mirrors and make-up/grooming counters to allow for a quick phone charge, shave, etc. Utilitarian functions that require power include for automatic sensors on plumbing fixtures, soap dispensers, and hand dryers and power tools in plumbing chases.

All receptacles near moisture need to be the ground-fault circuit interrupter (GFCI) type. There are two methods of ground-fault protection: at the circuit breaker and at the individual device. GFCI circuit breakers have better sensors and are less likely to nuisance trip, but they typically cost more and require the breaker to be reset (by facility staff). GFCI receptacles are a bit more cost effective and allow the user to reset the device, but they do trip more often. Refer to the National Electrical Code and local codes for exact ground-fault protection requirements.

3.3.8 Lighting

Of all the building systems, lighting can have the most dramatic effect on a space. In restrooms especially, lighting affects people's perceptions of everything from cleanliness to noise levels. Bright lights can be jarring and make travelers appear garish. Muted lights are calming and can make the room feel "quiet," a welcome benefit considering the whir of hand dryers and flushing toilets. Lighting that is too dark or a space filled with deep shadows is potentially hazardous as occupants bump through the space. They also make a person feel unsafe and the space seem dirty.

The color temperature of lighting, measured in kelvin (K), is also a critical consideration. Warm white lights are in the 2700 K to 3000 K range. This coloration is similar to incandescent lamps. Cool white lights in the 3500 K to 4100 K range appear bright and are good for detailed tasks. Natural daylight is in the 5000 K to 6500 K range and is the coolest colored light. Cool lighting can bring out a bluish cast in a space. At the mirror, this can make a person appear like they have traveled for days rather than hours. Warmer color temperatures feel welcoming and soft. Colors and materials under consideration should always be reviewed under lighting that has the same lamp coloration as that to be used in the restroom space.

General (Ambient) Lighting

Ambient lighting fills the space as opposed to task lighting, which highlights areas of specific activity. Ambient light levels should be bright and even to provide a feeling of clean and airy not dark and dismal. This lighting type should provide approximately five foot-candles (FC) in the walk zones for safety, security, and cleaning.

Task Lighting

The following sections address different locations for task lighting.

Entry. Lighting at the entries should accent signage that designates wayfinding, art, or other pertinent information. Lighting levels should not be too bright (or dim) such that users have a hard time transitioning visually from the adjacent area into or out of the restroom.

Sink Area. Lighting at the sink should be oriented to provide even vertical illumination (from the sides) onto the face, but somewhat softly to avoid glare into the eyes. Lighting from above the mirror can supplement the vertical lighting but should not be the sole source as it casts shadows that make a person's face look tired and gaunt. Vertical lighting should be evenly balanced on both sides of the face. Lighting integrated within mirrors works well to keep the walls clear of clutter and surfaces that collect dust. Recommended light levels at the sink area are 15 FC horizontal and 20 FC vertical.

Toilet Stalls. Lighting at the utility wall or over the toilet stalls will offer a clean and crisp appearance. Providing a linear slot or a light panel along the toilet wall or downlights within each stall will assist in evenly lighting all locations. Recommended light levels are 15 FC. Note that lighting from above and behind the toilet can cast the stall in shadow when a person is finished and stands. Consider providing light from the walk aisle or adding a small downlight.

Switch/Occupancy Sensor

Occupancy sensors provide energy savings by switching off lighting when no one is present. Occupancy sensors can also be used more creatively, such as tying them into mechanical systems to increase ventilation when the space is occupied.

Care needs to be exercised when selecting types of sensors for restrooms, so lighting does not go off when people are present. Line-of-sight sensors (for example, infrared) should not be used

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in restrooms with partitions or walls that shield the sensor's view of the space. Ultrasonic sensors placed too close to an entrance without a door may pick up people walking by and turn on lights when not needed. Dual technology (DT) sensors cost more but can "see" around walls and partitions, making them the best choice for larger restrooms. The time and sensitivity on devices should be properly set to provide maximum energy savings and minimum false offs.

Lamps

See Appendix A for component comparisons.

Lamp types can have a significant impact on maintenance and operational costs for any facility. Longer-life fixtures can lower maintenance and operational costs but typically have a higher initial cost.

LED lamps have long lamp life and good color temperatures and color rendering. The technology is changing rapidly, so fixtures and lamps selected now may be obsolete in the near future. Initial costs for LED lamps are higher than fluorescents and the drivers are likely to fail before the lamp expires. Maintenance costs are lower as relamping is rare.

Fluorescent fixtures also have a long lamp life and good color temperature and color rendering. Relamping adds more cost over time. Ballasts for fluorescent fixtures also need to be maintained. Compact fluorescent lamps provide more flexibility for use but have a slight warm-up time before coming to full on. This may be bothersome in smaller restrooms where they are the only light source and an occupancy sensor is utilized to turn lights on.

Daylight

Daylight has an amazing effect on people. It can change their demeanor, especially after being cooped up in a crowded checkpoint or concourse. Many restrooms are located with at least one exterior wall. Unfortunately, these walls are usually opaque. Even curtain walls have metal panels instead of glass for privacy or for a pipe chase. With a little creative planning, daylight can be pulled into a restroom, enhancing even more the ambience of a calm oasis.

