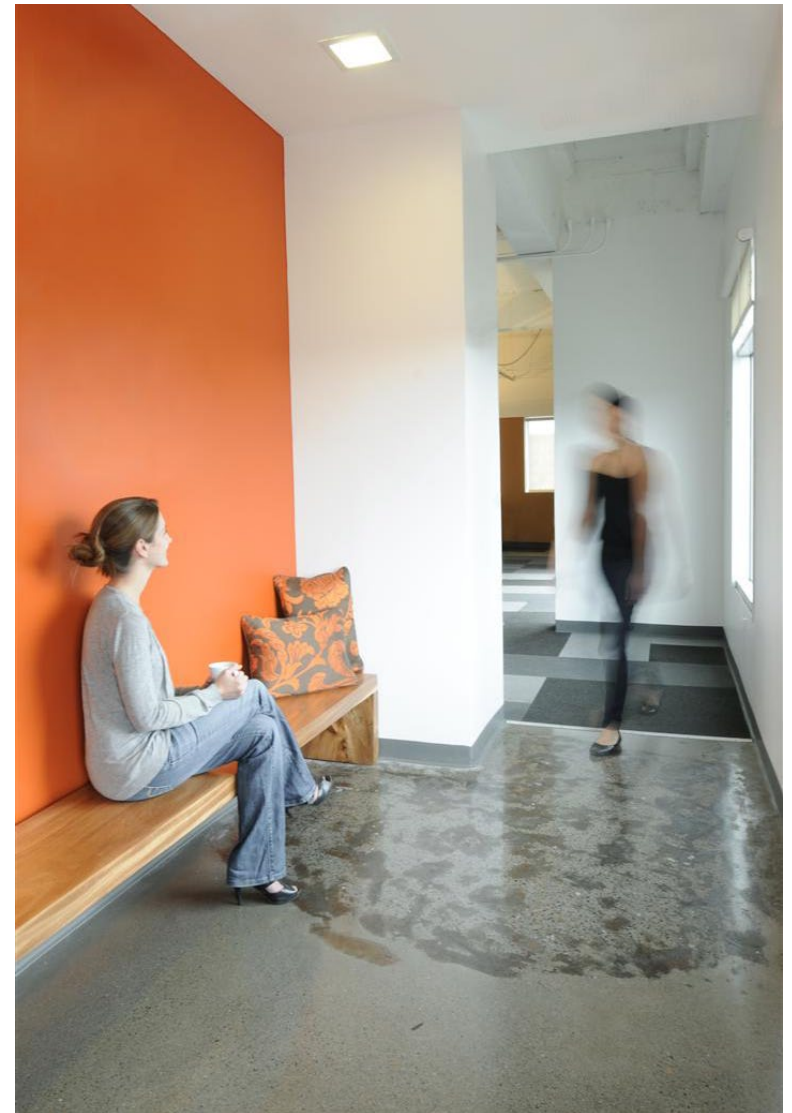


CIRCULATION: DEFINING AND PLANNING

May 11, 2012

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INTRODUCTION

If the amount of area dedicated to circulation is underestimated, the programmed Usable Area may not reflect the amount of space needed to accommodate the envisioned workplace.



Determining an organization's space needs typically begins by itemizing the various space types, their area, and quantity. The subtotal of this calculation, also known as Net Area, is then adjusted to take into account pathways leading to and in-between the different types of spaces. This is accomplished by applying a Circulation Multiplier, which takes the form of 1.## (e.g., 1.50), to the Net Area. The resulting subtotal becomes the total Usable Area for the organization and forms the starting point in the design and planning for a new workplace.

Despite this seemingly straight forward approach, Circulation Area is often underestimated. For decades, facility planners, designers, architects, and real estate professionals have adjusted the Circulation Multiplier in order to achieve a target Usable Area, rather than reducing the space requirements for individual and support spaces. However, circulation is a necessary component of a space program. If the amount of area dedicated to circulation is underestimated, the programmed Usable Area may not reflect the amount needed to adequately accommodate the new workplace.

Circulation: Defining and Planning is an attempt to bring clarity to this topic. It explores terminology, the difference between Circulation Multipliers and Circulation Factors, and a recommended method to estimate and plan for circulation.

This document also explains, through the use of case study examples, how to evaluate a building's efficiency by calculating the actual circulation. It's worth noting that the case studies and examples shown in this document are illustrated on full floor tenants, rather than multi-floor tenancy, for ease of explaining the concepts. They also use ANSI / BOMA Z65.1-1996, "Standard Method for Measuring Floor Area in Office Buildings", as the basis for terminology definitions.

Circulation: Defining and Planning consists of four sections:

DEFINING

Adopting a common language about circulation

PLANNING

Determining how to use the right Circulation Multiplier for a project

CASE STUDIES

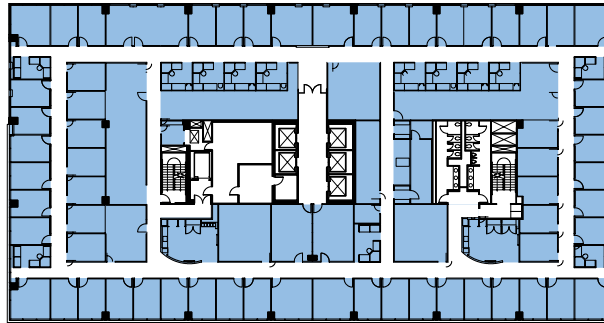
Demonstrating the impact of circulation in completed projects

KEY TAKEAWAYS

Factors that should always be considered when calculating the Circulation Area

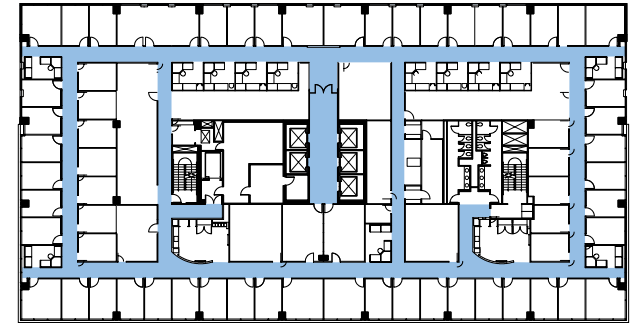
DEFINING

A common language about office space.