Privacy is indeed important, so a good strategy is to provide a band of clerestory windows up high. For full-height glazing, a translucent white film up to the height where modesty is no longer a concern is recommended. Thin, clear strips toward the top of the glazed area can foster a connection to the outdoors without compromising privacy. Daylight can be borrowed from adjacent spaces, such as skylights in the concourse, again by provide strips of clerestory glazing.

Equipment, such as aircraft de-icing rigs, that may pass nearby should be considered because equipment operators are often at a height where they can see in. Even if they cannot, the perception that they can may make restroom occupants uncomfortable. Shadows at night can also be unintentionally revealing, so lighting should be placed to avoid casting shadows on the glass.

3.3.9 Technology

Some of the greatest customer service potential resides in the rapidly advancing realm of technology. Ironically, because the speed of change is so fast, incorporating cutting-edge products into restrooms may not be the most practical long-term strategy. Attempting to do so may find the airport in a constant state of obsolescence as each project finds newer versions of previous products. Standardization would be nearly impossible. The key is to find balance between innovation, especially in areas of sustainability, and long-term integration of updated products into the restroom spaces.

Fire Alarm

Fire alarm design is based on national and local codes. The airport may choose to go over and above the code requirements for added protection and peace of mind. This typically will include smoke-detection coverage throughout the facility. A good strategy is to locate manual pull stations adjacent to the restrooms as restrooms typically occur at standard intervals throughout terminals (see "Amenity Node" in Section 3.3.2).

Paging

Paging is used to inform patrons of flight status and other important announcements. The volume needs to be loud enough to be intelligible, but not overpowering. In larger restrooms, ambient noise sensors might be utilized to increase/decrease the volume of pages. Depending on the type of fire alarm and paging system, the paging speakers can reinforce announcements from that system.

Visual paging for the hearing impaired is also a requirement of the ADA and some airports have been sued for not providing this accommodation. With the clutter of accessories within the restroom, locating such a device can be a challenge. Providing FIDS outside the restroom, as recommended elsewhere in this guidebook, appears to be a reasonable accommodation; however, it has not been legally tested.

Ambient Music

Ambient music can be used to create a relaxed mood for travelers. In most facilities, the paging system has the ability to have an ambient music system input connected to it. Modest travelers appreciate the sound-masking properties of music as well.

Restroom Management System

Larger airports should consider incorporating an RMS. This system integrates several technologies, including some of the following:

- **Card reader.** Airports can leverage their existing card reader and badge systems to implement an RMS (see Figure 3-3). Cleaning personnel present their airport security badge to a card reader to indicate that the restroom is being cleaned. When the restroom is being cleaned, lighting and ventilation is increased through facilities automation controls. Displays near the restroom let passengers know that the restroom is being cleaned and where the nearest open restroom can be located.
- **Occupancy counter.** Airports can clean restrooms based on the number of travelers that have visited the restrooms when they use occupancy counters. This helps the cleaning staff work more efficiently.
- **Video displays.** A display, possibly integrated into the room entrance signage, can be used to indicate whether a restroom is open or closed for cleaning. This status can be generated by integration with the airport's card reader system. The screen should also indicate the location and direction of the nearest open restroom.

3.4 Cost Analysis

Airport restrooms are generally considerably more expensive than other types of public restrooms. If designed and constructed as recommended in this guidebook, they will require more space per person and use higher-quality materials. Managing the budget is a challenge. To help find the optimum balance in terms of customer service needs, life cycle costs, and the constraints on the construction costs, it is recommended that a professional estimator or contractor familiar with the local building climate be included on the restroom team.

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Figure 3-3. RMS with information monitor and backlit room sign. The card reader to activate maintenance features is located behind back-painted glass below the sign.

The matrix in Appendix A provides guidance in making initial selections of products with numerous variations based on costs, life spans, and features. Section 3.4.2 provides a worksheet to help prioritize the components. Coupled with periodic cost estimates, these tools will help keep the scope of the project within the allocated budget.

3.4.1 Estimates

If the restroom is not part of a larger building project, the restroom estimate should be prepared at the completion of the schematic design (when the general concept is complete). It should be a high-level estimate to test the scope based on system or square-foot costs. If the total is too high, the scope and quality of materials can be re-evaluated to meet the budget or the airport can elect to increase funding.

About midway through the architect's development of the construction documents, it is prudent to have a second estimate prepared. This estimate should be detailed, itemizing the labor and materials for each element in the project. This detailed estimate is the last chance to verify that the scope and quality is in conformance with the budget. It is much easier (and less costly) to make modifications at this point than after the bids are submitted.

3.4.2 Prioritization

With so many components to consider, it can be an overwhelming task to narrow a project's scope. Some components—floor materials, stalls, etc.—are easy; they are "must haves." Others—a make-up and grooming area, for example—are extras that might be nice to have if there is sufficient space and budget.

Table 3-1 lists the components described previously and provides a tool to identify components that are "Must Have," that belong on the "Wish List" if resources can accommodate it, or in

Table 3-1. Prioritization worksheet. Refer to Section 3.4.2 for information on worksheet organization.

MUST HAVE	WISH LIST	NOT INTERESTED	COMPONENTS
			SIGNAGE
			Concourse Wayfinding
			Location Sign
			Room Name
			Room Number
			Accessible Stall
			Ambulatory Stall
			Employees Wash Hands
			Advertising
			AMENITIES
			Waiting Area / Seating
			Full-Length Mirror
			Make-up / Grooming Area
			Dressing Room
			Adult Changing Table
			Severe Weather Shelter
			Amenity Node
			▪ AED
			▪ Fire Extinguisher
			▪ Manual Fire Alarm Pull Station
			▪ Airport Phone
			▪ Vending Machines
			▪ Shipping Drop Boxes
			▪ Lockers
			▪ Service Center
			Art / Display
			Storage
			SURFACES
			Floor
			▪ *Porcelain Tile*
			▪ *Porcelain Stoneware Slab*
			▪ *Epoxy Terrazzo*
			Wall and Base
			▪ *Porcelain Tile*
			▪ *Porcelain Stoneware Panel*
			▪ *Quartz*
			▪ *Epoxy Terrazzo Cove*
			Ceiling
			▪ *Gypsum Board*
			▪ *Metal Panel*
			▪ *Acoustic Ceiling Tile*
			Stall Partition - Type
			▪ *Ceiling Hung*
			▪ *Floor Mounted / Overhead Braced*
			▪ *Floor Mounted*
			▪ *Floor and Ceiling Mounted*

MUST HAVE	WISH LIST	NOT INTERESTED	COMPONENTS
			Stall Partitions / Urinal Screens
			▪ *Powder Coated Steel*
			▪ *Solid Plastic (HDPE)*
			▪ *Phenolic*
			▪ *Stainless Steel #4*
			▪ *Stainless Steel Textured*
			▪ *Recycled Paper - Resin Core*
			▪ *Solid Surface*
			▪ *Quartz*
			▪ *Granite*
			Stall Doors
			Counter / Backsplash
			▪ *Stone*
			▪ *Quartz*
			Solid Surface
			Room Door
			▪ *Stainless Steel*
			▪ *Painted Metal*
			▪ *Wood*
			Wall Protection
			ACCESSORIES
			Mirror
			Paper Towel Dispenser
			▪ *Folded*
			▪ *Center Pull*
			▪ *Roll Type*
			Sink Area Waste Receptacle
			▪ *Free Standing*
			▪ *Surface Mounted*
			▪ *Recessed*
			▪ *Enclosed*
			Hand Dryer
			▪ *Top Access*
			▪ *Bottom Access*
			▪ *Through Access*
			▪ *Recessed*
			▪ *Faucet Mount*
			Biohazard Disposal
			▪ *Exposed*
			▪ *Surface Mounted*
			▪ *Recessed*
			Toilet Paper Dispenser
			▪ *Surface - Standard Roll*
			▪ *Surface - Jumbo Roll*
			▪ *Recessed - Standard Roll*
			▪ *Recessed - Jumbo Roll*
			Stall Waste Receptacle
			▪ *Surface*
			▪ *Recessed*
			▪ *Combination*

(continued on next page)

Table 3-1. (Continued)

MUST HAVE	WISH LIST	NOT INTERESTED	COMPONENTS
			Seat Paper Dispenser
			▪ *Individual*
			▪ *Combination*
			▪ *Automatic*
			Shelf
			▪ *Wall Mounted*
			▪ *Fold Down*
			▪ *Built In*
			Hooks
			Sanitary Products Vendor
			Baby Diaper Changing
			▪ *Fold Down*
			▪ *Counter - Surface*
			▪ *Counter - Integral*
			Diaper Kit Vendor
			PLUMBING
			Sink
			▪ *Wall Mount*
			▪ *Under Counter*
			▪ *Self Rimming*
			▪ *Integral*
			▪ *Trough*
			Faucet
			▪ *Automatic*
			▪ *Turbine Powered*
			▪ *Solar Powered*
			▪ *Manual*
			Soap Type
			▪ *Foam*
			▪ *Liquid*
			Soap Dispenser
			▪ *Automatic*
			▪ *Manual*
			Soap Container
			▪ *Bulk*
			▪ *Bottle*
			Toilet
			▪ *Blow Out*
			▪ *Siphon Jet*
			Toilet Flush Valve
			▪ *Manual*
			▪ *Automatic*
			▪ *Turbine Powered*
			▪ *Solar Powered*