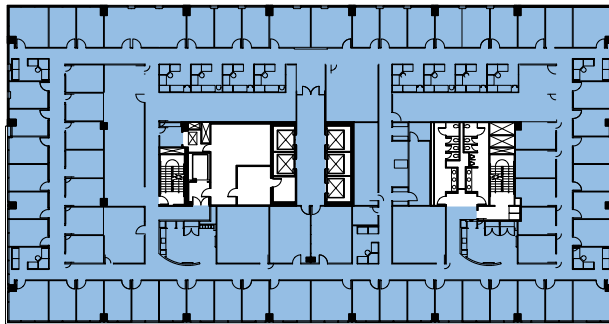
NET AREA (NET SQUARE FEET - NSF)

The area of each identified program space. For example, the Net Area of an 8' x 8' workstation is 64 NSF. It includes individual workspaces, dedicated and shared support spaces, and special mission-critical spaces.



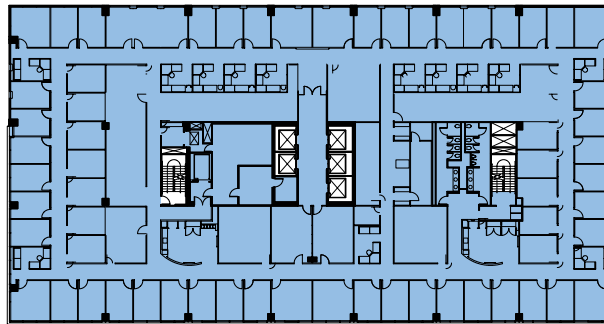
CIRCULATION AREA (PRIMARY & SECONDARY)

Primary circulation is the main circulation route connecting to the building core and common spaces, such as elevators and exit stairs. Secondary circulation includes the aisles between individual spaces, such as offices and cubicles, and support spaces.



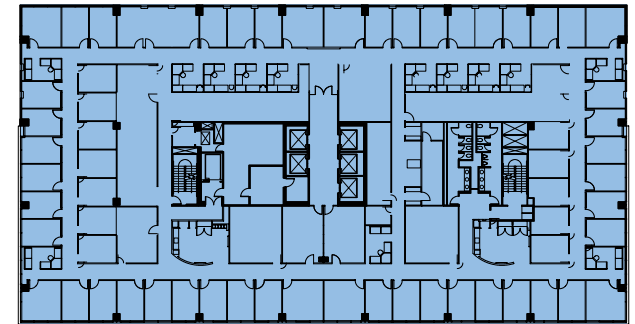
USABLE AREA (USABLE SQUARE FEET - USF)*

Area of a floor occupiable by a tenant where personnel or furniture are normally housed.



RENTABLE AREA (RENTABLE SQUARE FEET - RSF)*

Total Usable Area plus a prorated allocation of the floor and building common areas within a building.



GROSS AREA (GROSS SQUARE FEET - GSF)*

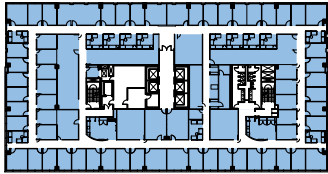
Total area of a building enclosed by the exterior face of the perimeter walls, calculated on a floor-by-floor basis.

* Definitions per ANSI/BOMA Z65.1 - 1996, "Standard Method for Measuring Floor Area in Office Buildings"

DEFINING

A common language about office space.

NET AREA (NSF)



What it Includes

Includes workspaces (office and workstations), dedicated support (conference rooms, supply rooms, etc.), shared support (shared copier rooms, break rooms, etc), and special mission-critical support spaces (evidence rooms, laboratories, courtrooms, etc.)

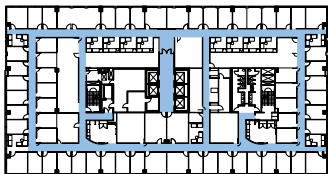
How it is Measured

Measure to the centerline of interior partitions of a space. Total Net Area is calculated by adding together all programmed areas.

When is it Used

- Space Programming
- Space Standards/Guidelines
- Tenant Improvements

CIRCULATION AREA



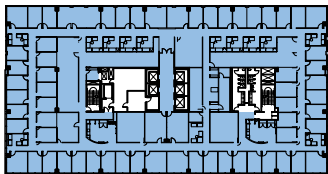
Circulation Area can be broken into two types: primary and secondary. Primary circulation is the main route connecting the building core and common spaces, such as elevator lobbies, exit stairs, and core toilets. Secondary circulation is the aisles between individual and support spaces.

Based on the ratio of enclosed spaces to open spaces, a Circulation Multiplier is estimated and applied to the total Net Area to determine the Circulation Area.

Planning Formula: Circulation Area = NSF x (Circulation Multiplier - 1)

- Space Programming
- Space Standards/Guidelines
- Tenant Improvements

USABLE AREA (USF)*



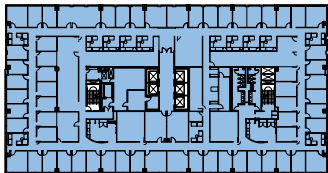
Includes Net Area and Circulation Area, but excludes building core and common spaces such as elevators, exit stairs, mechanical rooms, and core toilets. For multi-tenant floors, common building corridors are excluded from Usable Area and instead, are included in the Rental Area.