MUST HAVE	WISH LIST	NOT INTERESTED	COMPONENTS
			Urinal
			▪ *Standard Flow*
			▪ *Waterless*
			▪ *Low Flow*
			▪ *Pint*
			Urinal Flush Valve
			▪ *Manual*
			▪ *Automatic*
			▪ *Turbine Powered*
			▪ *Solar Powered*
			Drinking Fountain
			Bottle-Filling Station
			▪ *Manual*
			▪ *Automatic*
			Mop Sink
			Mop Sink Faucet
			Hose-Bibb
			HVAC
			Radiation
			Air Supply
			Exhaust
			Diffusers
			Thermostat
			ELECTRICAL
			Power
			LIGHTING
			General (Ambient)
			Entry
			Sink Area
			Toilet Stalls
			Switch / Occupancy Sensor
			Lamps
			▪ *LED*
			▪ *Fluorescent*
			Daylight
			TECHNOLOGY
			Fire Alarm
			Paging
			Ambient Music
			Restroom Management System (RMS)
			▪ *Card Reader*
			▪ *Occupancy Counter*
			▪ *Video*

which the restroom team has decided it is "Not Interested." The orange headings are the primary component groupings used throughout this chapter. The purple heading indicates that the component has sub-components. The blue headings indicate that the component has options (the bulleted items) that are compared in the component comparison matrix in Appendix A.

Components should be considered that will have the greatest impact on the airport's customer service needs, especially those that draw frequent complaints. Maintenance should also be considered; for example, would desired components place additional burdens on the facilities staff in the long term? The component comparison matrix (Appendix A) can be used to narrow choices for those components with numerous alternatives. A preliminary cost estimate of the must have and wish list selections will add that important variable to the decision-making process.

CHAPTER 4

Implementation

4.1 Construction

Typically a restroom project will be part of a larger airport project. It may be within a new terminal or expansion, or it may be part of a renovation of a particular area of the airport, perhaps baggage claim. In these types of projects, construction is fairly straightforward. The work occurs within the construction limits and is simply another space that is built out. Renovations of individual restrooms, usually part of a restroom upgrade program throughout the airport, is a whole different world of complexity.

4.1.1 Phasing

Unless the project is merely a facelift with new finishes and replacement of fixtures and accessories, it is unlikely the project will be contained within the current walls. The customer service driver of providing larger stalls and more circulation space implies enlarging the restroom space. This will likely affect the neighboring spaces and require relocating fixtures and their associated plumbing.

For obvious reasons, it is not possible to renovate all the restrooms at once so the restroom team will need to develop a phasing plan. While not efficient, it works best to spread out the work so each phase includes no more than one restroom from any concourse or terminal location at a time. The loss of even one restroom can have a significant impact on a concourse, especially if the fixture count is inadequate to begin with.

Construction barriers will temporarily shrink circulation spaces, a significant impact in concourses. The airport code official should be consulted to discuss how this condition may create egress concerns with the narrowed corridors that may need an alternative path.

If fixtures are relocated, power panels added, etc., utility shutdowns for plumbing, HVAC, sprinklers, and power will need to be planned for and coordinated between the contractor and airport managers.

Similar impacts occur if the restroom is being moved to a better location based on the master plan developed in Chapter 2. This kind of move will typically require the relocation of another tenant or function area, which will need to be completed before demolition and construction work can occur for the new restroom. Timing can be affected by lease terms so decisions should be made in the context of the airport's overall master plan.

4.1.2 Delivery Methods

Today's construction industry offers a variety of project delivery methods:

- Design-bid-build
- Design-negotiate-build

- Design-build
- Construction management
- Owner-build
- Integrated project delivery

However, every airport has unique legal requirements based on the type of governance. In an ideal world, the general contractor is brought in at the same time as the architect to be part of the restroom team. Their knowledge about construction methods and costs are invaluable and makes for a more efficient project planning and design process. However, as most airports are a public entity, public bidding is required.

In a bidding situation, it is recommended instead to bring in a construction manager (CM) early on in the process. With a similar knowledge of the local construction industry, a CM can provide similar insight to construction and costs. A CM can also manage the construction period, which can be especially useful for airports that are smaller or have infrequent projects. Regardless of the delivery method, it is vital that the owner, architect, and contractor (and/or CM) have a frank discussion upfront about expectations and limitations so the partnership is on the same page from the start.

4.1.3 Maintaining Standards

To maintain the project's design standards, it may be best to sole source some or all of the products. However, on a publicly bid project, it is standard practice to provide three manufacturers for a given product. Sometimes it is a legal requirement and the number of manufacturers may vary. While the intention of creating non-exclusionary bidding is laudable, it can wreak havoc on a project's design and the airport's product standards.

Finishes are particularly vulnerable in that often the entire finish scheme may be based on a particular wall material's color and pattern. Likewise, leaving the toilet manufacturer open to the capriciousness of the bidding climate can cause the airport to have to stock spare parts for multiple toilet models.

A successful strategy used by some airports is to allow substitutions. In this scenario, the bid specifications will list the desired manufacturer and their product. Then, instead of listing comparable manufacturers, the specification indicates that substitution requests are permitted. Standard specification language puts the onus on the bidder to demonstrate that the proposed substitution is an equivalent match to the desired product. The argument can also be made legally that the cost of sole-sourced products in the overall construction cost is a small percentage as the labor cost is not included.

4.1.4 Prefabricated Restrooms

Prefabricated restrooms are a concept that evolved primarily from hospital projects where pre-assembled headwalls with all equipment and finishes in place when shipped to the site were installed in a fraction of the normal construction time. While an entire prefabricated airport restroom might only be feasible in new construction, portions of the space can successfully be prefabricated. Restrooms have numerous repetitive modular elements that could be considered for prefabrication including pipe chase plumbing assemblies, sink walls, and possibly an entire family room. Here too finishes would already be complete. Shortening construction time significantly minimizes disruption caused by an out-of-service restroom(s).

4.2 Post-occupancy Evaluation

Since airport restrooms, especially in large airports, are repeated throughout the facility, it is important to think of the restrooms as living prototypes that are ever evolving. As each set is

designed and completed, there should be a cycle of evaluation. In the construction industry, a valuable final phase of a project is a post-occupancy evaluation.

This evaluation is conducted near the one-year anniversary of the project's completion, the milestone when the contractor's standard one-year warranty period concludes. The evaluation is conducted by the representatives from the airport, the architect, and the general contractor. The purpose is to verify that everything functions as planned. If not, the design might be tweaked, if not in this current project, then in the next. If a product is failing, replacement can be made under warranty.

More important, the product selection can be revisited to see if there is a better alternative available now. This is also the time to update the airport design and materials standard as well as the maintenance SOP. Customer service comments from the past year should be collected, analyzed, and discussed.

Ideally, the entire restroom team is reconvened for this important conclusion to the restroom project. With the wisdom of lessons learned, the team will be ready to begin the entire planning, design, and implementation process anew for their next restroom project.

Appendixes A–H

The following appendixes are included on the accompanying CD-ROM:

- Appendix A: Component Comparison Matrix
- Appendix B: Existing Restroom Evaluation Forms
- Appendix C: Case Studies
- Appendix D: Focus Group Summaries
- Appendix E: Survey Summaries
- Appendix F: Restroom Design Guidelines/Standards Sample
- Appendix G: Standard Operating Procedures (SOP) Sample
- Appendix H: Bibliography

APPENDIX I

Airport Restroom of the Future

"Toilets remain contested terrain, with the question remaining of how, truly, to make all toilets, and toilet users, equal before the law of the commode."

From "Pissing Without Pity: Disability, Gender, and the Public Toilet"
by David Serlin in *Toilet: Public Restrooms and the Politics of Sharing*,
Harvey Molotch and Laura Norén (Eds.)

I.1 Introduction

What if you could . . .

- Use small, flexible planning modules
- Add right-sized restrooms easily
- Prefabricate major elements
- Minimize maintenance shutdowns
- Help calm the harried traveler
- Provide a little extra help
- Accommodate all disabilities

What if you could . . .

- Create airport restrooms that are truly barrier free . . .

. . . BECAUSE ANYONE CAN USE ONE.

I.2 The Issues

Planning

Many airports were built with restrooms squeezed into inferior, leftover spaces. Now, especially in the wake of the events of 9/11, it is difficult to enlarge typical restrooms to accommodate travelers' carry-ons as well as accessibility for travelers with disabilities without decreasing the fixture count.

Construction

Renovating restrooms in airports is inefficient, working with varying vintages of layouts, infrastructure, and finishes. With differences in space constraints, it can be difficult to standardize layouts.

Maintenance

In typical restroom layouts, an entire gender's restroom becomes unavailable during cleaning or repair. Even restrooms designed to close down half are dependent on the unpredictable gender mix of the maintenance staff.

Accessibility

The ADA requires one accessible stall in a typical airport restroom. As travelers with disabilities are a small (but growing) percentage of the public, those in need often find the accessible stall occupied by an able-bodied person.

Gender

The issue of gender requires a brief history of the public restroom (synopsized from *The Bathroom* by Alexander Kira and *Toilet* edited by Harvey Molotch and Laura Norén). The earliest evidence of public restrooms is from approximately 1700 BCE at Knossos on Crete. The technologically sophisticated facilities were not unlike contemporary restrooms and were available for townsfolk as well as travelers. Most of the great cities of the ancient world up through the time of the Roman Empire had similar accommodations for the public although it is not known if genders were separated.

For the next thousand years, public restrooms fell out of fashion to the point where public dung heaps were the norm if there was anything at all. Even during the opulent times of Louis XIV, it was common to use streets, cellars, and yards when the need arose. In his proposals for public housing in new towns, Leonardo da Vinci noted that all stairways should be spiral to prevent sanitary misuse of landings.

The nineteenth century saw a renewed interest in public facilities because of disease epidemics like the cholera outbreak during the Civil War, events such as the Crystal Palace Exhibition in London with 800,000 visitors, and, more significantly, the rise of rail travel and the new terminals to accommodate the travelers. Today, public restrooms are generally easy to find in malls, gas stations, parks, etc. with separate facilities for men and women and even unisex spaces for families and those traveling with a companion for assistance. Restrooms for both men and women, however, are a relatively recent provision.