See ANSI/BOMA standard* for detailed calculation method. Generally speaking, measure the area enclosed between the finished surface of the office area side of corridors and the dominant portion of the exterior walls or vertical penetrations.

Planning Formula: USF = NSF + Circulation Area

- Space Programming
- Space Standards/Guidelines
- Tenant Improvements

RENTABLE AREA (RSF)*



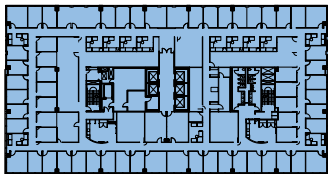
Usable Area and building common spaces, such as the building lobbies, egress corridors, service spaces (mechanical/electrical, toilet, janitorial, etc), and loading docks. Excludes major vertical penetrations, such as stairwells, elevators, and major shaft spaces.

See ANSI/BOMA standard* for detailed calculation method. Generally speaking, add the usable area to building common spaces while excluding major vertical penetrations.

Planning Formula: RSF = USF + prorated share of Building Common Area

- Commercial Leases
- Rent Calculation

GROSS AREA (GSF)*



Includes exterior wall thickness, and all vertical penetrations (mechanical/electrical, plumbing, elevator shafts, stairwells, etc.), as well as basements, garages, and penthouses. Excludes parking lots and loading docks outside the building line.

See ANSI/BOMA standard* for detailed calculation method. Generally speaking, measure to the outside finished surface of permanent outer building walls.

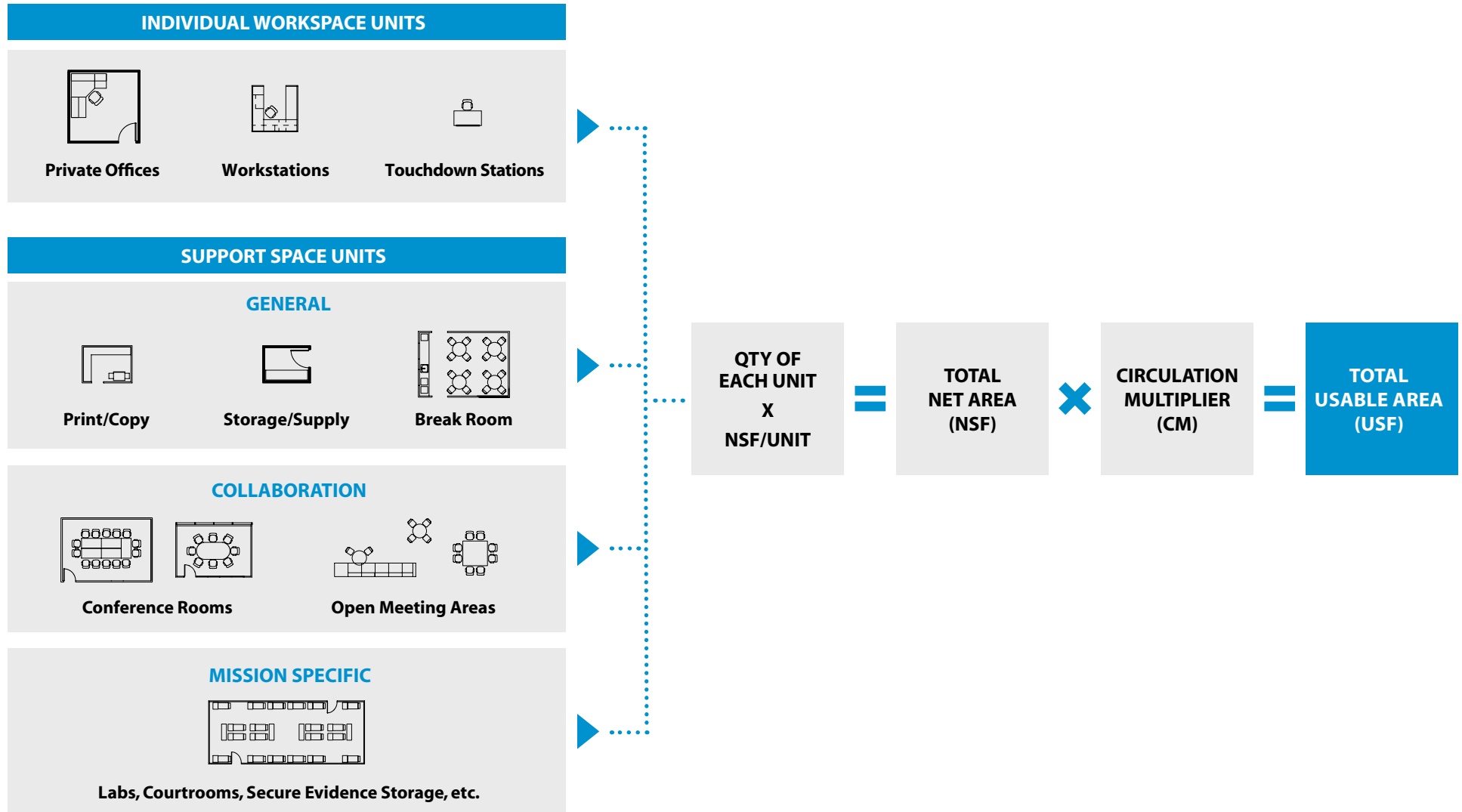
Planning Formula: GSF = RSF + Vertical Penetrations and Building Exterior Walls

- Construction
- Real Estate Portfolio

* For additional details on these definitions and space calculation methods, please refer to ANSI/BOMA Z65.1-1996, "Standard Method for Measuring Floor Area in Office Buildings".