The first law in the United States to require restrooms for women in addition to men was enacted in 1887 in Massachusetts and was aimed at factories and workshops. By 1920, only 43 of the 48 states had adopted similar legislation. The reason for such a law in the first place came into being in the early nineteenth century when the industrial revolution saw men leaving their homes daily to work at the aforementioned factories, etc. The rapid growth in technology and industrialization invaded life with new dangers and filth at every turn. This, coupled with the Victorian assumption that females were endowed with greater moral sensibility and religious inclinations than men, effectively made the workplace the domain of men and the home that of women.

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These intrusions of urban life also increased the desire for personal privacy, which in turn led to increased concerns of modesty, especially regarding the human body and bodily functions.

The anxiety of women emerging from the homestead to work, shop, socialize, etc. led to the notion to create separate home-like spaces in public places like libraries, department stores, hotels, restaurants, and railroad cars. But in the industrial workplace, men and women took turns using the meager facilities provided by employers. Women's "physical vulnerability" to unsanitary conditions was a primary justification behind the creation of separate restrooms as was the protection of their virtue and morality. Also included in the "Ladies Room" was a space for emergencies resulting from dizziness, fainting, and other symptoms of illness. In summary, the first sex separation laws for public restrooms were not based on the anatomical differences of men and women but rather to vindicate Victorian era moral ideologies concerning the appropriate role and place for women in society.

So why is this relevant now in public restrooms, particularly in airports? It seems that the common pairing of a restroom each for males and females has functioned just fine for decades. But the "toilet laws" have impacts that remain influential. As has been seen in other aspects of our society, "separate but equal" rarely is equal. The typical 50/50 ratio of fixtures in men's and women's rooms has actually created a barrier for women in terms of time. Building codes allow one-half to two-thirds of the toilets in a men's restroom to be substituted with a urinal. The quick-zip design of men's clothing and the ease of maneuvering at urinals shorten their visit compared to women who also have needs due to pregnancy, menstruation, and higher levels of incontinence in old age. Women are also more likely to have in tow babies, small children, or elderly relatives, all of whom need to use the restroom more often and require more space within the stall for the number of persons and equipment. Last, women comprise a larger proportion of persons with disabilities.

Even though current building codes have been revised to provide more fixtures for females in certain building types, they remain 50/50 in airport terminals in the International Building Code. Another impact unique to airports that affects women as well as men is the constantly varying gender mix of travelers throughout the day. At any point in time, a line can be encountered at either gender's restroom.

Gender segregation also creates difficulties for parents with opposite-sex children or traveling companions in need of assistance such as an elderly relative or a person with a physical disability. Another side-effect that is more understood today is the symbolic message that there are two sexes, which is an impediment to the acceptance of those persons who are transsexual, transgender, and intersexual. Modern society has taken steps to remedy some of these discriminations with the provision of a unisex restroom. However the common names of "family room," "companion care room," and "assisted care room" have their own exclusionary connotations.

We seem poised at the next step in the evolution of public restrooms and gender, a step away from antiquated mores about the sexes and toward seeing people as collectively human. Take our subtle differences out of the equation, and we are faced with the need for only a single type of facility for our personal hygiene; see Figures I-1 and I-2.

I.3 What Is Solved

Barrier Free

Every fixture is accessible for all disabilities and genders—universal design realized.

Planning

The compact module maximizes the number of fixtures by fitting around obstructions (like shafts) and is more flexible to configure in odd-shaped spaces.

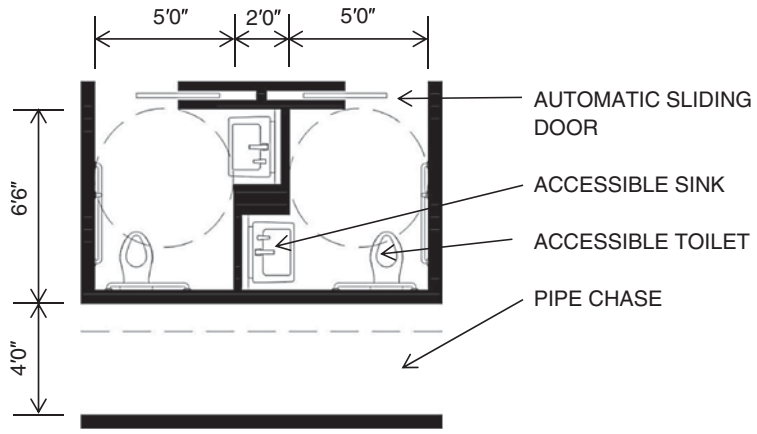

Figure I-1. The airport restroom of the future module.