PLANNING: NET AREA, CIRCULATION, & USABLE AREA

A Circulation Multiplier is applied to the Net Area to estimate the amount of Circulation Area that should be included in the Usable Area.



PLANNING: CALCULATION METHODOLOGY

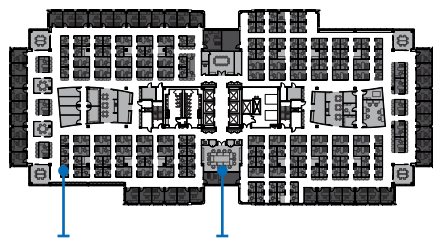
The proportion of open to enclosed spaces is the best gauge for determining a Circulation Multiplier.

CALCULATION METHODOLOGY

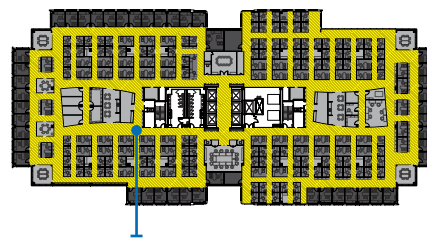
Circulation Area is a function of the open and enclosed spaces that exist in the workplace. When a floor plan is comprised of mostly open workstations, the Circulation Area will typically be a greater portion of the total Usable Area than a plan made up of primarily enclosed office spaces.

A unique Circulation Multiplier should be chosen for each project after considering the anticipated proportion of open to enclosed spaces to be provided. Planners should avoid the practice of using the same Circulation Multiplier on all workplace projects (see *Common Misconception* at right). Care should also be taken to not confuse the Circulation Multiplier with the Circulation Factor. The Circulation Multiplier is applied to Net Area. The Circulation Factor is the percentage of Usable Area that makes up the Circulation Area. This distinction is demonstrated below:

EXAMPLE REQUIREMENT: 45,000 NSF



PERSONNEL + SUPPORT = ~ 28,000 NSF



CIRCULATION AREA = ~ 17,000 NSF

NSF + CIRCULATION AREA = NSF

28,000 + 17,000 = 45,000

NSF ÷ CIRCULATION AREA = CIRCULATION MULTIPLIER (CM)

28,000 ÷ 17,000 = **1.65**

CIRCULATION ÷ NSF = CIRCULATION FACTOR (CF)

17,000 ÷ 45,000 = **37.8%**

1.65
MULTIPLIER

37.8%
FACTOR

COMMON MISCONCEPTION

Historically, a Circulation Multiplier of 1.35 applied to the Net Area was assumed to provide adequate space for circulation, regardless of the configuration of the building or the type and ratio of open and enclosed spaces. However, when this method is used, the resultant Circulation Area is just 26% of the total Usable Area.

The following calculation illustrates this distinction using a total Net Area of 28,000 square feet and a Circulation Multiplier (CM) of 1.35:

NSF × CM = NSF

28,000 × **1.35** = 37,800

NSF - NSF = CIRCULATION AREA

37,800 - 28,000 = 9,800

CIRCULATION AREA ÷ NSF = CF

9,800 ÷ 37,800 = **25.9%**

1.35
MULTIPLIER

25.9%
FACTOR

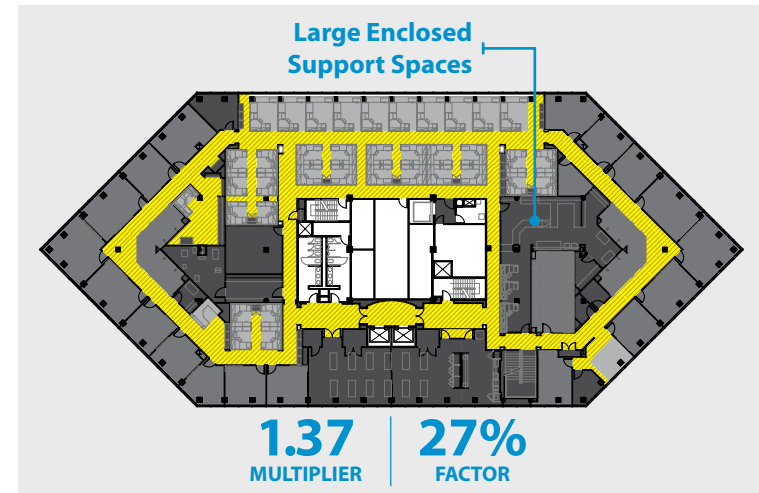
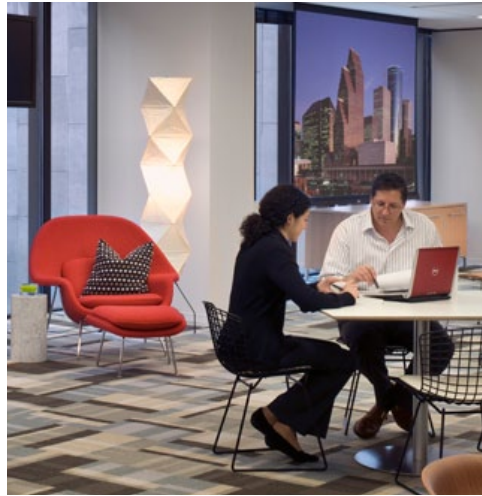
As subsequent case studies will illustrate, this Circulation Multiplier can be appropriate when the total Net Area is primarily composed of enclosed spaces, such as private offices. In open workplace settings however, a Circulation Multiplier of 1.35 will often be insufficient.

PLANNING: CIRCULATION MULTIPLIER CONSIDERATIONS

There are many factors that can affect circulation, such as: Large Enclosed Support and Special Spaces, Open to Enclosed Workspace Ratios, and Building Design and Efficiency.

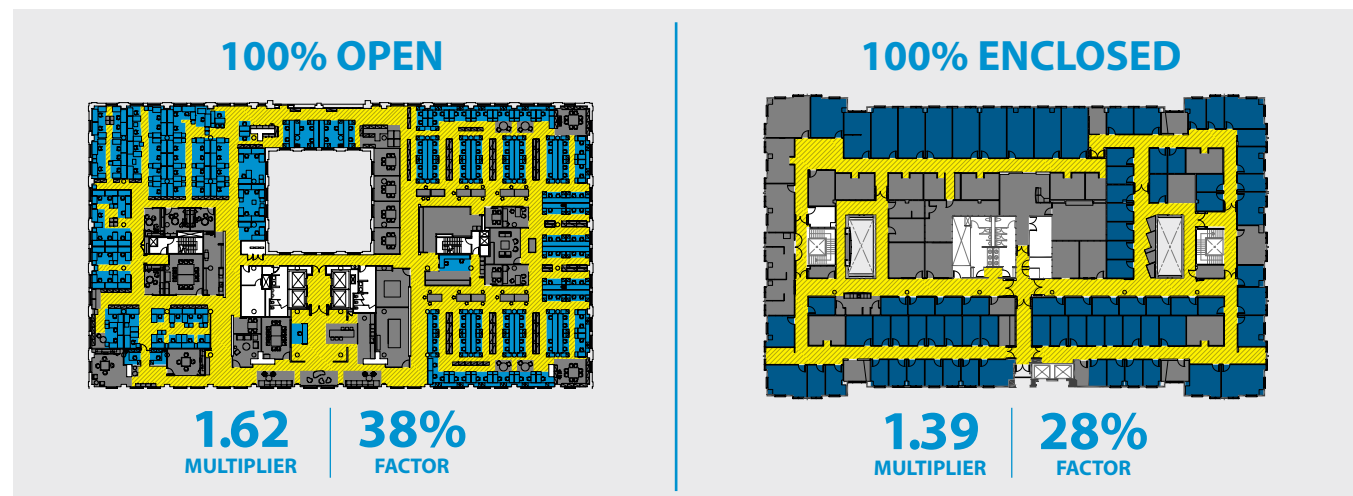
LARGE ENCLOSED SUPPORT AND SPECIAL SPACES

If an organization's program includes large support spaces (e.g., training rooms, storage) or special mission-critical spaces (e.g., courtrooms, law libraries), the requirement for Circulation Area may be reduced. Large enclosed rooms generally incorporate internal secondary circulation within the program area and require less additional circulation than a comparable total area of smaller clustered workstations.



OPEN TO ENCLOSED WORKSPACE RATIOS

The amount of circulation that is needed for a future workplace is strongly correlated to the ratio of open workstations to enclosed private offices. The quantity and unit footprint area of open plan workstations impacts circulation since they require proportionally greater circulation than larger, enclosed spaces. Also, as workstations are constructed of fixed, usually rectilinear elements, the need to plan around columns or building irregularities can hinder efficient layouts.



PLANNING: CIRCULATION MULTIPLIER CONSIDERATIONS

BUILDING DESIGN AND EFFICIENCY

The efficiency of a floor plate can vary depending on the location of the building core, the regularity of column spacing, or the building configuration. Historic building floor plates are often less efficient due to column sizes and the building configuration. Some modern buildings also provide unique irregular floor configuration challenges.

Even with the most efficient layout, there may be a mismatch between the building module and the tenant’s standard office depths or workstation dimensions. This can result in inefficient configurations and thus, a greater amount of unaccounted for circulation space.

PLANNING FOR CIRCULATION

Workplace requirements are developed early in the planning process and often before a building is selected. As such, a Circulation Multiplier (CM) should be selected based on the anticipated amount of Circulation Area that will likely be needed given a typical building design and efficiency.

A Circulation Multiplier of 1.4 can be used if there is a much greater portion of enclosed offices and support spaces. Conversely, a Circulation Multiplier of 1.6 should be used if the space is a predominantly open plan or if the building floor plate is highly irregular. To further compensate for anticipated inefficiencies in building floor plate choices, a penalty or “fit” factor may be added to the Circulation Multiplier as a type of contingency.

RECOMMENDED RANGES

CIRCULATION MULTIPLIER (CM)	
1.4 - 1.6 RANGE	1.5 AVERAGE
CIRCULATION FACTOR (CF)	
28 - 38% RANGE	33% AVERAGE

CASE STUDIES: OVERVIEW

The floor plans of four different organizations, representing a range of different office configurations, were analyzed to understand the impact of open to enclosed ratios on circulation.

To illustrate the impact of open and enclosed workspace ratios on the Circulation Multiplier, GSA commissioned Gensler to provide case studies from full floor tenants, whose profiles range from 100% enclosed offices to 100% open workstations. This section presents four case studies that demonstrate workplace environments which provide minimal circulation space and others that provide more generous Circulation Area to encourage informal staff interaction and collaboration.

These case studies further explore the relationship between workspace type and circulation in existing buildings. The corresponding Circulation Multipliers represent a rounded range of 1.4 to 1.6, and can be used to more accurately determine the Circulation Area that will be needed for a future workplace. As a general rule, plans with a higher ratio of open to enclosed workspaces also require higher Circulation Multipliers due to the increase in seat capacity per floor.