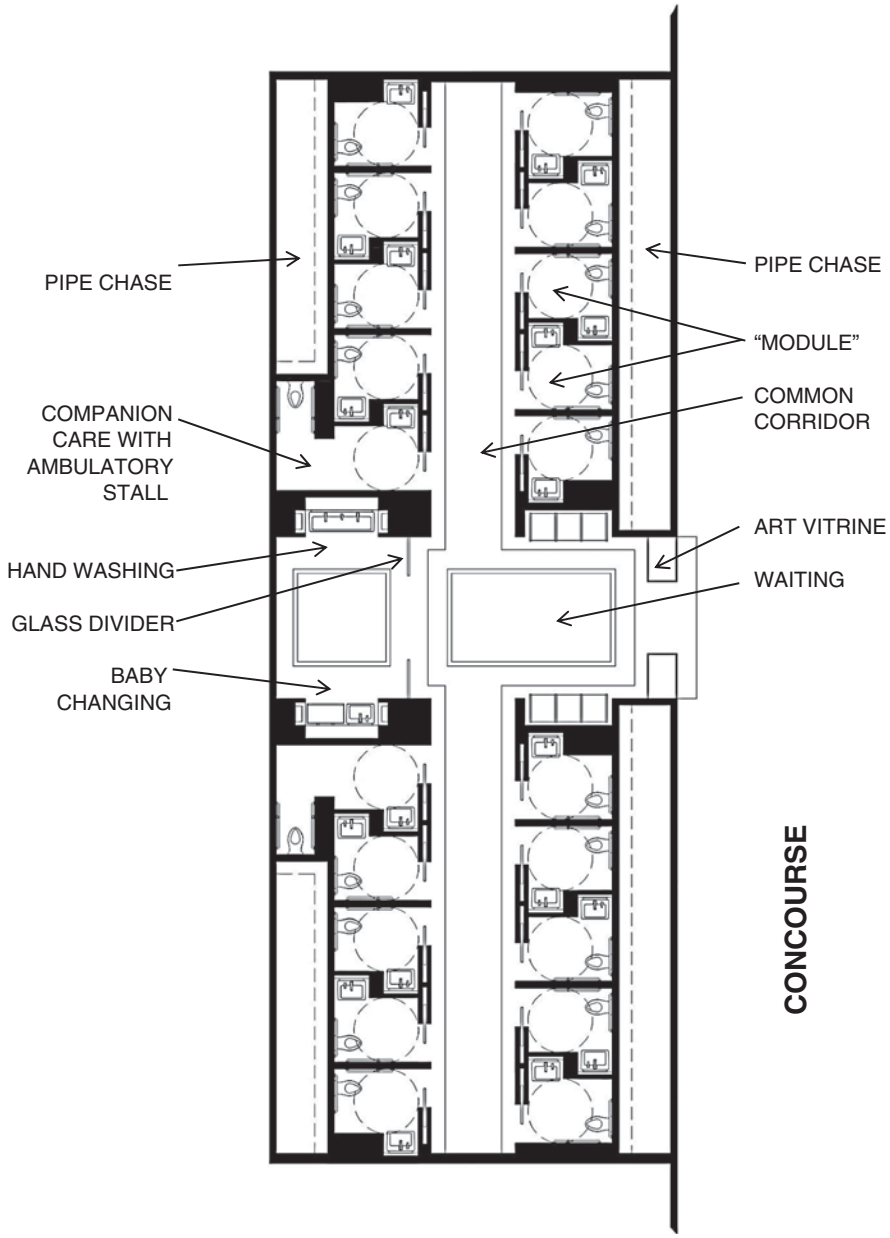

Figure I-2. Conceptual airport restroom of the future layout.

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Construction

The module is ideal for prefabricated assemblies. The entire module or entire wall assemblies can be built offsite and brought in and fit together with other modules, speeding up construction time and minimizing disruption for renovations within the airport.

Maintenance

One module can be cleaned or repaired at a time, taking only one fixture out of service instead of an entire restroom.

Personal Space

Calm and quiet. Room enough to change clothes, space to shave, put on make-up, etc.

I.4 Still to Be Addressed

Security

Airport police will likely have concerns about illicit behavior in closed rooms (drugs, sex, etc.). These rooms, however, are no different than family rooms. In addition, having more people circulating in the restroom area would likely deter undesired behaviors.

Gender Separation

People have expectations of privacy when they go to a restroom, especially from other genders. There may be discomfort among the genders about comingling in the common corridor, and likely too about using the same restroom space right after someone of a different sex. There is a precedent for sharing restrooms, however, with family rooms, airline restrooms, and porta-potties, although the latter two are fairly universally considered unpleasant experiences.

Cleanliness

A primary factor in this attitude is probably the biggest obstacle to the acceptance of this restroom concept: the cleanliness practices of the other sexes. Specifically, this includes splashing and (not) aiming while urinating for males and, for females, hovering (and thus splashing while urinating) and remnants from menstruation. It's easy to say that people just "need to shape up," but changing behavior is difficult, especially as it relates to a transient public space that the users have no vested interest in.

Multiple Disabilities

Some disabilities require getting onto the toilet seat from a front approach, others with a side transfer. One works best with a side and rear grab bar, the other with parallel side grab bars. These two configurations are in conflict, which is why the current concept plan has ambulatory configurations in the two companion care rooms. Ideally, a grab bar system would be created that could accommodate both scenarios. There are swing-down grab bars available that are allowed in housing, but not in public restrooms. This product also conflicts with the rear grab bar location in an accessible stall. Until these two configurations can be combined, two types of restrooms will be required and therefore the module will not be completely barrier free.