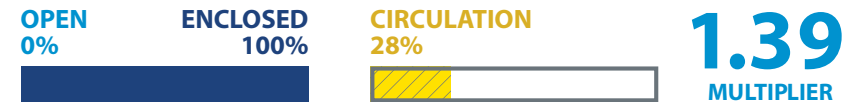
Each case study plan is annotated with the following:

- percentage of open plan workstations to enclosed offices
- total Usable Area
- total seat count on the floor
- Circulation Multiplier
- Circulation Factor

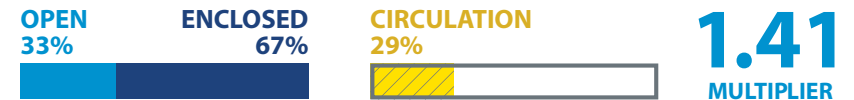
It should be noted that the indicated Circulation Multipliers and Circulation Factors are based on as-built circulation as a percentage of the total Usable Area. They are not necessarily the numbers that were used during pre-design programming to estimate the amount of space that would be needed.

CIRCULATION COMPARISON BETWEEN PLAN TYPES

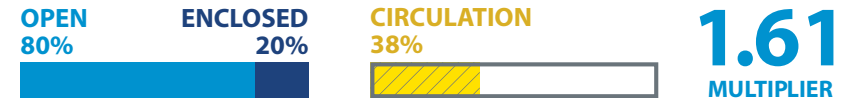
CASE STUDY #1



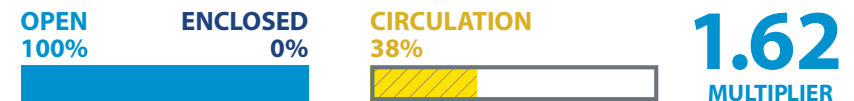
CASE STUDY #2



CASE STUDY #3



CASE STUDY #4



CASE STUDY #1

0% OPEN / 100% ENCLOSED | USABLE AREA: ~23,000 USF



OBSERVATION

A floor plan with a large number of private offices and enclosed spaces requires less circulation, but also accommodates fewer headcount.

FLOOR CALCULATIONS

OPEN
0%

ENCLOSED
100%

79
SEAT COUNT

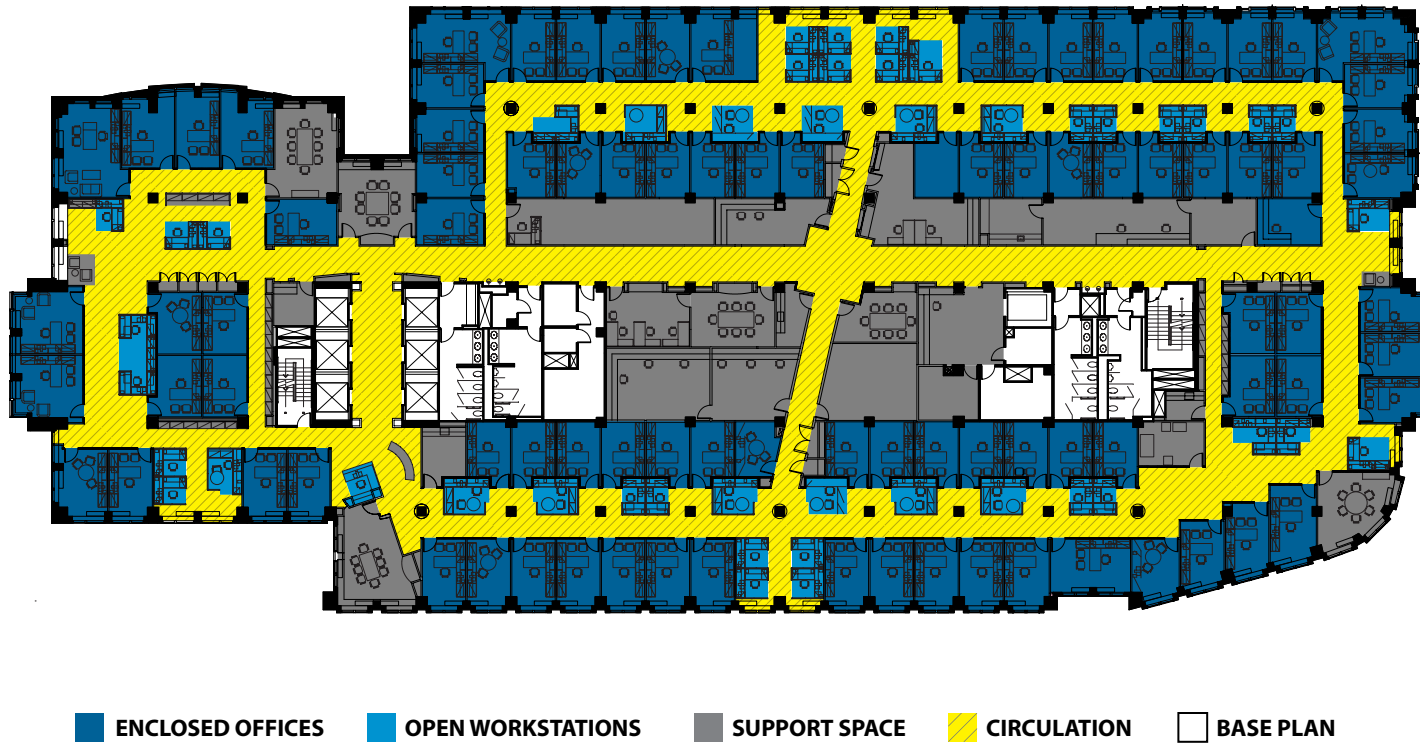
CIRCULATION CALCULATIONS

1.39
MULTIPLIER

28%
FACTOR

CASE STUDY #2

33% OPEN / 67% ENCLOSED | USABLE AREA: ~33,000 USF



OBSERVATION

Even workplaces with an open to enclosed ratio of 1:2 can possess a fairly low Circulation Area because the floor plan is predominantly enclosed offices.

FLOOR CALCULATIONS



138
SEAT COUNT

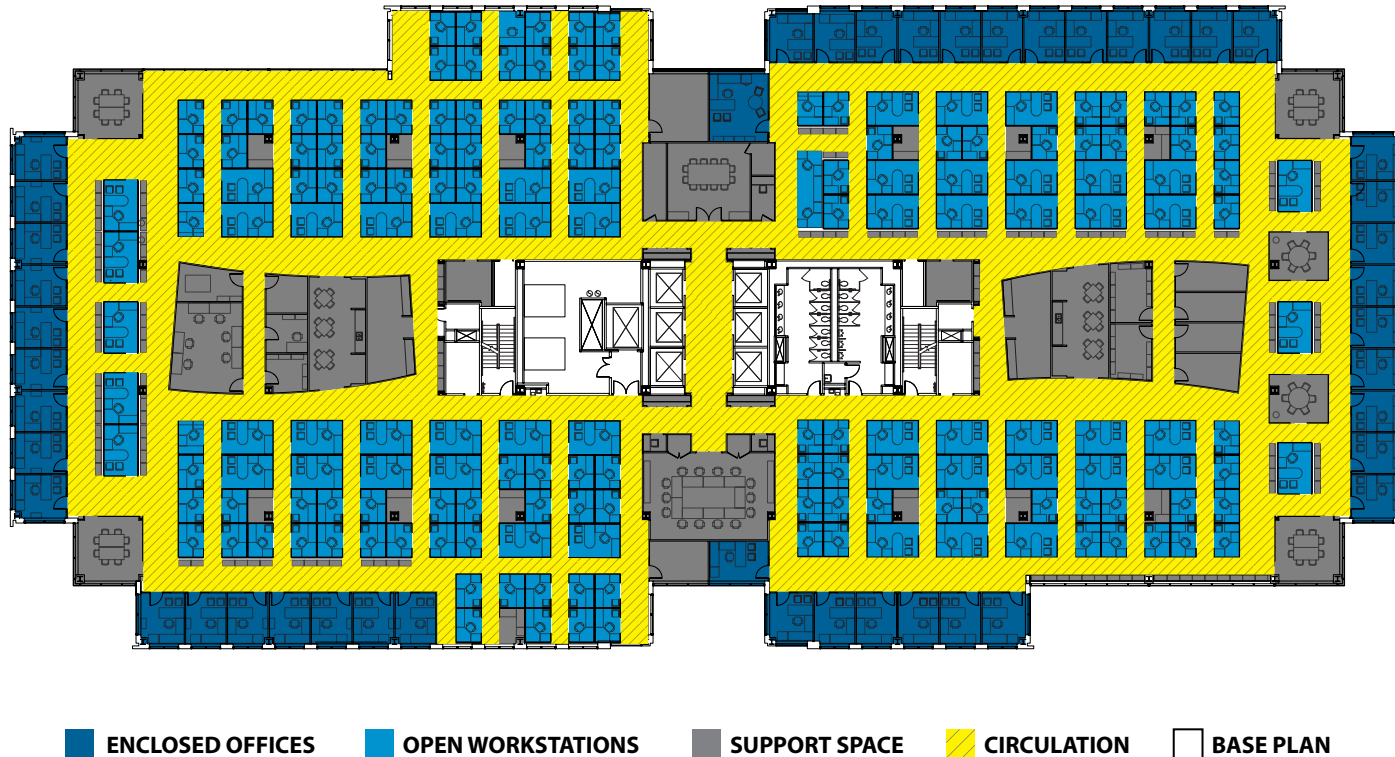
CIRCULATION CALCULATIONS

1.41
MULTIPLIER

29%
FACTOR

CASE STUDY #3

80% OPEN / 20% ENCLOSED | USABLE AREA: ~45,000 USF



OBSERVATION

A predominantly open plan requires a higher percentage of Usable Area for circulation, but also accommodates a higher capacity of seats on a floor.

FLOOR CALCULATIONS

OPEN
80%

ENCLOSED
20%

221
SEAT COUNT

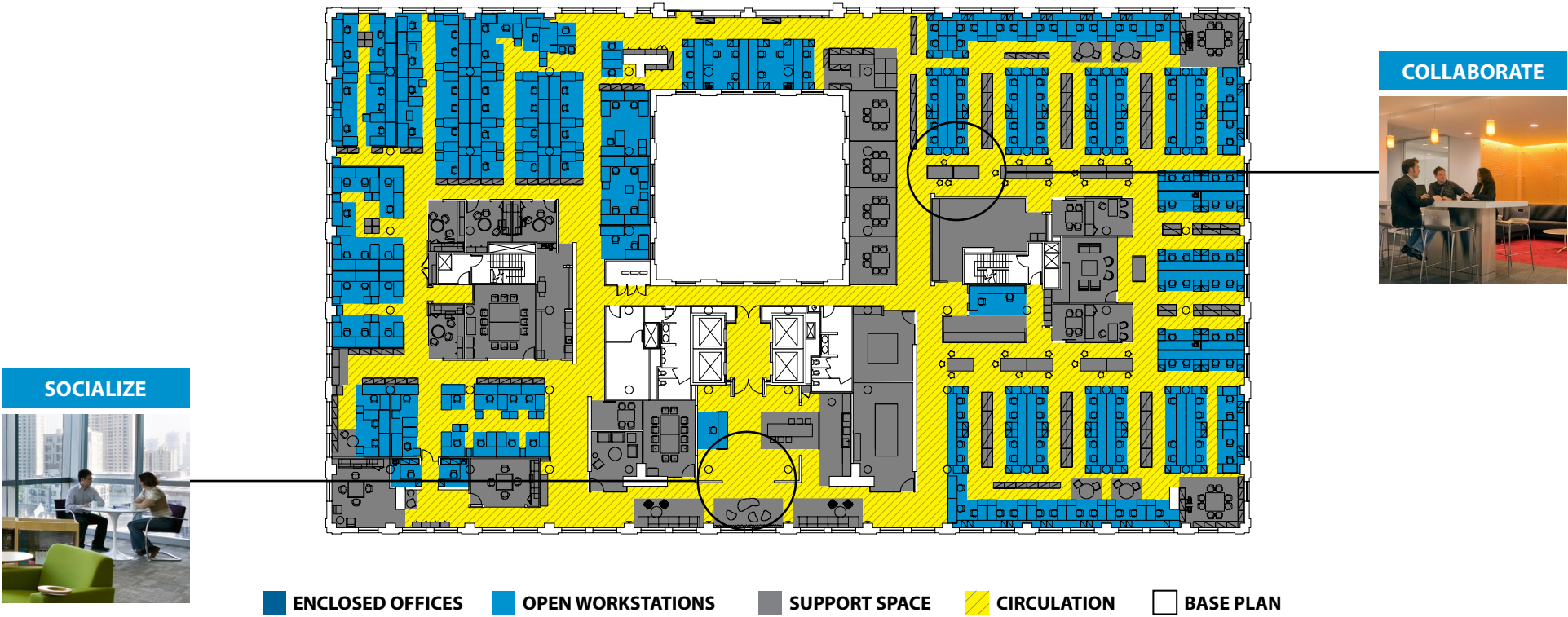
CIRCULATION CALCULATIONS

1.61
MULTIPLIER

38%
FACTOR

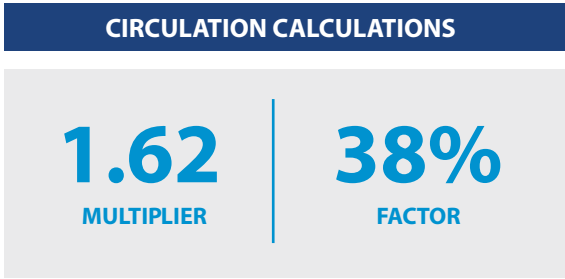
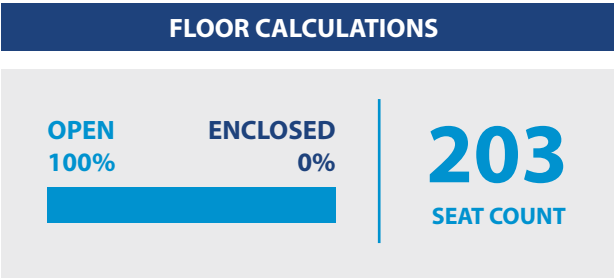
CASE STUDY #4

100% OPEN / 0% ENCLOSED | USABLE AREA: ~29,000 USF



OBSERVATION

In addition to addressing necessary open plan circulation, a higher Circulation Multiplier can also provide impromptu meeting spaces for socializing, learning, and collaboration.



KEY TAKEAWAYS

While this report explores many different attributes and factors affecting circulation, there are four key takeaways that should always be considered.



Circulation Area is a necessary component of the workplace and should not be underestimated. An inadequate amount of circulation could introduce problems within the workplace, such as inefficient traffic flow or a sense of overcrowding. It could also create insufficient area to accommodate an organization's space needs.

It is for these reasons that reducing the Circulation Area to meet an overall space goal should be avoided. A unique Circulation Multiplier should instead be estimated based on the types and quantities of spaces to be provided. Further, the following Key Takeaways should be kept in mind when planning for a future workplace:

KEY TAKEAWAY #1

The Circulation Area should not be compromised. As a general planning “rule of thumb,” Circulation Area comprises roughly 25 to 40% of the total Usable Area. Planning for this allotment will better ensure that the programmed Usable Area will represent the space needed to accommodate the future workplace, in most fairly efficient buildings.

KEY TAKEAWAY #2

The Circulation Multiplier (CM) and Circulation Factor (CF) are not synonymous. While the Circulation Factor represents the percentage of Usable Area space that consists of Circulation Area, the **Circulation Multiplier** is used during the planning process to determine the total Usable Area. For example, a CF of 35% of the Usable Area would require a CM of 1.54, not 1.35.

KEY TAKEAWAY #3

While there are many possible factors that may affect the selection of an appropriate Circulation Multiplier, **the ratio of Open to Enclosed workspaces has the most consistent correlation to the required amount of Circulation Area.** Circulation Multipliers will typically range between 1.4 to 1.6. As the portion of open workspaces increases, the Circulation Multiplier will also correspondingly increase.

KEY TAKEAWAY #4

The Circulation Multipliers addressed in the preceding case studies are based on moderately efficient buildings. **If occupancy in an inefficient building is anticipated**, which can be attributed to such factors as column spacing and floor configuration, **the Circulation Multiplier should be further increased to compensate for the likely need for greater Circulation Area.**

Following the approaches presented in *Circulation: Defining and Planning* will create more predictable space programming estimates and ultimately, a more efficient workplace. For additional details about utilizing Circulation Multipliers or other aspects of this report, please contact the GSA Public Buildings Service at workplace@gsa.gov.



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