Companion Care Rooms

Ideally, companion care rooms, family rooms, etc. would be configured in a way to provide visual privacy from anyone else in the space for the person using the toilet. The module in this

concept is purposefully compact for efficiency. With the required clearances for accessibility, there is room for more than one person in the module, but there is no privacy. The two companion care rooms do provide privacy, but again this is a second layout so the module is technically not barrier free for all.

Perception of Cleanliness

It was noted by some of the case study participants that having a full-time cleaner in a restroom gives the perception that the space is clean because someone is actually seen working at it. Even if some part is dirty or a toilet paper dispenser is empty, people tend to be more forgiving because the cleaner will get to it soon.

The configuration of the Airport Restroom of the Future concept is ideal to be staffed by a full-time cleaner who can move continuously from one unoccupied room to the next. This person could also be available to provide assistance to people with special needs if they are on their own. Developing technologies such as using motion detectors to monitor the number of users in each module could be used to inform the cleaners which rooms need to be cleaned next.

Building Code Requirements

Current building codes require restrooms for both men and women. Unisex rooms, like family rooms, are an optional extra and contribute marginally, if at all, to the fixture count requirements. A significant change in thinking and legislation would be required to allow the Airport Restroom of the Future concept.

I.5 What Next?

Perhaps nothing. Ideally, though, discussion will occur and possibly some airports and their designers will test the waters with certain aspects. Our current society and culture may not be ready yet for such a drastic change from our Victorian underpinning, much as they would not have been 100 years ago with the typical airport restroom of today. According to air travelers, however, who have become particularly vocal about their expectations, there is ample room for improvement.

APPENDIX J

Glossary

AED: Automated external defibrillator.

Airplane Design Group (ADG): FAA roman numeral aircraft classification based on wingspan and tail heights.

Airport Authority: An independent governmental public organization responsible for the operation and oversight of an airport or group of airports under its jurisdiction.

Airside: The secured area of the terminal located post-security containing aircraft gates, holdrooms, concessions, aircraft apron maneuvering areas, etc.

Americans with Disabilities Act (ADA): Civil rights act requiring access throughout buildings and their surroundings for people with disabilities. Not a building code. Various code authorities such as the International Code Council (ICC) and American National Standards Institute (ANSI) provide enforcement.

Attic Stock: Additional materials or equipment parts specified to be provided to the owner by the contractor at the completion of a project. Stored for future replacement or repairs. Typically includes long lead-time items and materials with finishes and colors that could be discontinued in the future.

Concourse: Primarily the secure area (airside) of the airport used by travelers, containing aircraft gates, holdrooms, concessions, restrooms, circulation, and other passenger services and functions to support aircraft operations.

Deplaning Passenger: A terminating or connecting passenger exiting an arriving aircraft.

Design Demand: The number of passengers expected to use the facility.

Double-Loaded Concourse: Aircraft parking positions located on both sides of a concourse.

Enplaning Passenger: A passenger boarding a departing aircraft.

Equivalent Aircraft (EQA): A metric used to normalize the capacity of a gate based on the seating capacity of the aircraft that can be accommodated at the gate: 1 EQA is equivalent to 145 seats or that of a typical narrowbody aircraft.

Family Room: A restroom with one fixture and sink for use by people traveling with a companion(s) with special needs such as children, caregiver, etc. Also for use by transgender individuals. Other names include companion care, unisex, special needs, and family care.

FIDS: Flight information display system.

Fixture: A toilet or urinal within a restroom.

Gate: The physical space containing the passenger holdroom and associated aircraft apron parking position.

Ground Transportation Center (GTC): A centrally located facility which provides commercial passenger pick-up and drop-off.

Hub: An airport that has a high level of connecting flight activity.

Landside: The non-secure area of the terminal located pre-security, containing passenger processing functions such as check-in, security screening, baggage claim, concessions, ground access connections, and other functions located outside the secured area of the terminal.

Load Factor (LF): A measure of an aircraft's capacity utilization expressed as a percentage of total seats.

Meeter & Greeter (M&G): Visitors associated with arriving (deplaning) passengers.

Module: A restroom set containing both men's and women's toilet locations and associated family/companion care facilities, janitorial closets, chase space, and other passenger amenities such as drinking fountains, FIDS, etc.

MUFIDS: Multi-user flight information display system.

Origin and Destination (O&D) Passenger: Passengers starting or ending their journey at a particular airport.

Peak-Hour Arriving Passenger Demand: The number of deplaning passengers in a given rolling hour of the design day.

Peak-Hour Departing Passenger Demand: The number of enplaning passengers in a given rolling hour of the design day.

Short-Haul Domestic Flights: Domestic flights associated with routes which typically last less than 1.5 hours in duration.

Single-Loaded Concourse: Aircraft parking positions located on one side of a concourse.

Total Peak-Hour Passenger Demand: The number of enplaned and deplaned passengers in a given rolling hour of the design day.

Well-Wisher (WW): Visitors associated with departing (enplaning) passengers.

Wingtip: The outer most edge or tip of an aircraft wing.

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation