Theater Planning: Facilities for Performing Arts and Live Entertainment is an introduction to the design and construction of performing arts buildings. It is in the planning of these buildings that the disciplines of performing arts and architecture meet—each with its own vocabulary, processes, and conceptual constructs. This book introduces theater planning to students and practitioners of each field, and provides a detailed guide to the process and the technical requirements particular to theater buildings. Part I is a guide to the concepts and practices of architecture and construction, as applied to performing arts buildings. Part II is a guide to the design of performing arts buildings, with detailed descriptions of the unique requirements of these buildings. Each concept is illustrated with line drawings and examples from the author’s extensive professional practice.

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For Caroline
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Foreword

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Theaters have a long history, perhaps as long a history as any building type in our culture. The Greeks and Romans built large, beautiful and remarkably effective theaters. These were important buildings, representing the ambitions of those cultures—and the ambitions of the powerful people in those cultures.

In the Middle Ages, public theater moved to the streets. The structure was a wagon or a simple platform, perhaps raised, a canvas backdrop—all utterly temporary and moveable. Over time religious pageants gave way to secular dramas. Political and social subjects became an essential part of the theater’s role—and its broader appeal.

Of course, by the seventeenth century in London, The Globe Theatre presented Shakespeare’s works. The breadth and depth and humanism of his plays were joined to a profoundly wise design of theater space.

In the twenty-first century why are theaters, as a building type, so damn complicated? Certainly, fundamental human characteristics are relatively unchanged. Human dimensions for seats, rows, and sightlines are little changed; the quality of the human voice and the seeing of the whites of the eyes of the actor on stage continue to be dependent on similar human dimensions.

Every theater built today struggles with seat count, seat organization, and sightlines. Stages change size and form to some degree. Audience chambers seem to change size and form all the time.

Gene Leitermann has outlined the nature of the design challenge of theaters in this fascinating—and admirably succinct—book. Part I describes the process of designing and building theaters. Very few writers have given such a complete overview of the building process in so few pages. Leitermann explains the process with a clarity and economy that make his text valuable to anyone contemplating the construction of a theater. It is not a simple task. His outline is profoundly instructive for a host of participants: actors/actresses, directors, audience members, theater administrators to be sure. Likewise for Trustees of theater organizations and universities (for so many theaters in the United States are being built today on university campuses) as well as college and university Presidents, Provosts, Deans, and theater department chairs.

Part II moves into the arena that is Leitermann’s great love: how one actually designs the theater space within these complicated buildings. His succinctness elevates his observations to the profound. His long career in the day-to-day practical design of theaters and his broader teaching in the academy join to
create a point of view that is singular. That one could get so much information into a few sentences or a couple of paragraphs on a particular topic is remarkable. Here, in a few short pages, is Leitermann’s well-developed point of view about theater design. He takes strong stands on controversial topics, topics which themselves can often become entire books.

One might say, upon reading this, that theater design is all about dimensions, dimensions which relate to our dimensions (leg length, eyesight) and which are so much a part of our humanity. But Leitermann does not stop there. He ties these dimensions into all types of communal activity in the theater, not only the human way an actor connects with an audience member, but also the way an audience as a “collective” must engage with itself.

Owners, theater designers, and architects must make major decisions, often in the first days or weeks of a theater project. All the players in the process—from actors and directors to donors and university sponsors—should carefully study Leitermann’s chapters here. As Leitermann quotes Peter Brook: “The science of theater building must come from studying what it is that brings the most vivid relationships between people.” Leitermann points out that the famous director Tyrone Guthrie (who himself designed one of the most important twentieth-century theaters in the United States) reminded us that “when the French say they are attending a performance, the literal translation is assisting at a performance.” In short, performer and audience are equally critical to the theater, and Leitermann shares with us how that “assisting” can happen in our best designed theaters.

Here is a book that will “assist” all of us in this powerful collective enterprise of theater design.
Preface

This book grew out of the theater planning courses that I’ve taught for several years at Yale School of Drama. The students in my classes are graduate students in technical theater and theater management, joined on rare occasions by an intrepid student from Yale School of Architecture. A few students earn an MFA degree with a concentration in Theater Planning and go on to work in theater consulting, theme park design, or a related field. Most move on to other careers, but at some point in those careers almost all find themselves involved in planning a theater building. Theater planning stands betwixt the performing arts and architecture, and my hope is that this book will be a helpful resource for people in both fields.

If you are interested in architecture and the performing arts, in theaters as a building type, or if you find yourself involved in the planning of a new or renovated performance space, I think you’ll find this book valuable. Part I, “Context and Process,” introduces the concepts and practices of architecture and construction as applied to buildings for the performing arts and live entertainment. Part II, “Planning,” provides an overview of the design of these buildings. This book does not cover certain areas: it’s about North American practice, and theater planning elsewhere is discussed only tangentially. It does not discuss the acoustical design of performing arts buildings or the detailed design of theater equipment, other than to place this work in the context of the overall process.

Any course or book in theater planning is merely an introduction; it’s a profession that one learns on the job. One of the appeals of a career in theater planning is the opportunity to always be learning new things, and I’m grateful to my colleagues who’ve been patient enough to teach me. I’m especially indebted to Bill Warfel, who was my teacher at Yale School of Drama and who brought me into his consulting firm, Systems Design Associates, where I learned much from him and Bill Conner. I’m indebted to Brian Hall, Robert Long, Iain Mackintosh, Richard Pilbrow, Joe Volpe, and many other great colleagues at Theatre Projects. And I am particularly grateful to Tony Forman, my partner at Nextstage Design, from whom I continue to learn daily.

Ben Sammler, my department chair at Yale, provided encouragement, advice, and helpful critiques of the manuscript. Alan Hendrickson provided insightful comments on the chapter on auditorium design. Ali Mignone assisted with the manuscript and permissions. Mitchell Cramond and Matt Welander helped with the illustrations, and Julia Leitermann designed the cover illustration. I’m grateful to the photographers who have allowed me to include their work, and to the architects and arts organizations that generously provided source documents and other assistance. I’d like to acknowledge the Eastman School of Music for providing me with the original drawings of Kilbourn Recital Hall. I’d like to especially thank Ryan Miller, Dr. Katrina Ray, and Bob Waddle at Bowling Green State University, Elaine
Molinar at Snøhetta, and Mike DiNardo at The Collaborative for their invaluable help with the illustrations to Chapter 6.
Part I

Context and Process
Chapter 1
Theater Buildings

This is a book about the planning and construction of buildings for live entertainment. It’s about how theater buildings come into being. But not just theater buildings—also concert halls, opera houses, casino showrooms, and other related building types.

If we are part of a theater company—a manager, director, technician, or actor—we go to the theater to prepare a performance. If we are members of the public, we go to experience the performance. A theater is animated by its inhabitants and truly comes alive in performance. But theater buildings have an existence separate from their inhabitants—before they are occupied and even before they are built. Long before the first performance takes place, an owner decides to build a theater, an architect undertakes the design, and a builder makes it real. This book is about that part of a theater building’s story.

The owner, the person or organization commissioning the theater, expects a well-functioning building serving their specific needs. Fortunately, most architects share this view of the theater building as a functional response to a need. Architects also view theater buildings as aesthetic objects in their own right. Since architecture and theater are both arts, then theater buildings are works of art that serve as vessels for art. The builders the owner hires to execute the architect’s design are exercising craft, but they probably aren’t focused on making a work of art. They’re simply tasked with building a surprisingly complicated building.

A theater building is ideally all of these—a functional response to a need, a work of art, and (we hope!) a routine construction project. On a truly successful building these potentially conflicting objectives are kept in balance. Emphasizing only art may result in a stunning architectural achievement that is unworkable as a theater. Emphasizing function and craft without art may result in a serviceable but utterly uninspired and uninspiring theater. Striving for this balance is one reason why theater design and construction is such an interesting and challenging endeavor.

Another reason for the interest in theater design and construction is the fascination that the theater building itself elicits. Foucault cited the theater as an example of a heterotopia—a space that is simultaneously both mythic and real. The overlapping of real and mythic space within a theater can be expanded upon: the theater building exists, in physical space, in relationship to a city or landscape. The stage (or performance area) is a physical space in which the actors move; it exists within the theater building and in relationship to the audience area. The scenographic space occupies the physical stage space and suggests a fictional space in which the characters of the play live. Layered on the scenographic
space is the dramatic space created by language and theater craft. This dramatic space encompasses both the space in view of the audience and the fictional world “off stage.”

Let’s consider a specific example. An audience member sits with 490 fellow patrons in the Yale Repertory Theatre, a converted Baptist church in the center of a college town on the East Coast of the United States, for the American premiere of *A Lesson from Aloes*. On the stage, the scenographic space suggests “the backyard and the bedroom of a small house in Algoa Park, Port Elizabeth, South Africa in 1963.” Actors James Earl Jones, Maria Tucci, and Harris Yulin occupy the stage. Their characters—Steve, Gladys, and Piet—sit or stand in the backyard of Gladys and Piet’s home. Offstage are Port Elizabeth and South Africa, the prison from which Steve was just released, and a society still under government repression. The audience is aware of each other’s presence and their own physical reality. They’re aware that James Earl Jones is on stage, but they’re also aware of Steve sitting in his friend’s backyard. The actor/characters and audience are simultaneously in two spaces—in a theater and in South Africa, an ocean away.

We may never articulate this overlapping of real and fictional space, but we are instinctively aware of it. And we understand that somehow the fictional space is always a latent presence. Perhaps that’s why even an unused theater building anticipates the performances that could take place. And why, once occupied, a theater is changed by the performances it houses.

**Theaters as a Building Type**

The heterotopic quality is one of the ways in which theater buildings are a distinct building type. In fact, theaters possess multiple characteristics that make them an extraordinary building type. And these characteristics are additional reasons for the fascination they hold for both architects and the public.

**Theaters Have a Limited Function**

Theater buildings exist for the preparation and presentation of live performing arts. A theater can also be used as a lecture hall, cinema, or meeting place, but its range of uses is limited. This lack of versatility reinforces the perception of the theater as a separate space with a quality of “otherness.”

**Theaters Are a Persistent and Consistent Building Type**

With the exception of the Middle Ages, the theater has been a persistent architectural type from ancient Greece up to the present day. Places of worship and dwelling places have been as persistent, but have not maintained the remarkable consistency of form that theater buildings exhibit. The historic context is part of what makes a theater building such an appealing design commission. It probably also explains the desire of some architects to break free of convention and invent new theater forms.
Multiple and Varied Meanings Are Attached to Theater Buildings

A theater building can be a showcase for the ruling or moneyed classes, a monument to civic pride, or a locus of social and political change. Theaters can be perceived as churchy—in both religious and secular senses—and as places of debauchery.

The social meanings attributed to theaters vary over time and place, and between the types of theater building. In the cities of ancient Greece and Rome, the theater was a civic monument and central to communal life. The Greeks used the natural shape of hillsides for their theaters, and often them integral parts of the city plan, emphasizing their monumentality and centrality. In contrast, the playhouses of Elizabethan London were located on the margins—on the South Bank of the Thames or to the north of the city, not within the city walls. This was reflective of the marginal and ambiguous social position of theater and actor. It hadn’t improved a century later when Archbishop of Canterbury John Tillotson declared the playhouse “the temple of the devil.”

In yet another contrast, Haussman made the Palais Garnier (1875) a centerpiece of his ambitious plan for the urban renewal of Paris. Indeed, an opera house was seen as both a monument and a necessary credential for any cultured city, an idea that prevailed well into the twentieth century. The Sydney Opera House (1967) was described by one of its designers as “a civic symbol for a city which seeks to destroy once and for all the suggestion that it is a cultural backwater.” In the mid-twentieth century, monumental performing arts centers (not just opera houses) were still seen as a means of urban renewal—in London the Royal National Theatre (1976) was sited on the South Bank of the Thames not to marginalize it, but to lay claim to the South Bank as a place of culture. Similarly the Lincoln Square neighborhood in New York was razed to accommodate the construction of Lincoln Center (1962–1969) as part of that city’s revitalization of the area. And the idea of civic pride persists. The lead donor for the Segerstrom Concert Hall in southern California (2006) described it as the “symbol of Orange County’s pride and self-esteem.”

By the early twenty-first century, all but a handful of cities in the United States had erected some form of performing arts center. Construction of monumental theaters has all but stalled in the United States, but the “prestige” performing arts center is still popular elsewhere in the world. In the United States, the current trend is on regional playhouses, school facilities, and smaller community centers that emphasize the participation of the public as arts makers. The public is generally less intimidated by these theater types, which are more likely to be perceived as community meeting spaces (even community “living rooms”) than as civic monuments.

Theaters Are Complicated Buildings

Theaters bring with them a complicated set of requirements, as or more intricate than hospitals, although this is not widely recognized in the design and construction professions. In fact, theater buildings are not well understood by the architects and contractors who design and build them, and this only adds to the complexity of creating them.
What makes theaters such a complicated building type?

*Population*

Theaters house a large number of people (up to tens of thousands) in one room. The need for the audience to see and hear the performance defines particular three-dimensional room geometries. Protecting the life safety of large numbers of patrons is a further complication.

*Program*

Program here means the architectural program and includes all the functions that must be accommodated within the building.

The front face of the building invites the public into exciting, elegant, or monumental front-of-house spaces. Around the back of the building is a loading dock leading to utilitarian, often factory-like back-of-house spaces. In between are many individual rooms with unique requirements. A classroom or office building may have many identical rooms, but a theater does not. And each individual room in a theater has critical relationships to other unique rooms. Accommodating the optimal locations and adjacencies of these rooms is a challenging task.

*Structure*

The auditorium requires long structural spans and often multiple cantilevered balconies. In addition, the structural system of a theater must accommodate rigging and other equipment loads. Unlike downward gravity loads, rigging loads point in all directions, including up! The structural design may be complicated by acoustic requirements for massive walls, ceilings, and roofs—for sound reflection and/or noise isolation. Sometimes critical rooms have independent and isolated structural systems (called box-in-box construction) to prevent intrusion of exterior noise.

*Services*

The heating and cooling system must be quiet, so as not to disturb the performance. Usually this means a high volume, low velocity system where a large quantity of slow-moving air is delivered via huge ducts snaking through the building. Similarly, thousands of electrical conduits for power, lighting, sound, projection, and broadcast equipment must find their way from control and equipment rooms to distribution points throughout the building.

Table 1.1 Typical Theater Forms and Seat Counts by Performance Type
Theater Types

Theaters can be classified into several types by their use, form, and seat count. As indicated above, the social meaning and public reception of these types can vary greatly. The types also differ in their character and functional requirements.

Each of the performing arts has an inherited repertoire, conventional modes of presenting that repertoire, and a theater type (or types) best suited to that mode of presentation. The ways we present and experience the performing arts are always changing, but history and tradition exert a strong influence on current practice. As a result, the design of new theater buildings is heavily influenced by precedent.

Table 1.1 presents typical theater types and seat counts, and the theater types are described further below. An understanding of type will inform early design decisions about theater form, and will provide necessary context for much of the remainder of this text. Of course, any attempt to categorize performance spaces requires simplification, and will not capture the full diversity of spaces that exist!

Drama and Musical Theater

Drama encompasses both comedy and tragedy, and is adaptable to a wide range of formal and “found” performance venues. A drama theater may have a fixed configuration of acting and seating areas—arena, thrust, traverse, endstage, proscenium, and open stage are common forms. Or it may be designed to accommodate multiple configurations.

Drama is dependent on the spoken word and the facial expressions of the actors, so spaces for drama tend to have lower seat counts. Smaller drama theaters range from 50 to about 400 seats. The preferred maximum for larger spaces is 1,100 seats, but this can be stretched to about 1,600. Some drama theater
forms are best suited for low seat counts, and each form has a workable upper limit.

Musical theater combines the elements of drama with vocal performance. It can be presented in drama spaces of all types and sizes, but the conventional venue for musicals is the proscenium theater.

**Arena**

In the arena form (also called theater in the round) the audience completely encircles the performance area, placing the audience in close proximity to the action on all sides. Sightlines allow furniture and props but preclude extensive scenery. The actors enter the performance area through vomitories (voms) or via the aisles, blurring the separation of audience and performer space. Most arena theaters have a single seating level, which is steeply raked to provide sightlines to the near stage edge. A few arena theaters have balconies, and this greatly magnifies the intimacy of the space.

![Figure 1.1 Drama Theater Forms](source: Author)

**Thrust**
A thrust theater places the audience on three sides of the performance area. The fourth side usually opens onto a proscenium stage. This stage is typically used for scenery and entrances only, as sightlines into the stage aren’t sufficient to allow significant action there. Actors enter the opposite end of the thrust via voms or aisles, as in an arena theater.

![Diagram of a thrust theater](image)

**Figure 1.2** Fichandler Theatre, Arena Stage, Washington, DC (1960, 680 Seats). Original Architect: Harry Weese. 2010 Renovation: Bing Thom Architects

Source: Author

The thrust theater form can be as intimate as an arena theater, but the form can also support grander staging and larger audiences while still providing an engaging experience. It’s common for a thrust theater, especially a larger one, to have a balcony seating level, and this increases intimacy.

**Traverse**

In traverse (or alley) staging, the performance area is a central runway with seating on each side, so that the audience faces itself across the width of the playing area. It is such a strong form that it is used as staging for particular productions, but rarely as a form for a permanent theater. The Steppenwolf Upstairs Theater (1993) in Chicago is a 299-seat traverse. And the Traverse Theatre in Edinburgh is so named
because it was originally housed in a tiny 60-seat traverse form theater. It currently performs in two flexible theater spaces that offer traverse as one of several forms.

Figure 1.3 Ruth Caplin Theatre, University of Virginia, Charlottesville, Virginia (2013, 310 Seats). Architect: William Rawn Associates
Source: Author

Endstage

In an endstage theater the performance area is located at one end of the room and the audience is seated at the opposite end. The endstage form does not provide the intimacy of the arena or thrust, nor the stagecraft possibilities of a proscenium theater. It therefore works best for smaller seat counts. The Tony Kiser Theatre at Second Stage in New York (1999) is a typical and successful endstage at 292 seats.

Flexible Theater

Smaller drama spaces are often flexible. These flexible spaces can typically be configured in the arena, thrust, traverse, and endstage forms described above, and many other configurations—limited only by the scenic designer’s imagination and the kit of parts provided. These small flexible spaces are found on
many college campuses, as the second or third space in a performing arts center, or as the main performance space of a small theater company.

There is a practical limit to the size of this type of theater. The cost of the labor and equipment to change configurations increases as seat count grows. Perhaps more importantly, any space with multiple configurations requires compromise, and some configurations will be less than ideal. A small space can be very forgiving in this regard, but in larger spaces these compromises are more obvious and problematic. The design challenge increases greatly when the seat count exceeds 300 and becomes nearly impossible when the seat count is over 600.

Different terms are used for flexible drama theaters, with each term denoting or implying a certain characteristic of the space or the performances intended to take place there. Four common terms are black box, studio, environmental, and promenade.

A black box is a void space, without architectural character or embellishment. These spaces are often painted black, although they do not have to be. The black box presents a “blank canvas” on which the production team creates both the performance and the environment for the performance. The architectural space can be shaped and decorated to suit the production, which can be a great benefit, but the additional time and expense required can be a considerable burden.

A studio theater is a fairly well developed architectural space, with raised audience galleries on three or four sides of the room and catwalks or a walkable woven wire grid (also called a tension wire grid) for overhead lighting and scenic effects. A studio theater is a form of courtyard theater.

Environmental and promenade are distinct but related terms. An environmental theater can be a found space or a formal theater space in which the production team has created an immersive environment for the performance. In either case the theatrical space is integral to the production. A promenade theater is one without seating on the main level. The dramatic action takes place in multiple locations throughout the room, sometimes simultaneously, and the standing audience moves about the space to follow the action.
**Courtyard Theaters**

*Courtyard theater* is a broadly descriptive term that can be applied to several theater forms. It describes a theater with one or more seating galleries surrounding a central area. The central area may hold a platform stage surrounded by spectators—as in Shakespeare’s Globe Theatre ([Figure 14.2](#)) and the historic Spanish *corrales de comedias* ([Figure 14.3](#)). Or it may hold fixed seating facing a proscenium opening and stage as in the Georgian playhouse and its many descendants. Or the central area may be configurable into arena, thrust, endstage, and flat floor configurations—as in the Tempe Studio illustrated in [Figure 1.4](#).

**Proscenium Theater**

By far the most prevalent form of drama theater is the proscenium theater. In this form, a wall (appropriately called the proscenium wall) separates the auditorium and stage. The audience seating is
arranged to provide a view of the performance through an opening (proscenium arch) in the wall. The auditorium may take any of several shapes, and may have a single seating level or one or more balconies. The separate stagehouse can be equipped with extensive equipment and machinery that allow the use of sophisticated lighting, scenery, and stage effects. The forestage or apron, where the auditorium and stage meet, is often flexible, allowing this area to be part of the performance or part of the seating area. Spaces intended for musical theater will have a sunken orchestra pit here.

The proscenium theater form can range from as few as 50 seats to many thousands, but a workable upper limit for drama is about 1,100. Most drama spaces are much smaller. Of the four regional theater spaces listed in Table 9.3, the Signature Theatre space seats 191, the South Coast Rep 340, the Philadelphia Theatre Company 365, and the Goodman Theatre 800.

New York’s Broadway and London’s West End playhouses are particular proscenium forms that developed in the early twentieth century and house both straight plays and musicals. The extant Broadway theaters range from 600 to 1,933 seats, while West End theaters range from about 250 to 2,300 seats.

*Open Stage*

The term open stage is sometimes used to refer to the thrust stage form, or to any open platform surrounded by audience. But an open stage is also a distinct form, closely related to both the proscenium and thrust forms. It might also be called an apron stage. In an open stage, the audience is arranged around a platform which is usually backed by a proscenium stage. The audience view is more frontal than in a thrust theater, and the seating does not encircle the stage to the same extent as in a thrust.

Examples of open stages include the 600-seat Angus Bowmer Theatre (1969) at Oregon Shakespeare Festival and the 1,200-seat Vivian Beaumont Theatre (1965) at Lincoln Center.
Acoustic Music

Acoustic music is not amplified, but rather is dependent on the natural acoustic response of the performance space. The typical music space is not divided into stage and auditorium—instead the performers and audience share the same room and (to some extent) the same acoustic environment. The number of performers ranges from one (a soloist) up to several hundred (a symphony orchestra with chorus). Venues can be classified as recital halls or concert halls based on the largest ensemble size accommodated.

Repertoire ranges widely and includes both vocal and instrumental works, western classical works, folk, and world music. To accommodate a range of repertoire, the room acoustics are often made adjustable. This is usually done by varying the absorptive material in the room, using drapery or acoustic banners. It's the rare music space that is used only for music, so infrastructure for lighting and staging is also often provided.
Recital Hall

A recital hall is a space for soloists and small ensembles up to the size of a chamber orchestra, say 20 to 30 players. Seat count ranges from about 100 up to 700, with 300 being a very common size.

Figure 1.6 Studzinski Recital Hall, Bowdoin College, Brunswick, Maine (2007, 280 Seats). Architect: William Rawn Associates

Source: Author
Figure 1.7 Laura Turner Concert Hall, Schermerhorn Symphony Center, Nashville, Tennessee (2006, 1,844 Seats). Design Architect: David M. Schwarz Architects. Architect of Record: Earl Swensson Associates

Source: Author
Figure 1.8 Helzberg Concert Hall, Kauffman Center for the Performing Arts, Kansas City, Missouri (2011, 1,600 Seats). Architects: Safdie Architects and BNIM Architects
Source: Author
**Concert Hall**

A concert hall is a space that will accommodate a symphony orchestra—up to 100 instrumentalists plus chorus. The interdependence of seat count, reverberation time, and sonic impact result in an optimal seat count range of 700 to 2,000 seats. However, both smaller and larger venues exist. Unless it’s tucked away on a college campus, a concert hall will present itself as an important (or even monumental) building, with extensive and well-appointed public spaces befitting of this status.

The traditional concert hall form is the shoebox—a long and narrow room roughly the proportions of the box your dress shoes are packaged in. The orchestra platform is at one end of the room, possibly with permanent choral seating behind. The audience seating is tiered, with shallow balconies at the opposite end from the platform and narrow side seating “ledges.”

A more recent concert hall form is the vineyard. In a vineyard hall the orchestra platform is placed closer to the center of the room and is surrounded by audience seating configured in terraces. This form creates a greater sense of engagement than the traditional shoebox, and it is increasingly popular. The Berliner
Philharmonie (1963, Figure 14.18) was the first important example of this form.

Opera and Ballet

The Italian Renaissance developed opera as a reinterpretation of Greek drama, and originated the opera house for the presentation of the new art form. For many centuries, ballet and opera companies have co-existed in opera houses, and as a result most large theaters for classical dance take the opera house form.

*Opera House*

The opera house has been a remarkably consistent theater form from the late Renaissance until the present day. Its fundamental form is a proscenium theater. The stage is large and well equipped, and may have multiple auxiliary stages to allow the performance of operas in repertory. The auditorium almost always has multiple tiers and side seating in the form of galleries or boxes. Seat counts typically range from 1,400 to 2,400. European halls tend to be smaller and American halls tend to be larger, but all opera houses are monuments.

Modern Dance

Many smaller spaces of 100 to 300 seats have been built for presentation of modern dance repertoire. These spaces often feature a single bank of seats with a frontal view of the stage and a steep rake for good sightlines to the stage floor. The arrangement may be endstage or proscenium. The seating bank is sometimes on telescopic risers so that the same space can do double duty as a performance venue and as a large rehearsal room.

There is no specific, large theater type for modern dance, as few such theaters have been built.
Multiuse

*Multipurpose Theater*

A community that isn’t large enough to sustain a concert hall for the local symphony, an opera house for the local dance and opera companies, and a large proscenium theater for touring Broadway musicals may instead build a multipurpose theater. This is a proscenium theater form. The auditorium design is driven by the acoustic requirements of symphonic music, while the stage design is determined by the needs of the local opera company (sometimes) or the latest and largest Broadway national tour (usually). (At the turn of the twenty-first century these spaces were described as “Phantom ready”—meaning they could accept the *Phantom of the Opera* tour with only limited advance work.) The room acoustics and the forestage area are greatly adjustable to accommodate a wide range of performance types. Municipal multipurpose theaters typically range from 1,500 to 2,200 seats. Smaller versions, down to 800 seats, can be found on university campuses.
**Multiform Theater**

There is a (relatively rare) version of the multipurpose theater in which the room geometry is adjustable to suit each performance type. In a multiform theater, the geometry is changed by relocating seat banks, theater walls, and other large architectural elements by means of mechanization and/or a lot of labor!

**Popular Live Entertainment**

The phrase “popular live entertainment” covers a lot of ground—an incomplete list includes acrobatics, animal acts, award shows, circus, comedy (sketch and stand-up), dance, hypnotism, ice shows, impersonators, juggling, magic, many styles of music, pageants (beauty, biblical, and everything between), pantomime, revues (adult), and ventriloquism. These entertainments are housed in many types and sizes of venues. Our intent here is merely to describe two distinct theater types used for live entertainment—the showroom and the big proscenium theater.

**Showroom**

A showroom is always a commercial venture, often associated with a casino or resort. It may be designed to accommodate headliners or variety acts. Or it may be purpose-built for a long-running stage production—for example a Cirque du Soleil or Franco Dragone spectacular. The auditorium form varies. The seating configuration is generally wider than for drama theaters, sometimes encircling the stage up to 270 degrees, and a few showrooms
Figure 1.11 Overture Hall, Overture Center, Madison, Wisconsin (2004, 2,250 Seats). Architects: Pelli Clarke Pelli Architects, Potter Lawson, and Flad Architects
Figure 1.12 Dolby Theatre (Formerly Kodak Theatre), Hollywood, California (2001, 3,400 Seats). Architects: Rockwell Group, Ehrenkrantz Eckstut Kuhn, and Altoon & Porter Architects
Source: Author

are theaters in the round. The seating may also vary, and include banquets, table seating, and sofas. Food and beverage consumption is a part of the patron experience, and a revenue source for the operator. A typical range of seat counts is 1,200 to 2,000, but some showrooms are as small as 600 seats and some are as large as 4,000 seats.

Big Proscenium Theater

The second type of theater used for popular live entertainment is the big proscenium theater with dry (that is, non-reverberant) room acoustics. These rooms are multipurpose—they house a variety of entertainments as well as musical theater and other performing arts that don’t depend on an intimate environment and natural room acoustics. The seat count ranges from about 1,500 to 5,000. The stage is often large and well equipped, especially if touring Broadway productions are to be accommodated. The auditorium form may be as varied as for proscenium drama theaters.
In the next several chapters, we discuss the people and the processes involved in bringing these buildings to life.
Chapter 2

Project Roles

The last chapter briefly introduced the three major players in the planning and construction of a theater—owner, architect, and builder. On very small projects, each of these roles might be filled by an individual, but on most projects each role involves tens or even hundreds of individuals. And on almost all projects, each role has its own organizational structure and sub-roles. The architect, for example, has collaborating consultants and engineers. The builder has subcontractors.

Major Roles

Owner

The owner has a vision to fulfill—and a theater building has been identified as the means to that end. The owner’s motivation may be as prosaic as the need to replace an aging facility, as aspirational as the desire to transform an entire community, or as self-serving as the creation of a personal monument. The owner pays for the design and construction, which is fundamental to the whole enterprise! The architect and builder work for the owner and are responsible to the owner.

Architect

The architect designs the building and prepares the drawings and specifications necessary for its construction. Other names for the architect are design team (obviously implying more than one person) and A/E, meaning architect/engineer.

Builder

 Appropriately enough, the builder builds the building. Other names for this role are constructor, contractor, or construction manager. Each of these titles denotes different responsibilities. These distinctions and the builder’s role will be discussed in Chapter 4—Project Delivery Methods.
Division of Labor

A division of labor exists between the architect and builder—one designs and the other executes the design. The architect and builder each have a contract with the owner, and together these contracts define a working relationship between the architect and builder.

![Diagram of contractual relationships]

**Figure 2.1** Primary Contractual Relationships
Source: Author

Sound Familiar?

The reader with experience in mounting stage productions may have remarked on the similarities between that process and the process of building a theater. Each divides labor between design and execution, and the collaborative process is similar in each. Usually the time scale is longer and the cost is greater for theater buildings, but not always.

<table>
<thead>
<tr>
<th>Building project</th>
<th>Stage production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Producer</td>
</tr>
<tr>
<td>Program Manager</td>
<td>Production Manager</td>
</tr>
<tr>
<td>Architect</td>
<td>Director</td>
</tr>
<tr>
<td>Consultants and Engineers</td>
<td>Designers</td>
</tr>
<tr>
<td>Builder</td>
<td>Scene Shop and Crews</td>
</tr>
</tbody>
</table>

**Owner**

Who builds theaters? The owner might be a university, a developer, a public body (municipal, regional, or national government), a group of civic-minded individuals, a theater company (either profit-making or
nonprofit), a casino owner, etc. Sometimes the owner is a partnership of two or more of the entities listed above.

User and Operator

It’s important to note that the owner is almost never the same as the user of the completed building. For example, on a university building the owner might be the university administration or trustees, while the user will be the dance, drama, or music department.

And the owner is often not the operator of the completed building. For example, the owner of a municipal performing arts center may be the city or a private developer. The operator will likely be a separate entity—this may be a profit-making company that manages multiple facilities under contract, or a nonprofit corporation created to manage just one facility. The users are likely the local resident ballet, opera, and symphony.

The architect and builder are responsible to the owner, not to the operator or users. Therefore the ability of the operator and users to affect the design and construction process is entirely dependent on their relationship with the owner. Their role can vary from complete integration into the design and construction process to no involvement at all.

Table 2.1 Owner and User Example: Overture Center, Madison, Wisconsin

<table>
<thead>
<tr>
<th>Owner</th>
<th>Overture Development Corporation (Private tax-exempt organization)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Independent public entity created by city with sanction of state legislature)</td>
</tr>
<tr>
<td>Operator (2012-)</td>
<td>Overture Center Foundation, Inc. (Private nonprofit organization)</td>
</tr>
<tr>
<td>Users</td>
<td>Bach Dancing &amp; Dynamite Society</td>
</tr>
<tr>
<td></td>
<td>Children’s Theater of Madison</td>
</tr>
<tr>
<td></td>
<td>Forward Theater Company</td>
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<tr>
<td></td>
<td>Kanopy Dance Company</td>
</tr>
<tr>
<td></td>
<td>Li Chiao-Ping Dance</td>
</tr>
<tr>
<td></td>
<td>Madison Ballet</td>
</tr>
<tr>
<td></td>
<td>Madison Opera</td>
</tr>
<tr>
<td></td>
<td>Madison Symphony Orchestra</td>
</tr>
<tr>
<td></td>
<td>Wisconsin Academy of Sciences, Arts and Letters</td>
</tr>
<tr>
<td></td>
<td>Wisconsin Chamber Orchestra</td>
</tr>
</tbody>
</table>
Owner Organization

The owner must have personnel and an organizational structure to keep on top of the design and construction process. Sometimes an owner will have one organizational structure for design and another for construction.

The simplest owner structure has three distinct sub-roles.

*Project Executive*

The project executive has ultimate authority over the project. For example, on a university campus this is usually the president.

\[\text{Figure 2.2 Simple Owner Structure}\]

Source: Author

*Building Committee*

The role of the building committee is to articulate the needs the building must serve and respond to design solutions offered by the architect. The committee may include donors and community representatives in addition to users. The building committee can be most effective in the early phases of design when the critical decisions about cost, use, and design of the building are made. They have less influence in the later design phases and almost no influence once the project moves to construction.
Owner’s Rep

The owner’s rep (or project manager) manages the project budget and schedule, coordinates the work of the building committee, and directs the design team and builder day-to-day.

![Diagram of Owner, Program Manager, Design Team, and Builder]

**Figure 2.3** Owner with Program Manager
Source: Author

Program Manager

An owner without the necessary staff or experience to run a building project may hire a company to serve as their program manager. This is a broad role that may include all of the duties of the owner except the highest level decision making and the actual funding of the project. It may also be a longer term role involving multiple projects—for example, a university may retain a program manager to serve as its planning department.

Architect

The architect works for the owner, but as a licensed professional the architect also has responsibility for the public good. One architect describes the role as “guardian of the public realm.” Architectural firms vary in size from a handful of persons to a staff of tens of thousands. Firms have different cultures and values, and individual firms may place emphasis on quality design, tight construction drawings, budget control, or project management. Firms may focus on specific building types, certain kinds of clients, or specific roles within the design process. There are many different “flavors” of firms, and finding the right firm (or firms) for a given project can be challenging, but also quite fun.
The architect has multiple responsibilities, and sometimes those responsibilities are shared across multiple firms. The most common division of responsibility is for one firm to function as the design architect and one to function as executive architect.

Design Architect

The design architect is (appropriately) responsible for the overall design of the building. The design architect takes the lead in the early phases of design, when the critical decisions that shape the building are made, then hands off the detailing and documentation of the design to the executive architect. The design architect usually retains authority over all aesthetic matters, even after the hand-off.

Some architectural firms practice only as design architects. They emphasize and have special expertise in design, and they always work with an executive architect. But many firms that serve as design architects will do the detailing and documentation of their own designs for some projects.

A famous design architect may be called a celebrity architect or starchitect, but probably not to his or her face. One architect refers to them as “black cape architects.” Part of their appeal is their ability to attract donor contributions.

Executive Architect

The executive architect shadows and advises the design architect in the early design phases, then takes responsibility for completing the drawings and administering the project during construction. Other names for this role are associate architect or production architect.

The executive architect will often be a local firm—that is, a firm in the community where the project will be built. This proximity allows the firm to service the project economically. A local architect will also have relationships with the local building officials and contractors, and knowledge of the availability of materials and crafts persons.

Most firms that work in the executive architect role also provide design services on their “own” projects, but there are a few architectural firms that work exclusively in the executive architect role.

Architect of Record

Either the design or the executive architect will be the Architect of Record— they seal and sign the drawings, and their name appears on the building permit issued for construction. And one of the two firms will be the prime— that is, they will hold the contract with the owner, and the other firm will have a contract with the prime firm. It’s possible for the two firms to have separate prime contracts with the owner, but this would be highly unusual.
How Are Firms Paired?

Design and executive architects are usually paired in one of two ways. Most commonly, the two firms seek each other out and agree to “team” in order to submit joint qualifications to the owner. The owner may be explicit in requiring a design/executive team, or the architects may decide that teaming gives them their best opportunity to land the commission. This teaming is a bit like getting a prom date. Some design and executive architects have longstanding relationships and teaming is almost assumed. Some local firms will scout for national design talent and attempt to lock up a teaming relationship early—months or even years before the commission is advertised. Other firms may scramble to find a partner a week before qualifications are due.

If the advertisement is for a national design firm, the design architects have a bit of an upper hand in teaming. In contrast, some publicly funded projects require that the prime be a local architect, giving the local architects the edge.

The second way architects are paired is through a sequential selection process. For example, on publicly funded projects that require a local prime, there are usually fewer local architects with the ability to do the job than there are national design firms with an interest in the project. If the selection is for a design/executive team, the owner’s choice of design architects will be severely limited. So the owner may select and appoint the local architect first. Then the design architect is selected, often with the local’s involvement since in this case the local is likely holding the design architect’s contract. The reverse process is also possible, with the design architect selected first. In this case, the design architect is likely the prime, and will select the local architect, but with the owner retaining veto authority over the selection.

No matter how the pairing is made, it’s critical that the responsibilities of each firm be clearly defined. And it’s very helpful if the firms are a good fit in values and culture.

Design Team

The design of buildings, like many other aspects of life, has become increasingly specialized. Successful design requires a collaborative team of individuals or firms from many different design disciplines. The architect leads this team and is ultimately responsible for coordinating their efforts.

It is usually the architect who assembles the team, often during the qualification process. This process is perhaps more akin to filling out a dance card than finding a prom date. Institutional owners (for example universities) are likely to have prior experience and may have strong preferences for certain team members, particularly in the engineering disciplines. The owner may provide a short list of firms for the architect to choose from, or may reserve the right to veto the architect’s selection. On some projects the owner may insist on selecting some team members, either in consultation with the architect or independently.
Landscape Architect

Unless the building is in an urban setting with no site, the design team will likely include a landscape architect. Landscape architecture is a design profession with training and licensing requirements very similar to architecture.

The remaining members of the design team can be roughly divided into licensed engineers and unlicensed consultants.

Engineers

Engineers (also professional engineers or consulting engineers) are licensed design professionals. They have a professional responsibility to the public, and they have the authority to seal and sign their design drawings. The typical disciplines involved in the design of a building are civil (or geotechnical), structural, mechanical (meaning HVAC—heating, ventilating, and air conditioning), plumbing, fire protection, and electrical. Fire protection and plumbing design are often provided by the same firm. It’s also common to combine the mechanical, electrical, and plumbing disciplines—shortened to MEP engineering.

Consultants

Consultants provide design services for which there are no licensing requirements. Despite the lack of licensing, professional societies exist for many consulting disciplines. And it’s possible to gain certification in some disciplines. For example the National Council for Interior Design Qualification certifies interior designers, and the United States Green Building

Table 2.2 Design Team Example: Overture Center, Madison, Wisconsin

<table>
<thead>
<tr>
<th>ARCHITECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Architect</strong></td>
</tr>
<tr>
<td>Pelli Clarke Pelli Architects</td>
</tr>
<tr>
<td>Kara Bartelt</td>
</tr>
<tr>
<td>Bill Butler</td>
</tr>
<tr>
<td>Dominique Davison</td>
</tr>
<tr>
<td>Anne Gatling Haynes</td>
</tr>
<tr>
<td>Peter Huang</td>
</tr>
<tr>
<td>Phil Nelson</td>
</tr>
<tr>
<td>Cesar Pelli</td>
</tr>
<tr>
<td><strong>Executive Architect</strong></td>
</tr>
<tr>
<td>PL&amp;F Architects LLC</td>
</tr>
</tbody>
</table>
Jim Adams
Jerry Anderson
Kevin Anderson
Bill Bibo
Betsy Braun
Dick Burton
Rich Davis
Jeff Gaard
Bill Garrett
Jana Healy
Ralph Jackson, Jr.
Mark Jenssen
Karl Kraemer
Eric Lawson
Dave Lawson
Bob Mangas
Jeannie Rhoden
Randy Schmitgen
Paul Selge
Stan Smith
Tom Starkweather
Paul Wagner

ENGINEERS

Geotechnical Engineer
STS Consultants Ltd.

Eric Bahner

MEP Engineer
Affiliated Engineers, Inc.

Mike Broge
Robert Bucci
JC Carver
Scott Easton
Amy Erickson
Dan Green
Dan Gunderson
Keith Kantola
John Kuyrkendall
Jim Lambright
Tim Mohrbacher
Larry Powers
Structural Engineer
Thornton-Tomasetti

Larry Adler
John Baluci
Faz Ehsan
Daniel Marquardt
Daesubb Oh
John Tingerthal

CONSULTANTS

Acoustical Consultant
Kirkegaard Associates

Pamela Clements
Clete Davis
Lawrence Kirkegaard
Martha Larson
Joseph Myers
Mark Penz
Eric Rosenberg

Architectural Lighting Designer
Cline Bettridge Bernstein
Lighting Design Inc.

Francesca Bettridge
Marty Salzberg

Art Center Program Consultant

Martin and Mickey Friedman

Code Consultant
Rolf Jensen & Associates

James Antell
Jeff Harper
<table>
<thead>
<tr>
<th>Position</th>
<th>Consultant Name</th>
<th>Company/Group</th>
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</thead>
<tbody>
<tr>
<td>Color Consultant</td>
<td>Donald Kaufman</td>
<td>Donald Kaufman Color</td>
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<tr>
<td>Cost Consultant</td>
<td>Richard Vermeulen</td>
<td>Vermeulen Cost Consultants</td>
</tr>
<tr>
<td>Curtain Wall Consultant</td>
<td>Bill Logan</td>
<td>Israel Berger &amp; Associates</td>
</tr>
<tr>
<td>Door Hardware Consultant</td>
<td>Jeff Pistone</td>
<td>Essex Industries</td>
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<tr>
<td></td>
<td>Mike Foley</td>
<td></td>
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<tr>
<td>Elevator Consultant</td>
<td>Bryan Hines</td>
<td>Lerch Bates</td>
</tr>
<tr>
<td></td>
<td>Charles F. Enger</td>
<td></td>
</tr>
<tr>
<td>Environmental Consultant</td>
<td>Andrew B. Inman</td>
<td>STS Consultants, Ltd.</td>
</tr>
<tr>
<td></td>
<td>Gerald A. Krueger</td>
<td></td>
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<td></td>
<td>David Markelz</td>
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<td></td>
<td>Larry Russell</td>
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<tr>
<td>Food Service Consultant</td>
<td>Dave Stewart</td>
<td>Stewart Design Associates</td>
</tr>
<tr>
<td></td>
<td>Brian Nelson</td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td>Consultant</td>
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<td>------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Graphics Consultant</td>
<td>Wendy Carnegie, Anna Gardner, Lowell Williams</td>
<td></td>
</tr>
<tr>
<td>Operations Consultant</td>
<td>Steven A. Wolff, Arts Axis, Andrew Taylor</td>
<td></td>
</tr>
<tr>
<td>Organ Consultant</td>
<td>Margaret Co Chen</td>
<td></td>
</tr>
<tr>
<td>Project Communications Consultant</td>
<td>Roberta Gassman</td>
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<tr>
<td>Source Reduction and Recycling Consultant</td>
<td>Sherrie Gruder</td>
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</tr>
<tr>
<td>Targeted Business Participation Consultant</td>
<td>Carla Cross</td>
<td></td>
</tr>
<tr>
<td>Theater Consultant</td>
<td>Paul Alegado, Dave Clark</td>
<td></td>
</tr>
</tbody>
</table>
Cyril Almey
Liz Diaz
Michael Ferguson
Elissa Getto
Brian Hall
Gene Leitermann
Michael Patterson
Richard Pilbrow

Council “credentials” Leadership in Energy and Environmental design (LEED) professionals.

Consultant services may be product-based (curtain walls, door hardware, and elevators) or function-based (food service, parking, and retail). Some consultants specialize in one building type (hospitals, prisons, or theaters), and some consultants provide services on a wide range of building types (acousticians, code consultants, and specification writers). The design of a complicated building will involve a dozen or more consulting disciplines.

The example team listing shown in Table 2.2 is taken from an Overture Center project directory from 2002. Twenty-five firms and nearly 100 persons are listed—and this is only a single slice in time, about mid-way through design. It’s not a complete roster of all the design firms and individuals who worked on the project over its six-year life.

**Core Design Team**
The early work on a theater building project is mostly accomplished by a much smaller group of firms. This group consists of the architect (or architects) and three or four important consultants—theater, acoustical, cost, and (possibly) arts management. It’s common for these consultants to work under contract to the architect, especially on smaller and publicly funded projects. On larger and more prestigious projects, the owner may contract directly with some or all of the core design team members. One motivation may be the owner’s desire to receive unfiltered advice from these key consultants.

![Diagram of Core Design Team Working for the Architect](source: Author)

The theater consultant (also called theater planner, theater designer, or theater design consultant) is the expert on the building type. All design team members will be familiar with the design and construction process, but the theater consultant is conversant in the specific design issues and functional requirements of theater buildings. He or she provides the other design team members with the design criteria and guidance they need to perform their roles. The theater consultant may also take the lead in explaining the design and construction process to the owner and users, and advising them on how to effectively communicate their needs and desires to the entire design team.

There are two professional organizations for theater consultants. The Institute of Theatre Consultants was formed in 1964 in the United Kingdom and has about 40 fully qualified members. The Institute offers a master of arts in theater consultancy in collaboration with Warwick University. The Institute applied for a
royal charter as a professional body, a possible step towards certification, but the charter was denied in 2014 due to the small size and limited visibility of the profession. The second organization is the American Society of Theatre Consultants (ASTC). It was formed in the United States in 1980 and has about 80 full members. The ASTC has not attempted to develop a certification for theater consultants.

The theater consultant will be asked many different questions—what lighting control console should be specified? How many public toilets are needed? What are the Actors Equity requirements for dressing rooms? Will the patrons be able to see? Richard Pilbrow, the originator of theater consulting in the United Kingdom, says “The theatre consultant is totally responsible for every aspect of the (theatrical) performance of the building.” Or more succinctly, “Everything is in our remit!”

The services that theater consultants provide fall into three major categories—theater planning, theater design, and theater equipment. These categories are useful in understanding the nature of theater design consulting, although they may become blurred in actual practice.

**Theater Planning**

Theater planning is the broadest of the categories and itself encompasses multiple tasks. The first is pre-design—the initial work with the owner and users to assess their current and potential needs and to determine the scope of the building project. Pre-design is described in detail in Chapter 5.

The second task is functional planning. This is comprehensive advice on the building design to ensure it has the required features and is suited for the intended use—for example, properly outfitted dressing rooms located appropriately near the stage.

The third task is providing advice on building systems and features that are special or unique to theaters. For example, the theater consultant will propose details for stage lighting positions and auditorium railings, and these items will be documented by the architect and provided by the miscellaneous metals fabricator.

The final task is design coordination—that is, the review of all the building elements and features proposed or dictated by other design disciplines to ensure they are properly coordinated and don’t inhibit the performance function. For example, the theater consultant and mechanical engineer will coordinate the routing of stagehouse ductwork to minimize its impact on stage productions.

**Theater Design**

The task of theater design is first to determine the size and shape of the audience chamber, and to develop seating layouts, access, circulation, and egress to ensure the safety of the audience and the quality of their experience. It also includes the layout of the stage or performance area, with circulation and technical elements such as traps, grids, and galleries.
Theater planning and theater design are advisory services, meaning the theater consultant is providing advice to the architect and other members of the design team. The advice may be comprehensive, highly detailed (and opinionated), but it is up to the other team members to adopt and implement the advice.

**Theater Equipment**

In contrast, theater equipment is the service area in which the theater consultant has “soup to nuts” responsibility. The theater consultant typically has responsibility for audience seating; stage rigging, lifts, and wagons; adjustable acoustic devices; and production lighting, audio, video, and projection. The theater consultant provides design criteria and collaborates with the architect and engineers on the infrastructure needed to support this equipment. For example, the theater consultant will provide design criteria for the structural supports for the stage rigging system, so that the supports can be designed by the structural engineer and provided by the steel fabricator. The consultant budgets the cost of the theater equipment, develops the design, prepares drawings and specifications, reviews the installation, and performs final testing.

This area of service closely parallels the typical responsibilities of a consulting engineer, with one important distinction—unlike engineers, theater consultants are unlicensed and do not have the authority to seal and sign their design drawings.

**Acoustical Consultant**

Most projects have an acoustical consultant (or acoustician) on the design team from the very beginning, and if the building is primarily for music performance the acoustician may take a lead role in early design discussions. The core acoustical service provided by all firms covers the three areas described below. Some acoustical consulting firms also provide design services for audiovisual and projection systems, potentially creating an overlap of the theater planner’s and acoustician’s scope. This overlap is usually identified and resolved quickly and amicably in the qualifications stage or early in design.

**Room Acoustics**

Room acoustics includes advice on the geometry and volume of the auditorium, wall and ceiling shaping, material selections, and architectural detailing.

**Noise Isolation**

In the area of noise isolation, the acoustician is concerned with preventing the intrusion of noise into the auditorium, where it may disturb the performance. The noise source may be outside the building (for example, traffic noise) or from other areas within the building (a scene shop, say). The acoustician advises
on structural systems, roof and wall construction, treatment of any penetrations of the roof and walls, and door specifications.

*Mechanical System Noise and Vibration Control*

This area of service involves advice on reducing the noise produced by the building services (heating, cooling, electrical, lighting, etc.) and/or limiting the transmission of this noise into the performance volume.

**Cost Consultant**

Cost estimating in the very early design phases and cost management throughout design are critical to a successful project. So a cost consultant is almost always a member of the core design team. (There may also be a construction manager providing cost estimating services directly to the owner. See [Chapter 8](#) for more detail.) Several large international firms offer both program management and cost estimating services. There are many smaller cost estimating consultants, and a handful of these firms specialize in cost management for performing arts projects.

**Arts Management Consultant**

An arts management consultant is sometimes a part of the core design team. They may evaluate the market potential for the new building and guide the owner on the governance and operations of the completed building. This work is often complete before design commences, but sometimes the management consultant has an ongoing role.
How do the firms and individuals planning and building a theater organize their work? A comparison to a stage production is again helpful—from script selection to opening night, a stage production follows a conventional process understood by just about everyone involved:

- Pre-production—budgets and concepts
- Production—rehearsal and build period
- Transfer to the theater—load-in, technical, and dress rehearsals
- Performances

At its most basic, a building project is also a four step process:

1. Pre-design
2. Design
3. Construction
4. Occupancy

The American Institute of Architects (AIA) has adopted a widely followed set of project phases. In the AIA phases, “design” is further divided into schematic design, design development, and contract documents. The AIA also divides “construction” into bidding and construction administration. And on a performing arts building, construction administration is usually followed by a period of final testing and tuning, so the complete conventional list of phases is:

1. Pre-design
2. Design
3. Schematic design
4. Design development
5. Contract documents
6. Construction
7. Bidding
8. Construction administration
9. Final testing and tuning
On any given project the process may be streamlined or more complicated. But some variation of this process is used everywhere in the world.

**Design Phases**

Each project phase is dependent on the work of the previous phase—it builds on that work, and also places limits on the work of the succeeding phases. The design phases are especially interdependent in this way, and this interdependence bears discussion before we describe each phase.

**Design Is Iterative**

The design of theater buildings is iterative. This is true at the macro level—during each of the design phases the project elements are examined and documented. Then in the next phase, these elements are further refined and developed, and documented again. At each phase the design is more detailed and more of the design disciplines become involved.

Design is also iterative at the micro level. Any given building element may be revisited again and again—refined, improved, adjusted to accommodate related and adjacent elements, and finally, detailed and specified for construction.

**Every Design Is Unique**

At each step in the micro and macro processes, the owner and design team make decisions. The completed design is an accumulation of thousands (perhaps tens of thousands) of discrete decisions, and the result is a unique
response to the owner’s needs. The building committee chair for a new arts center, who was also the head of a large manufacturing company, told the architect he didn’t want his new arts center to be “serial number one.” The architect replied that his firm had designed many arts centers and that this new building would be a “production model” not a prototype. This was an appropriate and reassuring response to the client’s underlying anxiety. But it was disingenuous, since every new arts building by definition is “serial number one.”

Design Is Risky

It follows that risk is inherent in the design and construction of theater buildings. In making those thousands of decisions, the owner and design team will get some wrong. Some of those wrong decisions may come to light during a later design phase, or during construction, and the design will be adjusted. Of course the builders must make hundreds or thousands of decisions as well, and some of those will be wrong, too. Inevitably, some problems will not be obvious until the building is completed and then it may be too late for corrections.
Almost every new building has a few disappointments. On most projects such problems do not seriously diminish the building’s aesthetics or function. And it’s important not to let the new building be defined by the outcome of a few wrong decisions, rather than the thousands of right ones. Of course, on a very few buildings serious issues arise after occupancy, and expensive fixes must be undertaken.

The design team’s responsibility in all this is to perform services to an appropriate standard of care. This is usually described as performance “consistent with the professional skill and care ordinarily provided by professionals performing similar services on similar projects.” The design team (or its insurance companies) must provide redress for problems resulting from substandard performance. However, so long as the design team performs to the appropriate standard of care, it is not responsible for the vagaries of the design and construction process.

Some owners try to shift the risk of the design process to the design team by defining a higher standard of care, or even attempting to require that the design team guarantee the outcome of the design and construction process. However, this is beyond the ability of even the most talented and foresighted design team, since much of the process is outside of their control.

**Choices Become More Limited Over Time**

The iterative nature of design also places greater constraints on the owner and design team at each step in the process. As the decisions accumulate, the options for changing the design become fewer. This means the early phases of the project are the most critical—the decisions made during pre-design and schematic design will largely determine the ultimate success of the project. Not coincidentally, it’s during these early phases that the owner and users have the most influence over the project. The decision-making in the later phases is more technical and is largely left to the design team and builders.

**Cost Savings Are Less Over Time**

It’s also at the outset that the owner has the best opportunity to control project costs. About 20 percent of design fees are spent during the pre-design and schematic design phases, but it’s during these two phases that the decisions affecting 80 percent of the cost are made. The opportunity to reduce cost diminishes as the design decisions become more limited in scope.

To illustrate, here’s a hypothetical example about a dance rehearsal room.

**Pre-Design and Schematic Design**

Should a dance rehearsal room be included in our new building? Questions about including (or excluding) significant building elements are appropriate for pre-design and still possible in the schematic design phase. The owner’s decision on the rehearsal room will change the construction cost by $500,000.
or more. Let’s say the owner decides to increase the budget and the dance rehearsal room is integrated into the schematic design. The dance instructor is quite happy.

**Design Development**

The rehearsal room’s finishes and services are defined in the design development phase. A maple basket weave floor is detailed, and an appropriate audiovisual system is specified. Dance barres, large mirrors, and curtains to cover the mirrors are shown on the drawings. The structural, HVAC, and electrical systems are defined.

At the end of design development the project cost estimate comes in high. The owner might be regretting the decision to add the dance rehearsal room, but the room is well integrated into the overall design and removing it now is not very feasible. The design team would have to redo significant work, which would delay the project and may require additional fees.

How else can costs be reduced? The total cost of the barres, mirrors, curtains, and audiovisual system might be $100,000. These items could be removed from the construction contract and furnished by the owner. This does not actually reduce the cost but shifts it to another budget or defers it to a later date. How about the basket weave floor? It’s desirable for dance, but it’s expensive and requires an extra deep slab depression. A simpler floor construction would cost less and may reduce the cost of structure as well. The dance instructor consults with colleagues and agrees the simpler floor is acceptable. The less costly floor saves $50,000, so the floor is changed.

**Contract Documents**

In the contract documents phase, the structural engineer designs and details the building structure to accommodate the less expensive floor. The architect specifies and details the floor and the edge conditions where the maple surface meets surrounding floor finishes. If more savings are needed, our choices now are quite limited. We could switch the top layer of the floor from 25/32″ T&G (tongue & groove) maple to 3/4″ Plyron sheets. This requires just a few changes to the floor details and specification, and doesn’t affect other parts of the design. This change saves $5,000.

**Bidding and Construction**

Once the bids for construction are received, it’s no longer a question of reducing costs but of avoiding additional costs in the form of change orders. Suppose a donor emerges during construction who wishes to pay the cost of adding back the maple surface. This requires changes to agreements with the contractors and suppliers. The Plyron is probably on order; it may even be on the jobsite. The cost to change the top surface from Plyron to maple will likely be $10,000 to $15,000—much more than the $5,000 we saved in the change from maple to Plyron.
Of course, the owner can cancel or significantly revise the project at any point in design, but the cost of doing so increases as the project progresses. Major changes made late in the design process can be very expensive and can delay the project. For this reason it’s critical to spend adequate time on the early project phases. And to protect everyone, the results of each phase should be well documented and signed off by the owner before the next phase is begun.

![Figure 3.2 Opportunity for Savings Versus Design Fees Spent](source: Author)

With this background, let’s move on to a description of each of the conventional phases.

**Pre-Design**

Pre-design may also be called pre-schematic, programming, project feasibility, or various other names. The basic questions that pre-design answers are:

- What are the needs to be addressed?
- Is a new or renovated building the right response to those needs?
- What should be built or renovated? What kinds and numbers of rooms should the building have? In other words, what is the building program?
- How much will the project cost and how much is the owner able and willing to spend? That is, what is the project budget?

Pre-design may be performed by the owner without the involvement of any consultants, but most owners do not have the necessary resources and expertise. More often a consultant or a team of
consultants is engaged—this team may be led by an architect, theater planner, arts management consultant, or by a consultant who specializes in architectural programming services. Once pre-design is complete, the same team may be retained for complete design services, or the owner may advertise for a new design team. On some publicly funded projects, the pre-design team is prohibited from performing the subsequent design work.

The result of pre-design should be a building program (a complete description of the building in words and numbers) reconciled to a project budget (more numbers). Owners and architects sometimes have the urge to jump right into design, but pre-design is a critical first step that should not be shortchanged. It will be discussed in more depth in Chapter 5.

**Schematic Design**

A primary task of schematic design is to organize the building, both functionally and aesthetically. The functional goal is to establish the sizes, shapes, and locations of each interior room, and to work out the best adjacencies and circulation paths between rooms. As noted in the first chapter, a theater has many individual rooms with unique requirements, making this a challenging task. The aesthetic goal is to make sense of the building massing—that is, the shape and appearance of the building as a sculptural object—and to fit the design into the context of the surrounding buildings or landscape.

There are projects in which the exterior form of the building was decided first, and the interior program elements were accommodated as best as possible within this form. The Sydney Opera House is a famous example of “designing from the outside in.” At the other extreme, the appearance of some theater buildings suggests a functional plan was established, and exterior walls and roofs were added, with no thought to the aesthetics of the building form. This is “designing from the inside out.” Neither approach is satisfactory. The functional and aesthetic goals are interdependent and must be addressed together.

This process is iterative, and will heavily involve the design architect, theater planner, and acoustician. The theater planner and acoustician will be more focused on function, and the design architect on aesthetics, but not exclusively so. These core design team members also work together to establish the basic geometry of the performance spaces. The structural engineer will advise on possible approaches to the building structure, and a preliminary structural grid will be established. The MEP engineers (mechanical, electrical, and plumbing) will document the design loads for these systems, and focus on reserving adequate space for equipment rooms and duct and riser chases. The IT consultant will reserve an excessive amount of space for telecom and data rooms. In this phase, the executive architect is managing the design team’s effort, arranging and minuting project meetings, and advising on local regulatory and construction issues. The owner and users participate in many of the meetings during this phase, though the design team may also schedule work sessions without the owner.

The schematic design package will include drawings—plans, elevations, and sections—and narratives describing materials, finishes, acoustic requirements, theater equipment and accommodation, the
Design Development

The task of design development is to refine and develop the design, again both functionally and aesthetically. Ideally, a design development package reflects a completely thought out design intention. The interior architecture of the performance spaces is defined—for example, shaping and detailing of walls, ceilings, and balcony fronts. Room layouts, furniture, and equipment are shown on the drawings. The structural, mechanical, and electrical systems are fully developed and integrated with the architectural design. Materials are selected, and critical finishes are shown on the drawings.

The role of the executive architect increases significantly in design development. It’s common for both the design and executive architects to have drawings in the design development package. While the design architect continues to develop and document the interior of the building, the executive architect is probably taking ownership of the building plans, confirming the structural grid, and preparing background drawings for the engineers and consultants to use. The executive architect may begin to detail the exterior elevations, wall sections, elevators, stairs, and similar building elements.

The design development package will include hundreds of drawings prepared by the architects, engineers, theater planner, acoustician, food service

Table 3.1 CSI MasterFormat Divisions

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consultant, architectural lighting designer, and other design team members. Some of these drawings will be developed into contract documents in the next phase. Other drawings will not. For example, the theater planner will prepare general arrangement drawings showing special structural and electrical needs, and the acoustician may prepare building plans showing acoustic requirements for walls and doors. The requirements shown on these drawings will be incorporated into the contract documents prepared by other members of the design team.

The design development package will also include preliminary specifications, often in outline form. Almost all projects in North America and many projects elsewhere use the specification format published by the Construction Specifications Institute (CSI). The CSI MasterFormat organizes the work into standard divisions, and individual systems or products are organized into sections within each division. For example, Division 05 is “Metals” and Section 05 12 00 is “Structural Steel Framing.” As a general rule, the scope of a project is shown on the drawings, while qualitative and procedural requirements are included in the specifications.

Progress sets are typically issued when the design development phase is 50, 75, 90, and 100 percent complete. The cost model may be updated midway through design development and again at the completion of the phase.

**Contract Documents**

The drawings and specifications prepared in this phase become part of the contract between the owner and builder—hence “contract documents.” This phase is also called working drawings or construction drawings, since the builders use these drawings to guide the work of construction. If the design development package defines a completely thought out design intention, then the task during construction documents is to coordinate and document that design for bidding and building.

At this point the executive architect is responsible for the documents, although the design architect will continue to make significant contributions. The design architect may be responsible for certain specification sections or may even prepare some of the drawings. Each of the engineering disciplines and the theater planner will prepare specifications and a significant number of drawings. The design team members who do not issue their own drawings at this phase—acoustician, architectural lighting designer, food service consultant, graphics designer, etc.—will carefully review the drawings prepared by the other design disciplines to confirm that their work and advice have been incorporated.

By way of example, at the time construction of the Overture Center in Madison, Wisconsin began, the contract documents included five bound volumes of architectural drawings and one volume each for structural, theater equipment, piping (plumbing and fire protection), mechanical (HVAC), and electrical—more than 1,000 unique drawings in all. See Table 3.2 for a description of each volume. Including revisions, the design team formally issued more than 5,000 drawings between the start of schematic design and the beginning of construction. Detailing and coordinating the work of all these design
disciplines across so many sheets of drawings is a challenge, and this occupies most of the design team’s time during the contract document phase. Progress sets might be issued at 35, 65, 95, and 100 percent complete.

The extent of coordination required is often a surprise to members of the design team who are not familiar with theater buildings. If the architect has previously been suspicious of the theater planner’s statements about the project’s complexity, it’s at this point that he or she may reconsider. If the team began the contract document phase with some design issues unresolved—a common event—then the task of coordinating and detailing is made that much more difficult. And unfortunately, it’s at this critical time that the design team may be running out of time, fee, and oomph. If the 100 percent set is not completely coordinated there will be pressure to put the project out to bid anyway. The project schedule may have been stretched to its limit—construction must start before the authorizing legislation expires, before the winter sets in, or before the lead donor gets very much older! The design team has billed out 75 to 80 percent of its fees and continuing coordination efforts will eat into the profits—if there are profits. Design firms’ responses to this situation vary greatly. Some firms will reassign almost all of their project staff (presumably to money-making projects) leaving one or two poor souls to continue the coordination and detailing work. Other firms will send in a fresh and experienced “relief team” for a concerted push to finish up the documents.

**Bidding**

When the contract documents are complete, the project is bid or priced. (In British English this process is called tendering.) Documents that define the bidding requirements (informally called the front end) are added to the

| Table 3.2 Contract Document Drawing Volumes: Overture Center, Madison, Wisconsin |

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<td>Foundation and Framing Area Plans (1/8”)</td>
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Concrete Column Schedule
Concrete Wall Schedules and Details
Concrete Wall Plans and Elevations
Slab Schedule and Details
Concrete Beam Schedule and Details
Concrete Sections and Details
Steel Truss Elevations
Catwalk Details
Steel Details
Steel Column Schedule and Key Plan
Steel Bracing Details
Acoustic Isolation Details

2A ARCHITECTURAL

Demolition Plans (1/8”)
Fire Safety Plans (1/16”)
Geometry Plans (1/16”)
Reference Plans (1/16”)
Area Plans (1/8”)
Enlarged Plans (1/4”)

2B ARCHITECTURAL

Exterior Elevations
Building Sections
Wall Sections
Exterior Details

2C ARCHITECTURAL

Vertical Transportation
Stair Details
Misc. Details
Door and Frame Details
Special Partition Types
Specialty Area Plans (1/8”)
Food Service Plans (1/4”)

2D ARCHITECTURAL

Interior Elevations
Finish Area Plans (1/8”)
Finish Enlarged Plans (1/4”)
Reflected Ceiling Area Plans (1/8”)
Reflected Ceiling Enlarged Plans (1/4”)
Ceiling Details

2E ARCHITECTURAL

Interior Details

3 NOT USED

4 NOT USED

5 THEATRE EQUIPMENT

Theatre Equipment Plans
Orchestra Pit Lift Plans
Orchestra Enclosure Plans
Theatre Equipment Details
Theatre Equipment Schedules
Theatre Equipment Control Risers and Details
Performance Lighting Box Schedules
Performance Lighting Control Risers
Performance Lighting Faceplate Details
Performance Lighting Cable Details
Theatre Seating Plans and Details
Theatre Sound, Video, and Communication Plans and Details
contract documents, and the resulting package is known as the bidding documents. Builders interested in providing the work analyze the bidding documents and estimate the materials, labor, and equipment
needed for construction. From their analysis, they develop and submit a price. The specifics of bidding will vary depending on the project delivery method (also called project procurement or contracting method). Procurement methods and the builder’s role in bidding and construction are discussed in Chapter 4. The design team’s role is discussed below.

The owner and design team may hold a pre-bid meeting for potential bidders. The purpose is to answer questions about the bid process and the documents, and to allow the bidders to familiarize themselves with the site conditions.

Bidders may submit questions about the documents—these are called requests for information or RFIs. Some bidding documents may require bidders to propose product substitutions for approval prior to the deadline for bid submission. The design team’s response to RFIs and substitution requests will be in the form of an addendum to the bidding documents distributed to all of the bidders. The addendum may include written responses to questions, revisions to specifications, sketches, and new or revised drawings.

Once bids are received, the design team participates in analysis of the bid results, evaluation of substitutes, and confirmation of scope. Sometimes individual pre-award conferences are held with the top two or three bidders to confirm that their bids are responsive—that is, that they conform to the substantive requirements of the bidding documents. Often on publicly funded projects, the construction contract must be awarded to the bidder who submits the lowest responsive bid. The construction contract usually stipulates both the price (called the contract sum) and the number of days before the building is expected to be ready for occupancy (contract time).

Construction Administration

The builder generally has control of the construction site and authority over the “means and materials” of construction. The construction contract requires the builder to conform to the “design intent” as described in the contract documents. The architect’s contract with the owner gives the design team the authority to interpret the contract documents for both the builder and the owner. The architect may also have the responsibility of monitoring the completeness of the work and approving the builder’s pay applications. The design team’s role during construction is therefore called construction administration.

With so much at stake, project communications and documents are treated more formally once the construction contract is awarded. The AIA publishes standard forms and other materials that can be used to manage project communications during construction, but today much of the communication is handled through project management websites.

Requests for Information

The builder will ask questions about the contract documents by submitting a written request for
information (RFI) which the design team will answer in writing with support material if necessary.

Submittals

The construction contract will require the builder to submit samples, mockups, product data, and fabrication and installation drawings for elements of the work. These submittals are reviewed by the design team for conformance with the design intent, marked up, and returned to the builder.

Field Reports and Punch Lists

Another way the design team monitors the builder’s conformance is by walking the construction site, reviewing the completed work, and documenting any concerns or observations in a field report. On large projects the architect and other design team members may have project representatives permanently on site to review the work in progress. As the building nears completion, the design team will prepare a punch list of the work remaining to be completed or needing correction.

Supplemental Instructions and Change Orders

The design team may make clarifications or minor changes to the work by issuing an architect’s supplemental instruction (ASI). For changes or additions that affect cost and schedule, the design team may issue a proposal request to the builder. If the owner accepts the builder’s proposal, the design team issues a change order—this modifies the contract documents and adjusts the contract sum or contract time or both. If a change affecting cost and schedule is needed, but there isn’t enough time to solicit a proposal and issue a change order, the designer can issue a construction change directive (CCD). This requires the builder to make the change, with adjustment of the contract sum and time to follow, which may lead to disputes about the value of the change.

Delays

Changes to the contract time are important because some contracts specify liquidated damages. These are damages that the builder must pay the owner if the building is not ready on time—say, $1,000 for every day that occupancy is delayed. These amounts are not meant to be a penalty, but are compensation to the owner for the loss of use of the building, due to the builder’s failure to perform on time.

The builder may also claim delay damages against the owner if, say, the information necessary for construction isn’t provided in a timely manner or the contract documents are so deficient that they contribute to delays in the work. The builder will seek compensation for the extra costs associated with the delay, and perhaps compensation for the construction work he or she could have been performing on other projects had the delays not occurred.
Does This Sound Adversarial?

It doesn’t have to be, but sometimes it is. The following anonymous example happened at a large university, but the situation can be found on projects of all sizes: the relationships between the owner, builder, and design team became very adversarial on a large performing arts center, resulting in many disputes and causing several people to leave the project and their jobs. One of the site architects observed that the builder’s project manager was putting more energy into assembling a delay claim than into the actual work. And, late in construction, the builder did file a very substantial delay claim against the owner. The builder and owner reached a settlement without consulting the design team, and two things happened immediately after: the builder recalled its project manager to corporate headquarters, and the owner sued the design team for indemnity—that is, to be reimbursed for the damages paid to the builder. The owner and design team eventually reached a settlement. Fortunately, the design team had jointly purchased a project-specific professional liability policy, and it was this policy that largely funded the settlement with the owner. The owner eventually took occupancy of the building, although the punch list was never completed. And the users—the only group left unscathed by the construction process—absolutely love their building. Fortunately, most construction projects are much more collegial, or at least much less adversarial, than this example!

Final Testing and Tuning

Final testing (or acceptance testing) of the theater equipment is performed by the theater planner. If the facility is to be used for music, the acoustician also tests and “tunes” the room with assistance from the theater planner. Final testing and tuning is sometimes called “commissioning.” But as commonly used in design and construction, commissioning concerns the building management system and building services—HVAC, electrical, fire alarm, etc.—and is usually performed by an independent commissioning authority or agent directly under contract to the owner. To avoid confusion, “testing and tuning” is the preferred term for what the theater planner and acoustician do.

Most performance equipment is completely custom—the British say “bespoke,” which makes one think of men’s suits. Or it is a highly customized assemblage of more or less standard pieces. In either case, we can’t really know if it all works together as planned until it’s complete and tested. The goals of final testing are to confirm that the installed equipment complies with the design intent and contract requirements, to put the equipment through its functional paces, and to coordinate final corrections and adjustments.

If an auditorium is intended for music, the acoustician will take measurements to determine how quiet the room is and how the room responds to various-sized musical ensembles. Often the acoustician takes advantage of the “hard hat” performance given for the construction workers to record the response of the room with an audience. The acoustician compares these measurements with the design criteria and proposes adjustments to the HVAC system, room finishes, etc. if required. If the room is equipped with
adjustable acoustic devices—a demountable orchestra enclosure, forestage canopy, adjustable absorption, or reverberation chambers—the acoustician and theater planner work together to confirm their proper operation, determine placements and settings, and program the system controls.

**Occupancy**

Surprisingly, most design teams have little formal role as the owner and users take occupancy of the new building. Most construction contracts require the builder to provide training for the users in the operation and maintenance of the building systems, and the designers may monitor this training. The design team also reviews the O&M (operation and maintenance) manuals prepared by the builder, to ensure that they adequately document the building systems. And the design team may prepare record drawings for the owner’s use. These are revisions of the contract documents that incorporate the changes made during construction.

If the new building is opening with a public performance, the theater planner may attend the technical rehearsals to advise on the theater equipment systems and to help resolve any problems that may arise with the equipment. Similarly, the acoustician may attend music rehearsals. This level of involvement is almost never required by contract, however, and in some cases it may even be unwelcome.

While the owner and users are taking possession of their building, the designers and builders are marking the end of a project that has consumed several years of their professional lives. The hard hat performance mentioned above is often an opportunity to celebrate and say goodbyes. The opening performance is often a fundraising event for the owner, but the design team members will appreciate the opportunity to attend, whether tickets are complimentary or paid.

**Post-Occupancy Walk-Through**

Even after occupancy the design team will assist the owner in getting any deficient work corrected. Sometimes the design team’s contract includes a post-occupancy walk-through. This is usually scheduled about a year after opening, but prior to the expiration of the builder’s warranty so that the design team can assist with any warranty repairs.

**Postmortem**

Project teams often gather for a postmortem with the owner and users—meeting one or two years after opening to discuss the users’ experience and the building’s performance. Although rarely a contractual requirement, it’s a great opportunity to learn from the project and to maintain relationships with the users.
Chapter 4
Project Delivery Methods

The implementation of the design created by the architect and design team is called project delivery (or project procurement or contracting method). Project delivery methods are evolving, and several methods, each with variations, are currently in use. The contractual relationships and exact roles of the parties vary depending upon the method, and each method has advantages and disadvantages that make it best suited to particular situations.

This chapter describes four basic forms of project delivery—design-bid-build, design-build, construction management, and integrated project delivery—with a few important variations. On public money projects the delivery method is often mandated. When the owner has a choice, the selection of delivery method is one of the most important decisions the owner will make. The AIA 2012 firm survey reported that design-bid-build represented 55 percent of all construction spending, design-build was 15 percent, construction management was 23 percent, integrated project delivery just two percent, and four percent was classified as “other.” The owner should be aware there is disagreement over the relative merits of these forms, and in fact there is disagreement over the definition of each form.

Some project delivery methods are better suited to fast-tracking—a method of shortening the time required for design and construction. We’ll discuss this as well.

Design-Bid-Build

The conventional form of project delivery is called design-bid-build (DBB) or the general contract method. This was the dominant form of project delivery throughout the nineteenth and twentieth centuries. And while the other forms have recently become more popular, design-bid-build is still the most prevalent form.

The contractual and working relationships are shown in Figure 4.1. The top portion of this figure is very similar to Figure 2.1, but the title Builder is now General Contractor (GC). The general contractor enters into a contract with the owner in which it assumes general (that is, comprehensive) responsibility for the construction of the building. In turn the GC contracts portions of the work to subcontractors and suppliers, but it retains authority over and responsibility for their work. The GC is at risk both for its own performance and the performance of its subcontractors.
Figure 4.1 shows the architect holding a separate contract with the owner, and the other members of the design team working for the architect. The variations in design team contracts that we discussed in Chapter 2 are all possible, but aren’t significant for the current discussion.

![Design-Bid-Build Diagram](source)

The architect and GC have no contractual relationship, but they have a working relationship defined by their individual agreements with the owner. The architect is the interpreter of the contract documents and usually has the responsibility to administer the contract between the owner and GC. The architect’s engineers and consultants have similar relationships with their counterparts among the GC’s subcontractors. For example, the electrical engineer is the interpreter of the electrical design and will assist the architect in administering the work of the electrical contractor. These relationships are more or less formal, depending upon the parties and the tenor of the construction site. The electrical engineer and the electrical contractor may have informal site conferences, but formal communications will be routed through the architect and GC.

The name design-bid-build emphasizes the sequential nature of the process—the design team completes the design and prepares contract documents, and the owner uses the contract documents to solicit competitive lump sum bids from potential general contractors. The bidding may be open to any interested party—often a requirement on publicly funded projects—or the owner may preselect or prequalify a small number of bidders. The successful bidder (who is almost always the lowest responsive bidder) is awarded the general contract for construction, and builds the building. There are variations to the bid process—rather than competitively bidding the work, the owner may negotiate a lump sum price with potential GCs. Or, instead of a lump sum, the GC may work on a time and materials basis (also
The latter is more likely for very small projects, or if the scope of work is not well defined, or for renovations with significant unknowns.

Advantages

The design-bid-build method of project delivery has much to offer. It allows the design team the best opportunity to design, document, and coordinate the building before construction starts. In theory at least, this results in complete and high-quality contract documents that clearly define the building.

Assuming there are enough interested bidders, the owner receives competitive pricing for the work. And, except for the cost of changes, the owner is able to establish a fixed cost for construction. (In addition to the contract sum, the owner’s budget should include a construction contingency—for unavoidable changes—and an owner’s contingency—for discretionary ones.)

The well-developed and coordinated contract documents remove ambiguity and cost uncertainty for the bidders. This allows the bidders to accurately assess their costs and risks, develop competitive pricing, and ensure their bottom line.

In fact, the overall advantage of this delivery method is that it equitably distributes the risk inherent in construction among the parties. And no party assumes risk disproportionate to its ability to manage it.

Disadvantages
The sequential nature of design-bid-build makes it the most time consuming delivery method. As illustrated in Figure 4.2, the design process for a large and complicated building may take 24 to 30 months, and construction may take 30 to 36 months or more. (Although smaller and simpler buildings can take much less time.) Sometimes the owner cannot afford this time. Perhaps the new building must be online to replace an existing facility by a certain date. Or perhaps the concern is opportunity cost. For example, the weekly box office gross for a Las Vegas showroom with 1,800 seats, eight shows a week, and an average ticket price of $165 is $2.4 million. The owner foregoes $10 million in revenue for each additional month spent in design and construction. Not surprisingly, design-bid-build is not the preferred delivery method for showrooms.

A second disadvantage of the design-bid-build method is the administrative burden it places on the owner. On all but the simplest projects, the owner will need at least one staff member to monitor the construction process, attend OAC (owner/architect/contractor) meetings, review submittals, answer questions, approve change orders, and process pay applications. This is a fulltime commitment and not a set of duties that can be assumed by, say, the production manager of a regional theater company—he or she has a season to produce.

No Longer the Master Builder

![Diagram of Multiple Prime Contracts](image)

*Figure 4.3* Multiple Prime Contracts
Source: Author

This administrative burden on the owner, and the decline in dominance of the design-bid-build method, are due in part to the architect’s diminished authority over construction. In 1886 British theater architect C. J. Phipps was able to stand in the Exeter Theatre construction site and declare “My will is law here.” While he might have been more polite about it, he wasn’t wrong—or exceptional. Frank Lloyd Wright
had the explicit authority to approve subcontractors, remove incompetent workers and superintendents, and to stop work. And throughout the first half of the twentieth century the AIA defined the architect’s role in construction as “general supervision and direction of the work.” But in 1960, in the face of increased claims against architects, the phase of work known as “construction supervision” was changed to “construction administration,” and the architect’s role was reduced to making “periodic visits to observe.” From the early 1960s to the mid-1980s claims against architects increased fourfold. These included injury claims by construction workers and claims made under new legal theories of liability. The sharp rise in claims led to increased costs for professional liability insurance, which reached a crisis point in the late 1980s when fully half of the firms surveyed by the AIA were practicing with no professional liability coverage at all. These circumstances drove the profession to further reduce the architect’s authority over construction in the hopes of minimizing exposure to lawsuits.

The field of construction management arose in the 1970s to fill the gap left by the architects’ retreat, and many complicated buildings today are built using a construction management model, a method we’ll discuss below.

Multiple Prime Contracts

Multiple prime contracts is a variation of design-bid-build. The critical difference is that, rather than awarding a general contract for construction, the owner enters into four or five separate (prime) construction contracts. These contractual relationships are shown in Figure 4.3. The mechanical (HVAC), plumbing, and electrical trades are all contracted directly to the owner. (Fire protection is sometimes separate and sometimes combined with plumbing.) All other work is provided by a general trades contractor who is also responsible for coordinating the work of the other primes. Of course the general trades contractor has no contractual relationship with (or substantial leverage over) the other prime contractors.

The multiple prime contract method is required on certain publicly funded projects, but it has little to recommend it, and it’s rarely used unless it is required. This method places increased burden and risk on the owner but offers little advantage to the project at hand. The apparent rationale is to provide the mechanical, plumbing, and electrical trades with equitable access to public funds. The supposition is that allowing these trades to submit direct bids opens up the playing field, increases competition, and ensures that the owner receives the lowest prices. Under a conventional general contract, these trades submit bids to GC bidders who control access to the work. The GC bidders can pick and choose their subs and may use their leverage to “shop” the work—that is, put pressure on trade contractors for favorable pricing which may or may not be passed on to the owner. The multiple prime method takes this leverage away from the GCs and may indeed result in lower prices to the owner. The question is whether this potential benefit outweighs the increased risk and burden of coordination.

Design-Build
Design-build (DB) is a procurement method in which the owner insulates itself from risk in exchange for relinquishing substantial control over the design and construction process. This method has been used for performing arts buildings, but it is not recommended. It would seem more suitable to simple buildings—a residence, say—or to buildings in which aesthetics take a back seat to function—perhaps an office building or warehouse.

In the design-build method, the owner enters into a single, turnkey contract with a design-build firm. The basis of the turnkey contract may be a program document or conceptual level drawings called basis drawings. At best these documents define the function and character of the building—the actual design is developed by the design-build firm, sometimes with little or no input from the owner. Some firms specialize in design-build, but for larger projects the DB firm is often a joint-venture or consortium of a developer, contractor, and architect. This consortium then enters into contracts with design firms and trade contractors for the necessary design expertise and construction ability.

Advantages

The great advantage of design-build is its turnkey nature—the owner receives a complete and (hopefully) functioning building for a fixed priced established at the outset. The owner has only one contract to administer and (since the owner is removed from much of the process) does not need staff to manage the design and construction process.

Another attraction of design-build is that design and construction tasks can proceed simultaneously, shortening the overall time required.
If the project is small enough or utilitarian enough that it can be well defined at the outset, design-build works fine. And some owners have long term, trustful relationships with DB firms, so their mutual expectations are understood even if not completely specified in the contract.

Disadvantages

The disadvantage of design-build is the owner’s lack of say in the finished product, and this makes it unsuitable for many building types and situations. If the DB firm has no motivation to provide more than the minimum functional requirement, design becomes subordinate to financial and construction considerations. This can be frustrating for the design firm that agrees to join a design-build consortium, and a real problem for the owner who has little influence over the design of the building.

Bridging Design-Build

Bridging design-build is a variation of design-build that addresses some of the disadvantages of “pure” design-build while retaining some of its advantages. In this method the owner engages a bridging architect (also called the owner’s design consultant) to develop the project to a certain level—perhaps roughly equivalent to schematic design or design development. These bridging documents form the basis for the owner’s agreement with the design-build firm. The DB firm develops the bridging documents into construction drawings and builds the building. (The DB firm’s construction drawings will be as detailed as DBB contract documents, but that name is not used to avoid confusion.) The bridging architect may remain on the job to assist the owner in selecting the DB firm, review the construction documents, and represent the owner during construction.

Bridging design-build offers the owner more control and is more suitable for specialized buildings than “pure” design-build. This method is used for performing arts buildings overseas—the bridging architect is often an international firm and the DB designers are usually local to the project.

Construction Management

The restructuring of the architect’s role in the 1960s and 1970s, and the acquisition of increased management training and expertise by contractors, led to the development of construction management as a separate discipline. Now about one-quarter of all projects utilize some form of construction management, and it is increasingly the preferred delivery method for complex building types such as theaters.
There are many variations of construction management, but they can be divided into two broad categories. The first is variously called agency construction management, construction manager as agent, or construction manager as advisor. The second may be called construction manager at risk, construction manager as constructor, or construction manager/general contractor (CM/GC). This is not an exhaustive list, and there are probably even more initials than spelled-out names. We’ll use agency construction manager (ACM) and construction manager at risk (CMR) to identify the two broad categories and the CM role under that category.

Agency Construction Manager

In agency construction management all contracts are held by the owner, as shown in Figure 4.5. The ACM is not directly engaged in the construction of the building—it does not have construction workers on the job site, nor does it hold any subcontracts. Therefore the ACM is not at risk for schedule, cost, or the performance of the contractors—the owner bears those risks. For a fee, the ACM undertakes to advise the owner in successfully managing those risks.

Strictly speaking, ACM is not a project delivery method at all—it’s a project management method. And in theory ACM can be combined with any of the project delivery methods we’ve discussed. In practice, however, the typical ACM project is one on which the ACM assists the owner in awarding and managing multiple, sequenced contracts with designers and builders on a schedule that minimizes the total design and construction time. This sequencing process is called fast tracking.
Pre-Construction Services

The ACM is engaged early in the project to provide pre-construction services. Sometimes the ACM is engaged before the design team. It may advise the owner in selecting the design team, and it may act as the owner’s agent in managing the design contract. In any case, the ACM is engaged early in the design process.

Project Scheduling

The ACM develops and maintains the project schedule in consultation with the owner and design team. Design work on the project begins as it would for a design-bid-build project, but midway through the design process the design team begins to issue construction documents in sequential bid packages, and the ACM uses these packages to bid and award individual trade contracts. (The ACM manages this process, but the trade contracts are held by the owner.) The ACM’s schedule ensures that the work is properly sequenced, that long lead time materials are ordered soon enough, and that critical and costly equipment (such as cranes or scaffolding) is available to the proper trades at the proper times. If individual tasks take more (or less) time than expected, the ACM adjusts the schedule accordingly.

Overlapping design and construction in this way means that early design decisions get “locked in” making changes more difficult and expensive than in the design-bid-build process. But by overlapping these efforts the owner can save a year or more in the overall delivery time, as illustrated in Figure 4.2.

Cost Management

The ACM provides construction cost estimates during design. (As noted in Chapter 3, the design team may also include a cost consultant.) And the ACM monitors and adjusts the cost model/budget as bid packages are awarded and costs become firm.

Constructability Review

The ACM will advise the design team on the availability and capability of the local trades. For example, the ACM will help decide if the building structure should be steel with masonry infill, poured in place concrete, or a combination. And the ACM will review the developing design for construct ability. At its best, constructability review means the ACM will grasp the architect’s intended end result and offer less expensive, more elegant, or more workable means of achieving it. On some projects the ACM’s personnel are fully integrated into the design process, and the group collaborating on the project design is referred to as the project team instead of design team.

Construction Phase Services
As the ACM bids the work it ensures there are no overlaps or holes in the total scope of work. The ACM evaluates the bids, consults with the owner on contract awards, manages the contracts and any changes, and approves payments to contractors. Once construction starts, the ACM provides site project managers who take responsibility for construction coordination, supervision, and cost control. For example, the ACM may assign individual project managers for the building enclosure, interiors, MEP, and equipment, each with authority over the trade contractors working in these areas.

Advantages and Disadvantages

The ACM method has several advantages. It provides the owner with more control than any other delivery method. For example, the owner has complete say in the selection of trade subcontractors. A competent ACM can bring much needed expertise and experience to a complicated building project—this not only allows fast tracking to shorten the delivery time, the added expertise also improves the design process and the final product. And with the ACM acting as its agent, the owner does not need the project staff it might otherwise require.

The main disadvantage of the ACM method is that the owner retains substantial risk. This is most obvious in the area of cost—rather than having a fixed cost before construction begins, the owner begins construction with no assurance of what the total final cost will be. And the owner is at risk for cost until (and after) the last of the multiple contracts is awarded. Similarly, the owner is exposed to the risks of schedule delays and poor performance by trade contractors.

Perhaps because of these disadvantages, only about five percent of construction spending uses the ACM method. The second category of construction management, construction manager at risk, is more prevalent.

Construction Manager at Risk

The construction manager at risk (CMR) method of project delivery retains many of the advantages of ACM. But in CMR, the owner transfers both control and risk to the construction manager, addressing the main disadvantage of ACM.

The CMR process is illustrated in Figure 4.6. The CMR provides the same pre-construction services as the ACM, but the CMR also participates in the construction of the building and assumes risk in doing so. The CMR can acquire risk in multiple ways, including any of the three described below. (But note that a CMR project doesn’t need to include all three of the elements below.)
Self-Performing

The CMR may perform some of the work of construction with its own workforce, assuming responsibility for the quality and conformance of the work, for performance on schedule, and (possibly) for the cost of the work. This is the source of the “construction manager as constructor” terminology.

Holding Contracts

The CMR may hold some or all of the subcontracts, thereby assuming responsibility for the subcontractors’ performance—hence the name CM/GC.

Guaranteed Maximum Price

The contract between the owner and CMR may provide for an open book, cost plus financial arrangement—the owner compensates the CMR for its costs and the costs of subcontracts it holds, plus a profit. But the CMR may also offer a Guaranteed Maximum Price (GMP). This is a not-to-exceed cap on the total cost of the building based on partially complete design documents—typically the design development document set. By agreeing to a cost cap, the CMR transfers some of the owner’s cost risk to itself.
Advantages and Disadvantages

CMR provides most of the advantages of the ACM method. It allows fast tracking, makes the expertise of the construction manager available during both design and construction, and removes administrative burdens from the owner. Depending on the financial arrangement, the owner can retain substantial control. Even under a GMP, the CMR and owner may jointly select trade subcontractors, agreeing to adjust the GMP if the preferred subcontractor’s bid is substantially more than the lowest bid.

Because the GMP is based on an incomplete design, disputes can arise over the scope of work the CMR is obligated to provide. This can lead to adversarial relationships among the parties—similar to those that can arise under design-bid-build, but with the addition of disagreements over what design features were anticipated at the time the GMP was established. However, such disputes are probably no more frequent under CMR than under design-bid-build. On balance, CMR can be a highly effective project delivery method that supports collaborative working relationships among the owner, designers, and builders.

Integrated Project Delivery

Integrated project delivery (IPD) is a procurement method that tries to codify these collaborative relationships among the owner, designers, and builders in contractual form. The central premise is that these parties share and collaboratively manage the risk and responsibility of project delivery. The IPD method currently represents just a few percent of total construction spending. It’s not a new concept, but it has recently garnered significant interest.

The IPD method requires that the key parties (at least) are assembled early and commit to collaborative decision making. Compensation for the parties (other than the owner) is based on reimbursement of actual costs, incentives for timely performance, and bonuses for achieving set goals. Project accounting is usually “open book,” meaning that the key parties share their cost information with each other. And instead of separate contingency funds—for design, construction, and owner’s changes—the team shares and jointly manages one contingency fund.

Contractual arrangements for IPD projects vary. The most common form is shown in Figure 4.7. This includes a tri-party agreement among the owner, architect, and construction manager, supplemented by agreements between the architect and the other designers and between the CM and subcontractors. These supplemental agreements may include incentivizing compensation. It’s also possible to have a more comprehensive multiparty agreement that includes the major design professionals and subcontractors.
Advantages and Disadvantages

The IPD method affords most of the advantages of the CMR method, providing the owner with enhanced opportunity to balance control and risk. However, it may place an increased burden on the owner. There are very few design and construction firms with IPD experience, and little guidance is available to owners on how to assemble a successful team. The negotiation of project goals and rewards, and agreement on the tri-party contract, can take substantial time. More so than in conventional CMR, the owner will need personnel to negotiate the contract and to participate in managing the project.

Finally, the reality of human nature means that successful team collaboration is more dependent on the behavior of the individuals who make up the team than on the contractual terms agreed to by their employers. This is not to say that IPD should be dismissed, but that it should be approached with open eyes and realistic expectations.
Chapter 5
Pre-Design Process

The first task of pre-design is to answer two basic questions: What are the needs to be addressed, and is a new or renovated building the right response to those needs? The process of investigating and answering these questions is called needs assessment.

If the outcome of needs assessment is positive, the next task is to develop workable answers to several additional questions. These questions correspond to the project parameters that must be aligned to set the project on solid footing:

- What will be built or renovated? That is, what is the building program and quality?
- Where will the building be built? That is, what is the project site?
- How much time is required? What is the project schedule?
- How much money is required? What is the project budget?
- How will the building affect the owner’s operating budget?

Some owners may undertake pre-design without outside consultants, but usually the owner engages a consultant or team of consultants to help ask and answer these questions. This team may be led by an architect, theater planner, arts management consultant, or by a consultant who specializes in architectural programming services.

The scope of pre-design can be narrow or broad, the level of inquiry can be cursory or in-depth, and the time spent can range from weeks to years. The process might be piecemeal, with the owner asking the consultant to investigate only one narrow question at a time. Or the owner may desire a broad, high level examination now, potentially to be followed by an in-depth inquiry should the project become “real.” The right approach depends on the circumstances and the owner’s needs. Eventually, however, the questions listed above must be answered.

Needs Assessment

The very first question to be addressed is “Should we build?” Or, more precisely, “Is a new or renovated building the right response to the owner’s needs and aspirations?” Needs assessment is the process of answering this question.
Sometimes this question is settled before any consultant is engaged. In this case the consultant’s task may be to assist the owner in documenting actual (or presumed) needs and writing a justification for the building project. The consultant may assess the situation, conclude a building project is not feasible or advisable, and tell their client they should not build. But this rarely happens, as it’s a quick way to get oneself removed from the project! Arts management and programming consultants legitimately argue that they are better suited to provide needs assessment services than architects or theater planners, since the latter have a commercial interest in the ongoing project. The counter argument is that architects and theater planners bring different—and necessary—expertise to needs assessment.

Needs assessment may address a region, a community, an institution, or a program within an institution. The effort may examine potential audiences (numbers, interest, and spending ability), existing facilities (those used by the client and competing ones), existing and potential uses and users (local and touring), and the broader impact of the proposed project on the institution or community. Not all needs assessment efforts examine all of these areas. For example, a university drama department is unlikely to commission a study of audience demographics.

In essence, needs assessment consists of the collection, synthesis, and interpretation of data from a variety of sources.

Prior Documentation

Data collection often begins with a review of any earlier studies, economic data, performance and class schedules, production budgets, academic bulletins, space inventories, drawings of existing facilities, and similar sources.

Interviews, Workshops, and Questionnaires

The most effective way to gather detailed and qualitative information is to conduct individual interviews with project constituents—performers, teachers, managers, university administrators, civic and business leaders, and others, as appropriate. A consultant team can interview dozens of individuals over the course of several days and gain a surprisingly nuanced understanding of the needs and potentials of a community, the attitudes held toward the performing arts, and issues the client will have to address if the project is to succeed.

The same process, scaled appropriately, works for an individual institution or program.

Group interviews, visioning workshops, and other types of public meetings can be used instead of or in addition to individual interviews. Constituents can be asked to complete a questionnaire in preparation for an interview, or the questionnaire may replace the interview. Most pre-design efforts use a combination of tools.
Tours and Observation

Tours may be conducted of existing facilities—those used by the client or those simply part of the regional mix—to evaluate their quality, condition, and availability. Observation of rehearsals and technical operations, and attendance at performances, give the consultant a first-hand understanding of current activities.

Databases

Information also comes from public and private databases. A study of audience demographics may pull data from a commercial database like Nielsen PRIZM. This database categorizes the households in each zip code into market segments by factors such as income, education, and spending habits. The market segments have cute names (Movers & Shakers, Pools & Patios, and Shotguns & Pickups) but PRIZM is serious business.

The National Center for Educational Statistics is a program of the US Department of Education that collects, analyzes, and distributes data related to education, including facility data that may be used for benchmarking the client institution against its peers.

Some individual consulting firms maintain proprietary databases on arts facilities, audiences, and campuses for demographic studies or benchmarking.

The job of the pre-design consultant is to stay afloat in this sea of data, organize and interpret the data for the owner, and advise the owner in decision making and planning next steps. Figure 5.1 provides a simplified example from the Overture Center in Madison, Wisconsin. The figure lists the performing arts groups that were interviewed or otherwise surveyed during the needs assessment effort, with their requests for performance space. (For simplicity, the figure doesn't include the non-performing arts groups or the requests for rehearsal, shop, and office space.) These requests were distilled and refined, resulting in the programming matrix shown in the middle column. The last column indicates the groups that are residents of the finished building and the venues they use. This simple chart only hints at the complexity of the process.

Project Parameters

After needs assessment, the next task of pre-design is to align five or six fundamental project parameters so that actual design work can begin with confidence.

Program
The program defines what and how much is to be built, measured in square feet or square meters. Program and budget/cost are strongly correlated. A larger building means a higher project cost. Or, a smaller project budget means a smaller building. The size, shape, and topology of the site can also constrain or otherwise influence the program. A small site will limit the size of the building or force a higher, stacked building. An oddly shaped site may increase the size of the building by imposing an inefficient layout.

Quality

Quality is the most difficult parameter to measure, and it’s often established by comparison with precedent buildings. Quality comprises many things—

<table>
<thead>
<tr>
<th>User Group</th>
<th>Initial facility requests</th>
<th>Programming matrix</th>
<th>Current resident companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadway and other touring</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Madison Opera</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Madison Symphony Orchestra</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Madison Ballet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children’s Theatre of Madison</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Madison Repertory Theatre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward Theatre Company</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bach Dancing &amp; Dynamite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kanopy Dance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wisconsin Chamber Orchestra</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Li Chiao-Ping Dance</td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Madison Savoyards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAPT/ New Works</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Madison Jazz Society</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Wisconsin Dance Council</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Festival Choir</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madison Area Friends of Piano</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madison Children’s Choir</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>MetroDance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silk Road Dance Troupe</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Madison Creative Arts Program</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Maureen Janson Dance</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Notes:
1. Current resident companies are shown in boldface.
2. Filled circles indicate primary venues.
3. Unfilled circles indicate secondary venues.

Key to venues:
1. 2,250-seat multipurpose theater
2. Initially new 500-seat multipurpose theater, eventually became 1,000-seat renovated Capitol Theater
3. 350-seat renovated Playhouse
4. Flexible rehearsal/performance space

Figure 5.1 Needs Assessment Example: Overture Center, Madison, Wisconsin
Source: Author

room acoustics, architectural materials and finishes, the number of rigging sets provided, efficiency of the building circulation, how sustainable the building is, etc. Quality is correlated with budget, but only weakly. It’s difficult to rein in a building that’s over budget by reducing quality.

We discuss program and quality later in this chapter.
Site

This is the land available (or to be acquired) for construction of the building. If the owner doesn’t already possess the land, the cost of acquisition can be a big part of the budget. The effect of the site on program (and therefore budget) was mentioned above. Site considerations are discussed in the next chapter.

Schedule

This is the time required, available, or allotted for design and construction. Schedule and budget have a complicated relationship. Construction costs typically rise with inflation. Unless or until the contract sum is locked in, a longer schedule means a higher cost. Also, there’s a base cost simply to keep designers and builders “on the job,” and these costs add up if the schedule stretches. The owner’s opportunity cost may also be a factor—in the showroom example given in the last chapter, the owner foregoes $10 million in revenue for each additional month spent in design and construction. However, there’s also a cost to working quickly—in mistakes, lower quality, the need to redo deficient work, and increased CM fees for heightened oversight.

Project Budget

The project budget (or project cost) is the total cost of land, building construction, site development, equipment, and development costs. This topic is discussed in detail in Chapter 8.

Business Plan

The pre-design effort may include business planning, and an arts management consultant may be retained for this work. Central to this effort is the pro-forma operating budget. The pro-forma can influence program— for example, the numbers of staff assumed in the pro-forma will determine the number of offices required in the building. The program influences the pro-forma, since operating and maintaining the physical plant can be a big expense. And most importantly, the type of venue proposed will determine the types of performances that are possible and the potential revenue from ticket sales. In addition to the pro-forma operating budget, the arts management consultant may advise on governance and operations, artistic programming, fundraising, and recruitment.

Programming

The process of establishing the parameters of program and quality—as influenced by budget, schedule, and site—is called programming. In prosaic terms, it answers the question “What shall we build?” But in essence, programming is the process of guiding the owner and users in examining, elucidating, and (if
necessary) redefining their corporate identity, values, and mission. Le Corbusier famously said, “To design requires talent, to program requires genius.”

The needs assessment effort has likely identified the users and uses to be served—but sometimes only in general terms. The first step of programming then is to explicitly identify the users. The consultant will likely conduct further interviews, workshops, or other exercises to guide the users through an examination of their needs and goals. The consultant then translates these attributes into a building program and concept. Like design, pre-design is an iterative process. So, rarely is a program and concept developed in one pass, but rather there are multiple iterations.

Space List

The central program document is a space list that tabulates all of the rooms in the proposed building and their required floor areas. The floor area of each room is expressed as net square feet (NSF) or net assignable square feet (NASF), and the total building area is expressed as gross square feet (GSF). The relationship between gross area and net (or net assignable) area is critically important. Commercial landlords, architects, and institutions all use different definitions of area, so it’s important to clearly define terms.

Area Definitions for Performing Arts Buildings

Performing arts buildings generally fall into two variants. Buildings for colleges and universities usually comply with the Postsecondary Institution Facilities Inventory and Classification Manual (FICM) or a close variant. These projects use NASF as the basis for calculating the building efficiency ratio:

$$\text{Building Efficiency Ratio} = \frac{\text{NASF}}{\text{GSF}}$$

A slightly different method is used for most other performing arts buildings. These projects use NSF, which is essentially the sum of NASF and the building service areas. And for some unknown reason, the inverse of the building efficiency ratio (called the net to gross multiplier) is preferred:

$$\text{Net to Gross Multiplier} = \frac{\text{GSF}}{\text{NSF}}$$

The importance of these ratios will become clear soon. The two approaches are illustrated in Figure 5.2, and we’ll further explain the differences below.
The basic building block of the FICM standard is Net Assignable Area, also called Net Assignable Square Feet or NASF. Net Assignable Area is the area that can be assigned to a specific occupant or use. It’s measured from the inside surfaces of the room (from “paint to paint”) and does not include the wall thickness. In typical practice, Net Area (Net Square Feet or NSF) is measured in the same way. The difference between Net Assignable Area and Net Area has to do with the types of rooms included in the definition.

**Nonassignable Area**

In the FICM standard, Nonassignable Areas are all usable areas not available for assignment to a specific occupant or use, but necessary for the general operation of the building. Nonassignable areas comprise three categories: building services, circulation, and mechanical areas. Building service areas include public restrooms and custodial supply closets. Depending upon the institution, building service areas may also include trash and recycling rooms, housekeeping and maintenance storage and workrooms, lockers and changing rooms for building staff, IT closets, and lactation rooms for nursing mothers. As already noted, the sum of the Net Assignable Area and building services area under the FICM standard is called Net Area in typical practice.

The other two categories of FICM nonassignable area are circulation (including corridors, stairways, escalators, and elevator shafts) and mechanical areas (including mechanical and electrical equipment...
rooms, risers, and service shafts). There’s no significant difference between the FICM standard and the typical approach to these areas, except in terminology. In typical practice these spaces are called Non-net Areas.

The division between Net and Non-Net (or Assignable and Nonassignable) is inconsistent in a few areas. Some programmers identify certain circulation spaces as net areas—public circulation into the auditorium, sound and light locks (that is, vestibules) into the auditorium and stage, crossover corridors, and even freight elevators. Their motivation is to ensure that these elements are included in the building. But this deviation from the standard makes it difficult to compare efficiency ratios and gross multipliers between projects.

The other area of inconsistency is in the treatment of gridirons, stage galleries, and catwalks. These are not considered floor areas by the building code, and most programmers do not classify these spaces as net area, but some consultants and owners do.

**Structural Area**

The structural area is the sum of all areas that cannot be occupied or put to use because of structural building features, including wall thicknesses and other unusable or inaccessible areas. There’s no significant difference between the FICM standard and the typical approach to structural areas.

**Gross Area**

The gross area of a building is the sum of all floor areas included within the outside faces of its exterior walls. Gross area is important as a measure of the scope of the building construction. Square foot costs for construction are expressed on the basis of gross area.

**Space List Organization**

The FICM standard includes a system of three-digit space use codes (formerly called HEGIS codes) that are used to classify assignable area. Space lists for publicly funded university projects are sometimes organized by FICM use code.

But most space lists for theaters are organized according to an informal industry standard. In the simplest version of this standard, all net spaces are organized into seven major use groups. Each proposed space is given a unique three-digit room number that indicates its function and its relationship to the other spaces within the building.

Use codes can be added for additional program elements. And in more complicated versions, additional digits are used to identify sub-uses within each major use group or venues within a multi-venue facility.
<table>
<thead>
<tr>
<th>Use Code</th>
<th>Use Group</th>
<th>Typical Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Public Spaces</td>
<td>Lobby, ticketing, concessions, donor and reception rooms, offices and locker rooms for front-of-house staff, and service areas</td>
</tr>
<tr>
<td>200</td>
<td>Performance Spaces</td>
<td>Auditorium, stage, support spaces located immediately offstage, technical areas above and below the stage, technical areas above the auditorium, and control and equipment rooms</td>
</tr>
<tr>
<td>300</td>
<td>Stage Support</td>
<td>Production offices, crew rooms, storage, and service areas</td>
</tr>
<tr>
<td>400</td>
<td>Performer Support</td>
<td>Dressing rooms, wardrobe room, wig/makeup room, musician rooms, and performer lounge</td>
</tr>
<tr>
<td>500</td>
<td>Production</td>
<td>Rehearsal facilities; fabrication shops and storage for scenery, paint, costumes, properties, automation, lighting, audio, and projection</td>
</tr>
<tr>
<td>600</td>
<td>Administration</td>
<td>Offices and common work areas</td>
</tr>
<tr>
<td>700</td>
<td>Services</td>
<td>Receiving, housekeeping, and building maintenance</td>
</tr>
</tbody>
</table>

The very simplest space list will include the room name and the required floor area—that is, net or net assignable area. It is useful to include a unique room number, the intended number of occupants, the floor area per occupant, and any critical room dimensions. Table 5.2 shows a simple space list for a 450-seat proscenium theater.

The proposed size of each room is developed by one or more of three methods:

**Unit Area**

In Table 5.2 the 3,000 NSF size of the orchestra level seating is developed by multiplying a standard unit area (10 NSF) by the intended number of occupants (300).

**Dimensions**

In Table 5.2 the 160 NSF size of the stage apron is developed by multiplying the proposed proscenium width (40 feet) by a proposed depth of 4 feet. Similarly the 3,200 NSF stage is developed from a proposed 80-foot width and 40-foot depth.

**Precedent**

The third method of determining floor area is by reference to existing spaces—“The wardrobe workroom at Brand X Theater is a good size—we need one just as large.”
Estimating Gross Area

Adding up each room on the space list results in the total net (or net assignable) area required, but one still has to account for the non-net (or nonassignable) areas and structural areas in order to arrive at the gross area of the building. This is done by estimating the building efficiency ratio or net to gross multiplier, and rearranging the formulas on page 82 to solve for gross area:

\[
GSF = \frac{NASF}{\text{Building Efficiency Ratio}}
\]

or

\[
GSF = \text{NSF} \times \text{Net to Gross Multiplier}
\]

---

**Table 5.2 Example Space List**

<table>
<thead>
<tr>
<th>Use Code</th>
<th>Room Name</th>
<th>Net Sq. Ft</th>
<th>Occupants</th>
<th>Unit Sq. Ft</th>
<th>Width</th>
<th>Depth</th>
<th>Height</th>
<th>WCs or Urinals</th>
<th>Seat Count</th>
<th>Seats/Fixture</th>
<th>% by Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>PUBLIC SPACES</td>
<td>4,050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Foyer</td>
<td>450</td>
<td>450</td>
<td>1</td>
<td>6</td>
<td>50</td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Inner Lobby</td>
<td>2,700</td>
<td>450</td>
<td>110</td>
<td>60</td>
<td>50</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>Ticket Sales</td>
<td>100</td>
<td>2</td>
<td>50</td>
<td>21</td>
<td>10</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>Front-of-House Storage</td>
<td>60</td>
<td></td>
<td>6</td>
<td>6</td>
<td>10</td>
<td></td>
<td>Public Restrooms</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>191</td>
<td>Women’s Restroom</td>
<td>500</td>
<td>10</td>
<td>50</td>
<td>450</td>
<td>30</td>
<td>67%</td>
<td>Women’s Restroom</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>192</td>
<td>Men’s Restroom</td>
<td>175</td>
<td>5</td>
<td>35</td>
<td>350</td>
<td>30</td>
<td>33%</td>
<td>Men’s Restroom</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>193</td>
<td>Family Assist Restroom</td>
<td>65</td>
<td>1</td>
<td>65</td>
<td>285</td>
<td>30</td>
<td>33%</td>
<td>Family Assist Restroom</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Fixtures</strong></td>
<td><strong>16</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>PERFORMANCE AREAS</td>
<td>9,505</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>Audience Seating—Orchestra</td>
<td>3,000</td>
<td>300</td>
<td>10</td>
<td>270</td>
<td>30</td>
<td>26%</td>
<td>Audience Seating—Orchestra</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>Audience Seating—Balcony</td>
<td>1,650</td>
<td>150</td>
<td>11</td>
<td>150</td>
<td>30</td>
<td>33%</td>
<td>Audience Seating—Balcony</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Seat Count</strong></td>
<td><strong>450</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>Apron</td>
<td>160</td>
<td></td>
<td>40</td>
<td>4</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>212</td>
<td>Stage</td>
<td>3,200</td>
<td></td>
<td>80</td>
<td>40</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>231</td>
<td>Orchestra Pit—Open to Auditorium</td>
<td>445</td>
<td>22</td>
<td>20</td>
<td>40</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>232</td>
<td>Orchestra Pit—Below Overhang</td>
<td>365</td>
<td>18</td>
<td>20</td>
<td>40</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Musicians</strong></td>
<td><strong>40</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>261</td>
<td>Control Room—Lighting &amp; Stg Mgr</td>
<td>180</td>
<td></td>
<td>15</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>262</td>
<td>Control Room—Sound</td>
<td>120</td>
<td></td>
<td>10</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What determines building efficiency? Building type and site constraints are strong determinants. Building efficiency is also affected by climate, design standards and building codes, and of course the actual building design.

Performing arts buildings range from about 50 to 60 percent efficient. Depending on the difference between NASF and NSF, this is equivalent to a net to gross multiplier in the range of 2.0 to 1.6. To put these numbers in perspective, the State of Maryland Department of General Services specifies efficiencies for a variety of building types, ranging from a highly efficient 85 percent for garages to 51 percent for performing arts centers and medical teaching facilities. Theaters are among the least efficient building types.

Why are theaters so inefficient? Many of the factors that make theater buildings complicated, as discussed in Chapter 1, also make them inefficient. The program includes many unique rooms with critical relationships to other unique rooms. The building layout must accommodate multiple (sometimes segregated) circulation paths for the public, performers, and staff. The layout that functions best is probably not the most efficient one. Requirements for noise isolation and room acoustics may mean massive walls and doubled up structural systems, increasing the structural space. The need for quiet heating and cooling results in large mechanical rooms and duct chases. And the needs of lighting, audio, and projection systems mean more area is devoted to electrical and mechanical systems.
Clients and architects unfamiliar with theater buildings are sometimes surprised at their low efficiency. If they apply an unrealistic efficiency ratio or net to gross multiplier (whether through ignorance or obstinacy) they can significantly underestimate the size and cost of the proposed building. This can contribute to a multiplication of errors: At a small Midwestern public university, the campus planner programmed a new arts building, omitting several critical spaces (Error #1). He applied an unrealistic efficiency ratio, underestimating the gross building area (#2). He then multiplied this gross area by an optimistic square foot cost (#3). The end result was a construction budget that was about half the amount actually needed. He next applied to the state legislature for funding using his budget number, and he received the funds, committing his institution to delivering a new arts building with half the needed funds.

Of course, being too conservative and overestimating the size and cost of the proposed building can also squash a project at the outset. It’s important to apply the highest attainable efficiency (or lowest attainable net to gross multiplier) when estimating gross area.

Other Program Documentation

Room Schedule

A more developed program will include a schedule of room requirements— this will list the required equipment and furniture, and parameters for finishes, doors, windows, acoustics, temperature and humidity, lighting, and electrical outlets for each room. Each room schedule will often be accompanied by planning diagrams that illustrate possible room layouts within the proposed size. These diagrams validate the floor area included in the program, and they help the owner and users evaluate the functionality of the proposed space.

Narratives

The program may also include one or more design narratives. These documents describe the proposed character and quality of the building and help inform the cost estimate. The narratives may include preliminary recommendations for interior and exterior finishes, proposed structural system, parameters for room acoustics, sound isolation, and noise and vibration control, required adjacencies, planning criteria, and sightline criteria.

A complete pre-design effort will also document the project site, schedule, and budget. We touched on schedule in the previous chapter. We discuss site analysis in the next chapter and budgets in Chapter 8.
Chapter 6
Design Process

Architectural design is a creative endeavor that stems from theoretical and conceptual underpinnings and produces pragmatic results. This chapter is about the process through which architectural theory is enacted and results are realized, and is based on observation of the design of many performing arts buildings over several years. One can divide the design process into several component parts:

- Shaping performance spaces
- Site planning
- Building massing
- Functional planning
- Establishing character and vocabulary
- Integrating systems

This division into parts is artificial, but useful in understanding the process as a whole. The parts are interdependent and must be approached iteratively. Shaping of performance spaces tends to come early in the process, and integrating building systems tends to begin later in the process. The four parts in between are approached more or less simultaneously.

A Note About the Illustrations

The illustrations in this chapter are from the design of the Wolfe Center for the Arts at Bowling Green State University in Bowling Green, Ohio. This new building provides collaborative space for the Department of Theatre & Film, School of Art, and College of Musical Arts. The Wolfe Center was the first completed project in the United States by Snøhetta, the architects of the Library of Alexandria in Egypt, the Oslo Opera House, and the 9/11 Memorial Museum in New York. (The 9/11 Museum was commissioned earlier but opened two years after the Wolfe Center.) Snøhetta served as design architect, and the Toledo firm The Collaborative served as executive architect. Akustiks (acoustician) and Theatre Projects (theater design consultant) rounded out the core design team. This team began work in March 2007, groundbreaking was in April 2009, and the gala opening of the new building took place in February 2012. The illustrations included here were prepared by Snøhetta and Theatre Projects. They are intended to be descriptive of the development of each part of the design process, but they are just a fraction of the hundreds of diagrams, drawings, and renderings actually produced by the design team.
Shaping Performance Spaces

The performance spaces (auditorium and stage) are important drivers of the overall building design, and so they are usually developed during pre-design or early in schematic design. These elements have large footprints and volumes, with unique geometries determined by (among other factors) the types of performances to be held. Without at least the footprint and height of the performance space, the designer cannot even confirm that the proposed building will fit on the site. And the planning of the building, both internally and in relationship to the site, cannot proceed until the basic geometry of these spaces is known.

The Wolfe Center for the Arts houses three spaces intended for performance: a 400-seat proscenium theater for drama and opera, a 150-seat flexible drama theater, and a 2,100-square-foot choral rehearsal room. The seat count, stage size, and types of performances to be accommodated were all determined during programming. But the shapes and details of the spaces were not developed until the core design team began its work. The architects, acoustician, and theater designer collaborated on shaping these spaces, with input and close review by the own and users.

Figure 6.1 Options for 400-Seat Theater Form—Clockwise From Upper Left: Broadway, Rounded Broadway, Round Courtyard, Square Courtyard (May 2007)
Source: Sketch: Theatre Projects. © BGSU

Figure 6.1 shows four options for the 400-seat theater at the Wolfe Center, the largest venue in the...
proposed building, illustrating the effect of the balcony form on the overall room. Figure 6.2 shows the footprint and volume of the Broadway option. Soft-line sketches like these are often used to express early design concepts.

As options for the room were explored, the design was refined iteratively. The round courtyard option shown in Figure 6.1 was selected for further development. Figure 6.3 is a conceptual diagram of this option, in which the surfaces of the room describe a sphere inscribed by the balcony form.

Figure 6.4 shows the hardline plan and section drawings prepared late in schematic design. Figure 6.5 shows a geometry study and Figure 6.6 shows a material and finish study, both prepared during design development. Figure 6.7 is a photo of the finished auditorium.

Figure 6.2 400-Seat Theater Footprint and Volume Study in Broadway Form (May 2007)
Source: Sketch: Theatre Projects. © BGSU
Figure 6.3 400-Seat Theater Conceptual Diagram (Early 2007)
Source: Rendering: Snøhetta. © BGSU

Figure 6.4 400-Seat Theater Plan and Section Drawings (August 2007)
Source: Drawing: Theatre Projects. © BGSU
Figure 6.5 400-Seat Theater Geometry Study (April 2008)
Source: Rendering: Snøhetta. © BGSU

Figure 6.6 400-Seat Theater Material and Finish Study (May 2008)
Source: Rendering: Snøhetta. © BGSU
Performance Space Models

Much early design work today is performed using BIM (Building Information Modeling) software. BIM software is very efficient for producing alternative or iterative designs, which can be shared with others on the design team for coordination and presented to the client in computer renderings. Despite these advantages, many designers still prefer to work in physical models, which are better at communicating depth, dimension, and scale. On many projects a combination of computer and physical modeling is used.

The earliest physical models of the performance space are created during concept design, often at 1/16” = 1’-0” scale. At this scale the emphasis is on the shape and size of the proposed design, and these models are often cut at centerline to allow side by side comparison with precedents. Later models are larger: 1/4” = 1’-0” is a common scale for geometry studies, and 1/2” = 1’-0” models may be used to study materials and colors. The largest physical scale models are those used by acousticians to test design concepts. They are typically built of plywood and other relatively heavy materials at 1:16 scale or larger. These models are quite large and expensive and therefore relatively rare.

Site Planning

Site planning may involve site selection—that is, identifying and evaluating multiple prospective sites and
advising the owner in selecting one site for development. Or if the site has already been determined, as it was for the Wolfe Center, then site planning involves analysis of the selected site and planning the building in relation to its characteristics. In either case, the process is begun by collecting data and analyzing the site characteristics. We’ll discuss the general case before turning to the Wolfe Center illustrations.

Site Characteristics

Site Size

The site must be large enough to hold the proposed building, accounting for any required setbacks from the site boundaries, protected wetlands, flood plains, archeological ruins, and sacred groves of trees. Yes, these are all real considerations encountered on projects! As noted earlier, room adjacencies are critical, and the proposed building will probably function best if at least the main entrance, loading dock, and major spaces are all on the ground floor. For example, it’s best to avoid having to move scenery between floors by elevator, as the extra time and labor required will have a negative long-term impact. If it’s not possible to keep the proposed building to a single floor level, its footprint will likely be determined by the largest performance venue and the minimum necessary adjacent spaces. Even a stacked building may be limited in size by restrictions on height. And in a densely built-up urban setting, building size may be further restricted by calculations of floor area ratio (FAR) and sky exposure planes—regulations that ensure light and air reach the street below.

Greenfield Versus Brownfield Sites

Sites can be characterized as “greenfield” and “brownfield.” Greenfield describes a site without existing structures or infrastructure, or more generally a site that places no significant constraints on the design and construction of the proposed building. A brownfield site has existing structures and infrastructure. It’s suspected of containing hazardous substances or known to contain them. The structures may contain vinyl asbestos tile, asbestos insulation, or other hazardous construction materials that must be abated. A more serious matter is land contaminated with the hazardous byproducts of a previous manufacturing operation, auto service station, or dry cleaner. Building on this type of site requires remediation of the hazard. Both abatement and remediation are additional expenses that must be included in the project budget, or funded from elsewhere.

Existing Structures

If the site contains existing buildings or other structures, they may be reused and incorporated into the proposed building, or they may be deconstructed or demolished to accommodate the new building.
“Deconstruction” implies more care in taking the building down, so that the materials can be reused or recycled. The cost of deconstruction or demolition must also be included in the project budget.

Site Infrastructure

Site infrastructure includes utilities (electricity, gas, water, and sewers) and sometimes steam or chilled water provided from a central plant. Existing utility lines crossing the site may constrain the size and placement of the building, if they are too expensive to relocate. Conversely, if site utilities are available on or near the site, then the expense of extending services to the site is minimized.

Site Access

Site access includes roadways, pedestrian paths, and public transportation. Access is required for the patrons, staff, performers, service vehicles, and (for academic buildings) students and teachers. The “patron” category may include school children arriving in a convoy of school buses for educational programming. The “service” category includes everything from deliveries of office supplies, to catering vans, lumber and steel deliveries to the scene shop, visiting productions with multiple tractor trailers of scenery and equipment, and trash pickup.

Parking

Parking requirements depend on the site context and the type of transportation used by the patrons. Most buildings will need to have parking for patrons with disabilities. A few spaces may be provided for staff, performers, and perhaps ticket buyers making a quick stop at the box office—for those few who still buy tickets in person. If the site and project budget do not accommodate parking for the general public, it must be located nearby, as there is a limit to the distance patrons will walk.

Site Context

The site context may be urban, suburban, pastoral, or a campus setting. If the new building will be part of a streetscape or other built environment, the scale and character of the neighboring buildings will influence decisions about the placement, mass, and style of the new building. On some university campuses with predominant architectural styles, the architect may be expected to design a new building that is sympathetic to the earlier buildings on campus.

If the proposed site is set within a landscape, the architect will design a building that responds to its topography (the surface shape and features of the landscape). Topography—particularly site slopes—can also be an important feature of urban settings. If the site contains large and significant trees, there is often a desire to preserve them, and in some jurisdictions they are protected by legislation.
In all settings, the architect will consider views of the building and from the building, the sun path, and the effect of sunlight and shadow on the proposed building and its occupants.

Evaluation Criteria

If multiple prospective sites are to be evaluated, the characteristics of each site will be documented and preliminary “building fit” diagrams will be prepared. And the following additional factors will be considered:

Cost Impacts

The cost of acquisition may vary considerably between the prospective sites. Project costs may vary, depending upon the presence or absence of existing buildings or contaminants, the availability or lack of parking, etc. Finally, the prospective sites may affect operating efficiencies and costs—for example, if scenery must be loaded in by elevator.

Amenities and Affiliated Programs

A further factor in site evaluation is the location of each prospective site and its proximity to desired amenities (restaurants, nightclubs, and hotels) or affiliated programs or facilities (for example, related academic facilities on a college campus).

Wolfe Center Site

The Wolfe Center site was identified by the University before the design team began its work. The site is quite large, about five acres, forming a rectangle with its long axis running east-west. Figure 6.8 shows the site in context, with buildings in dark gray, public and green space in light gray, and parking in black. Major streets are shown as solid black lines, and major pedestrian flow is shown by dashed lines. North is toward the top of the page.

The site is bounded on the south by the Fine Arts Center—home to the School of Art, one of the project constituents. The site is bounded on the north by Ridge Street and the Moore Musical Arts Center—home to the College of Musical Arts, another constituent. The site is bounded on the east by a student residence hall (it looks something like a spider in plan) and a large parking lot to the west. Before the Wolfe Center was completed, the Department of Theatre and Film—its primary constituent—occupied inadequate spaces in several buildings at the western edge of Figure 6.8.

Figure 6.9 is a conceptual site plan illustrating the buildings that form the site boundaries and the open space that is defined by the mass of those buildings.
**Figure 6.8** Site Plan Showing Context
Source: Adapted by Author From Original by Snøhetta

**Figure 6.9** Conceptual Site Plan (Early 2007)
Source: Diagram: Snøhetta. © BGSU
**Figure 6.10** Functional Site Diagram (Early 2007)
Source: Diagram: Snøhetta. © BGSU

**Figure 6.11** Site Plan (Mid-2007)
Source: Drawing: Snøhetta. © BGSU

**Figure 6.10** is a functional site diagram, showing the new building situated between the existing art and music buildings, and the three buildings connected by a circulation spine through the new building’s back-of-house (BOH).
Figure 6.11 is a developed site plan. The building fronts on a new plaza at the east edge of the parking lot, and the connection to art and music is shown bisecting the new building. The loading dock for the new building is shown at the southeast corner, near the Fine Art Center’s outdoor sculpture work area.

Figures 6.10 and 6.11 also illustrate (or at least intimate) the massing and interior organization of the building, both of which were developed in parallel with the site planning. We’ll discuss massing next, and then interior planning. As the figures illustrate, all are closely connected.

**Building Massing**

Massing concerns the shaping of the building as a sculptural object. It is the composition of the exterior form of the building in relation to its context. One way to approach massing is to work with a program block or stacking model, as shown in Figure 6.12, a photo taken at an early Wolfe Center design workshop on the Bowling Green campus. The program elements are represented in scale by blocks—usually color coded by program area—and the blocks are arranged on a site plan to examine site relationships, massing, and the functional interior arrangement of the building. Because of their large size relative to the rest of the program elements, the performance venues usually dominate the composition.

Strong massing can give a building an iconic identity, but as noted earlier in Chapter 3, iconic buildings can be problematic if the exterior form constrains the interior program elements. Snøhetta’s approach to the Wolfe Center was to develop a form that gave the building a clear, iconic identity while allowing flexibility in the functional planning of the interior. That is, the building mass is a “container” that allows interior planning to change while the exterior remains constant.

Snøhetta is named for a mountain outside Oslo, where the firm was founded. Clearly, *place* is important to them. Noting that the flat prairie and unbroken horizon of northern Ohio were formed by the retreat of a prehistoric glacier, Snøhetta describes the Wolfe Center as a glacial “erratic.” That is, the new building appears on the landscape like a rock transported perhaps hundreds of miles and deposited by the retreating glacier. This metaphor informed their design of the Wolfe Center.
Figures 6.13 and 6.14 are early site renderings and Figure 6.15 is a photo of a physical site model. These were prepared for another on-campus workshop held two months after the block model photo was taken. All three images show the building from the southwest. (The architects have optimistically shown the parking lot as a green quadrangle.) Certain key design decisions are already evident. The shape and positioning of the building and its relationship to the landscape are clearly defined, and the stagehouse extending above the main roof line hints at the interior organization of the building.

Figure 6.16 is a highly detailed site rendering prepared during design development, and Figure 6.17 is a photo of the finished building.
Figure 6.13 Site Rendering (July 2007)
Source: Rendering: Snøhetta. © BGSU

Figure 6.14 Site Rendering (July 2007)
Source: Rendering: Snøhetta. © BGSU
Figure 6.15 Site Model (July 2007)
Source: Photo Courtesy of Brian Hall

Figure 6.16 Site Rendering (May 2008)
Functional Planning

The objective of functional planning is to develop a pleasing and efficient organization for the interior of the building. This is sometimes called design “from the inside out.” The design team works out the location, size, and shape of each room in relationship to the program as a whole. As with massing, the performance venues are the dominant elements in this planning process. The design team considers circulation for students, teachers, patrons, and performers. The team plans routes for moving scenery, production equipment, grand pianos, and food service items through the building, and trash and recycling out of the building.

This planning process also fulfills larger aesthetic and social goals, since the built environment affects our emotions and behaviors as well as our actions. Consider the progress of a patron—to and into the building; through the front-of-house necessities of ticket office, coat check, and restrooms; and into the auditorium and to his or her seat. A skilled designer understands that this progression affects the patron’s emotional and psychological state as well as addressing his or her functional needs. Similarly, architecture can shape how the occupants of a building interact—or don’t interact. The Wolfe Center has two examples of spaces designed to encourage interaction—the lobby and the crossover that connects the art
If a building has multiple performance spaces, a decision on their arrangement must be made early in the planning process. The planning diagrams in Figure 6.18 address this question. The diagram at top left shows three performance spaces with a common lobby, but with isolated performance areas. The diagram at bottom left shows a common back-of-house (BOH), but discrete and isolated lobbies for each space. The diagram at right illustrates an arrangement with both a common lobby (labeled FOH for front-of-house) and a common back-of-house. But, as the diagram indicates, the difficulty with this arrangement is that the common spaces can become corridor-like.

The plan organization of the Wolfe Center results from two key moves. First, connecting the art and music buildings through the new building, as shown back in Figure 6.10. Second, placing the largest program element (the 400-seat theater) at the center of the plan. The auditorium is oriented west toward the front of the building, and the stagehouse forms one edge of the connecting spine that bisects the building. The planning variations shown in Figure 6.19 all have these features in common, but they are quite different otherwise. (Actually, they have one more commonality—they are all named after members of the Beatles.) As mentioned earlier, the building massing gave the designers great flexibility.
in developing the functional plan. In addition to the performance spaces, the building houses a dance studio, video production studio, digital media suite, scenery and costume shops, classrooms, offices, and the typical support spaces in the front and back-of-house. The building form allowed the design team to accommodate these program elements and to accommodate several late program changes made by the University.

The floor plans in Figure 6.20 were prepared early in design development. The building circulation is highlighted—a welcoming, two-story lobby and lounge area at the front of the building leads to corridors flanking the 400-seat theater and connecting to the atrium-like crossover that spans the width of the building. The rehearsal room is located to the north, and the 150-seat flexible theater is located to the south.

The presentation plans in Figure 6.21 show the final interior layout, and the sections give a sense of the character and vocabulary of the public spaces.

Figure 6.19 Planning Diagrams (June 2007)
Source: Diagrams: Snøhetta. © BGSU
Figure 6.20 Floor Plans (January 2008)
Source: Drawings: Snøhetta. © BGSU
Establishing Character and Vocabulary

What do we mean by the “character and vocabulary” of a building? Character is defined in part by period-based style: “That is a Georgian building.” The Georgian vocabulary includes rigid symmetry, geometric massing, red brick with decorative coursing, double-hung windows, hip roofs, and dormers. But character also transcends style, and some architects reject the idea of style and its labels. In his polemic *Towards a New Architecture*, Le Corbusier wrote that “Architecture has nothing to do with the various ‘styles.’” And he reminded architects of the centrality of mass, surface, and plan. Character is not something “applied” to the building. Rather, it’s expressed and defined by the building’s massing, surfaces, and plan. Its vocabulary consists in part of shapes, edges, openings, materials, light, colors, textures, and details.

The character of the Wolfe Center is largely defined by its geometric massing and relationship to the landscape. Architecture critic Steven Litt describes it as “a gleaming wedge of silver-gray steel that rises out of the ground like a sharp-edged geological outcrop.” The building’s clear symmetrical plan also
The massing and plan combine to generate the volumes within the building. The two complementary public spaces— the west-facing lobby and the crossover—merit particular mention.

Lobby

The lobby is the largest and main communal space within the building. Figures 6.22 and 6.23 illustrate the development of the space, and the photo in Figure 6.24 shows its final form. The volume is high and spacious, but not overwhelming. The windows and skylight fill the volume with light and emphasize the connection with the exterior, while the grand stair emphasizes the connection between floors. The lobby provides important circulation and serves as casual meeting and work space, in addition to its performance function. These uses animate the lobby and encourage interaction among the building’s diverse occupants.

Crossover

“The Crossover” became the preferred name for the circulation spine that connects the art and music buildings and runs directly behind the stage of the 400-seat theater. It provides a circulation path—a physical connection— between the art, theater, and music programs. It functions as a stage crossover, provides a loading route to the stage, and allows the users to

Figure 6.22 Lobby Rendering—Schematic Design (2007)
Source: Rendering: Snøhetta. © BGSU
Figure 6.23 Lobby Rendering—Design Development (May 2008)
Source: Rendering: Snøhetta. © BGSU

Figure 6.24 Completed Lobby (2012)
Source: Photo Courtesy of Bruce Damonte
Figure 6.25 Crossover Material and Finish Study (May 2008)
Source: Rendering: Snøhetta. © BGSU

Figure 6.26 Crossover Material and Finish Study (May 2008)
Source: Rendering: Snøhetta. © BGSU
move large scenic pieces between the stage and scene shop. (The scene shop occupies the large two-story volume adjacent to the loading dock.) The crossover satisfies these functional and technical needs but also has a public and social function similar to the lobby. The two-story crossover connects the first and second floors and the east and west halves of the building. It provides meeting space and the chance for informal encounters with students and faculty from different disciplines.

Figures 6.25 and 6.26 show two character studies of the crossover, developed during design development, and Figure 6.27 is a photo of the finished space.

**Integrating Systems**

The last component of our design process is integrating building services or systems into the design. All buildings have a structural system, and most have HVAC, electrical, and plumbing systems. Many buildings will also have fire protection, data, telephone, and security systems. Performing arts buildings place extra requirements on the typical structural, mechanical, and electrical systems. In addition, performing arts buildings have theatrical lighting, projection and audiovisual systems, adjustable acoustics, stage rigging, stage machinery, and show control systems. All of these systems “compete” for space, with each other and (sometimes) with the program areas.

Incorporating adequate mechanical equipment rooms into the building design is an early priority, as these spaces can represent 20 to 30 percent of the overall building area. (See Figure 5.2.) At the Wolfe Center, two large mechanical rooms were located at the east end of the first floor, one on the north wall...
with access to outside air, and one adjacent to a chiller well open to the sloped lawn. Two more equipment rooms are located on the second floor, one on either side of the crossover. These locations were established by the end of schematic design and then did not move, even as some program areas moved around them. A comparison of Figure 6.20 (early design development plans) and Figure 6.21 (final plans) illustrates these plan changes.

Coordinating the routes of ducts, pipes, and electrical raceways through the building is an effort that starts in early design and continues through construction. BIM models are routinely used for this coordination. The iconic shape of the Wolfe Center provided a flexible volume for routing the building services, but the sloping roof did result in a pinch point at the crossover. In early concepts, the crossover provided a clear sightline through the building, as illustrated in Figure 6.25. The need to provide an east-west path for ductwork and other building services led to the introduction of soffits, as shown in the rendering in Figure 6.26 and the photo in Figure 6.27—a minor compromise in an otherwise stunningly beautiful building.
Chapter 7
Building Regulations

In the United States, building design and construction is regulated by federal, state, and local governments. There are many types of legislation and regulations that impact buildings. Regulations concerning zoning, historic preservation, urban design, and land use are typically enacted and enforced at the state, county, or municipal level. The Occupational Safety and Health Act (OSHA) is an example of regulations enacted and enforced by the federal government. This chapter provides an overview of two types of regulations that most affect theater buildings—codes and standards, and accessibility requirements.

Codes and Standards

Codes and standards are developed by private Standards Development Organizations (SDOs). They become enforceable regulations when they are adopted by an arm of government—typically a state, county, or municipality. This adoption process is called “incorporation by reference,” and (like many other things related to codes) it has its own initialism—IBR.

Accessibility Requirements

Regulations concerning accessibility for persons with disabilities stem from both privately developed standards and government rulemaking. Accessibility legislation is enacted at all levels of government, but the most significant legislation has been at the federal level.

A knowledge of the intent and import of these two types of regulations will help the reader understand their application. Specific requirements pertinent to theater buildings are discussed in later chapters. The reader is cautioned that these requirements are subject to constant change, and that the latest relevant regulations must be sought out for any given project.
safety of building occupants. These codes specify minimum requirements for many building elements, such as structural integrity, exiting provisions (called “means of egress”), fire resistant construction, sanitation, lighting, ventilation, and safety equipment. Recent building codes also include requirements for energy conservation and accessibility. The building, life safety, and fire codes may all reference supplementary codes—for example, plumbing, electrical, and energy conservation codes—and all of these codes incorporate standards by reference.

Adoption and Enforcement

Immediately after “What is the program?” and “What is the budget?” one of the first questions the design team will ask is “What codes are we using?” This is because codes are adopted at the state, county, or municipal level, and the codes in force can vary between states and within a given state. New code editions will be adopted as they are published, but there is always a lag between publication and adoption, so even jurisdictions that use the same code title may be using different editions of the title. There is too much variation and change to attempt an inventory of the codes used in each jurisdiction. Instead, an outline of typical practice—to the extent there is such a thing—will aid the reader in understanding the answer to the question “What codes are we using?”

Building Code

The building code in most jurisdictions in the United States is based on a model code developed by the International Code Council (ICC), called the International Building Code (IBC). The building code typically applies to new construction, alterations, or a change in use of an existing building. The application of the building code ends when construction is complete and/or a Certificate of Occupancy is issued. The person or body responsible for interpreting and enforcing a code is called the Authority Having Jurisdiction or AHJ. For the building code, this is a building official. The code is typically administered at the local level, with provision for appeal to a state official.

Life Safety and Fire Codes

Most jurisdictions have life safety or fire codes in addition to the building code. These documents may be called “life safety code,” “fire safety code,” “fire prevention code,” or simply “fire code.” Some jurisdictions have more than one code. (For example, Connecticut has both a Connecticut State Fire Safety Code and a Connecticut State Fire Prevention Code.) These codes are typically based on model codes developed by the ICC or the National Fire Protection Association (NFPA).

Life safety and fire codes typically have two categories of requirements: The first are requirements for new construction, alterations, and changes of use. These requirements are administered parallel with the building code, and their application ends when the Certificate of Occupancy is issued. The second
category of requirements applies to existing buildings and conditions, and the present risk to building occupants. These requirements are always in force. Both sets of requirements are administered by a fire marshal. As with building codes, these codes are often administered locally, with provision for appeal to a state official.

**Standards**

Standards are documents that outline technical requirements for a material, product, process, or building element. They are similar to codes, but different in intent. Codes contain scoping requirements—that is, they inform “where and when” a particular requirement must be met. A standard says “how” to meet the requirement. Like code development, standards development in the United States is primarily a private sector activity. Compliance with most standards is voluntary, but many standards are referenced within codes or directly by federal, state or local legislation, and so compliance with their requirements becomes compulsory.

**American National Standards Institute**

The American National Standards Institute (ANSI) is a private, non-profit organization that oversees a significant portion of the voluntary standards activity in the United States. Its goal is to promote consensus standards based on a fair and open development process with participation by all affected stakeholders. ANSI promulgates a set of requirements for standards development, accredits Standards Development Organizations whose processes meet those standards, and approves the resulting documents as American National Standards. There are several hundred ANSI-accredited standards organizations and about 10,000 American National Standards. (About 40,000 more standards are not ANSI approved.)

**Standards Development Organizations**

The ICC and NFPA are ANSI-accredited Standards Development Organizations. Other ANSI-accredited organizations include the US Green Building Council—which developed the LEED standards for sustainable design, and the Entertainment Services and Technology Association (ESTA)—a theater industry trade group that develops standards for theater equipment and installations. Most SDOs are non-profit, and the bulk of the standards development work is performed by volunteer committee members and the public at large.

**Incorporation by Reference**

Most US courts have found that a model code or other privately developed standard incorporated by
reference into an ordinance or law remains a copyrighted work. A significant share of income for many SDOs comes from the sale of published standards, so protection of their copyright is important to their business model. At the same time, the public has a right to reasonable access to the codes and standards incorporated into law, and this issue has received increased attention recently. As a result, some SDOs (including ICC, NFPA, and ESTA) now provide free online access to their codes and standards as they work to develop alternative sources of income.

Accessibility Requirements

Requirements for buildings and facilities to be accessible to persons with disabilities come from multiple sources. The *International Building Code* defines requirements for accessible design. Many state and some local governments have enacted accessibility legislation—often by incorporating ANSI A117.1, a privately developed accessibility standard, into law by reference. But it is federal legislation, especially the Americans with Disabilities Act (ADA), which has brought about the most significant change. A given building project might be subject to three distinct sets of requirements—the building code, state or local regulations, and federal standards.

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<td>Section 504, Rehabilitation Act of 1973</td>
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<td>Organizations and programs receiving federal assistance</td>
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<td>Building Code</td>
<td>State or Local Government</td>
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<td>State or Local Regulations</td>
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ANSI A117.1 Accessible and Usable Buildings and Facilities

ANSI A117.1 was the first national standard for accessible design, initially published in 1961. It is a privately developed technical standard, and it does not contain scoping requirements. The ICC is secretariat for the standard, meaning it has responsibility for the document. The document is therefore sometimes called ICC A117.1 or ICC/ANSI A117.1. Accessibility laws in about one-third of the states incorporate A117.1 by reference.

Early Federal Accessibility Legislation

Architectural Barriers Act

The first federal law to require accessible facilities was the Architectural Barriers Act (ABA), enacted in 1968 and amended in 1970 and 1976. It mandated that certain federally funded facilities be accessible to persons with disabilities. The ABA still applies to some buildings, but many more are subject to the Americans with Disabilities Act.

Rehabilitation Act Section 502

Section 502 of the Rehabilitation Act of 1973 created the Architectural and Transportation Barriers Compliance Board (now called the Access Board). The Board was tasked with developing federal accessibility guidelines and ensuring federal agency compliance with the ABA. Later, the Access Board was assigned the task of developing the ADA guidelines.

Rehabilitation Act Section 504

Section 504 of the Rehabilitation Act of 1973 is significant because it outlawed discrimination towards persons with disabilities by organizations and programs receiving federal funds. For the first time, Congress placed disability issues in the context of civil rights—a framework that was subsequently used by the Americans with Disabilities Act. Section 504 regulates programs, not facilities. But, for example, requirements for interpretation, transcription, or captioning services can impact both space requirements and equipment selections. Section 504 applies to all schools and many universities, and is enforced by the Department of Education, Office of Civil Rights.
Americans with Disabilities Act

The Americans with Disabilities Act of 1990 (amended 2008) provides broad civil rights protection to persons with disabilities. We are concerned with Title III, which covers both public accommodations and commercial facilities, and went into effect in January 1992. Cinemas, theaters, concert halls, stadiums, auditoriums, lecture halls, and other places of exhibition, entertainment, or public gathering fall under the category of public accommodations. The Act requires newly constructed or altered facilities to be accessible to persons with disabilities, and it requires removal of architectural barriers in existing facilities, where removal is “readily achievable.”

1991 Americans with Disabilities Act Accessibility Guidelines

Congress assigned separate responsibilities under Title III to the Access Board and the Department of Justice (DOJ). The Access Board was directed to prepare minimum guidelines for the design of accessible facilities, which it published in 1991 as the Americans with Disabilities Act Accessibility Guidelines or ADAAG. The DOJ was directed to issue its own regulations, consistent with the Access Board’s “minimum guidelines,” and to serve as the ADA enforcement agency. In 1991 it published the complete and unchanged text of the ADAAG as the Justice Department’s Standards for Accessible Design (JDSAD).

2010 ADA Standards for Accessible Design

In the mid-1990s the Access Board began work on updated and harmonized guidelines for both the ABA and ADA, in a format matching that of ANSI A117.1. These guidelines were published as the 2004 ADAAG, but they had no legal force until adopted by the DOJ. In 2010 the DOJ issued revised regulations based on the 2004 ADAAG. The new standard, called the 2010 ADA Standards for Accessible Design, went into effect in March 2012. Unlike in 1991, the DOJ standard goes beyond the minimum guidelines of the 2004 ADAAG, and includes additional scoping and technical requirements. Many of these additional requirements cover assembly seating areas, and in particular the DOJ has added specific technical requirements for wheelchair locations, sightlines, and angles of vision.

Interpretation and Enforcement

While the 2010 ADA Standards for Accessible Design reads a lot like a building code, it’s interpreted and enforced quite differently. The building official interprets the requirements of the building code as needed, and reviews and approves the architect’s drawings and the completed building as complying with the code. In contrast, the Justice Department (not the local building department) is responsible for interpreting and enforcing its Title III regulations. The enforcement methods provided by Title III include private suits by affected individuals or organizations representing affected individuals, investigations by
the Attorney General, or suits by the Attorney General. Complainants can also propose mediation. The ultimate interpretation of the requirements of the ADA is made by the courts. Compliance with the 2010 Standards alone may not be enough to ensure that a design is compliant, since the courts may use the text of the statute, the legislative history, the 2010 Standards, attached commentary by the Access Board and DOJ, subsequent Technical Assistance Manuals (TAMs), and case law in its determination.

Design Firm Liability

No one can certify that a design complies with the Act, so the conscientious architect will not know if his or her design is compliant unless and until a complaint is filed and adjudicated. The courts are divided on whether architects can be named as defendants under the Act. It almost doesn’t matter, given the architects’ ethical obligations and liability exposure. Architects are, of course, obligated by professional ethics to design facilities compliant with the Act. And whether they are named defendants or not, if suit is brought against a facility owner or operator alleging non-accessible design, the owner or operator will almost certainly make claims for indemnity against the architect under tort or contract law. (And the architectural firm will in turn file claims against its engineers and consultants!)

Litigation

In the early years of implementing the Act, the design professions were concerned about ambiguity in interpreting the Act and their exposure to a new source of liability. The Act has generated significant litigation, including litigation over the design of assembly areas. Most of these cases have involved sports venues or cinemas, but they have implications for other venue types. DOJ has been slow to provide formal interpretation of some regulations, instead choosing to assert its positions in the courts, and this has led to conflicting interpretations by the circuit courts.

Evolving Interpretations

Since the goal of the Act is to achieve inclusive and equal treatment of people with disabilities, interpretation of the Act changes as our society and our built environment change, and therefore requirements are always evolving. During the first two decades of the ADA, the emphasis under Title III was equal access for persons with mobility impairments. During this same time, dialog between the design and disabilities communities has improved, and those communities have developed a shared understanding of many of the Act’s requirements for physical access. Now the area of emphasis and developing interpretation is equal access for persons with sensory and other types of impairments.
Chapter 8
Project Budgets

Predicting and managing the cost of building—that is, establishing and maintaining a project budget—is fundamental to a successful outcome. Unfortunately, budget and cost terminology is often used loosely, and what constitutes “cost” can vary from project to project. Any attempt to compare the costs of buildings requires an understanding of what is and is not included in the cost figures. Therefore, it’s important to understand what makes up the cost of buildings, the variations possible, and the common terminology used.

Budget and Cost Components

Project costs are divided into two major categories—construction cost and owner’s costs. On traditional design-bid-build projects, the construction cost is equivalent to the contract sum—the amount paid to the general contractor. Construction cost is also called hard cost, because it is the cost of tangible “bricks and mortar.”

Owner’s costs are also called soft costs. For the most part, these costs relate to services and intangibles. Unfortunately, “owner’s costs” is not a very meaningful term because, of course, all costs are borne by the owner. Project cost or capital cost is the sum of construction cost and owner’s costs.

These terms are widely used, but they are not always comparable between projects. This is because of variations in approach—that is, whether a

Table 8.1 Typical Project Cost Components

<table>
<thead>
<tr>
<th>CONSTRUCTION COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
</tr>
<tr>
<td>Building shell</td>
</tr>
<tr>
<td>Building interiors</td>
</tr>
<tr>
<td>Mechanical &amp; electrical services</td>
</tr>
<tr>
<td>Theater equipment and seating</td>
</tr>
<tr>
<td>Site Development</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Grading &amp; clearing</td>
</tr>
<tr>
<td>Demolitions</td>
</tr>
<tr>
<td>Site utilities</td>
</tr>
<tr>
<td>Parking and roads</td>
</tr>
<tr>
<td>Landscaping</td>
</tr>
<tr>
<td>Contaminated materials abatement &amp; removal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Add-Ons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design contingency</td>
</tr>
<tr>
<td>General conditions, overhead, and profit</td>
</tr>
<tr>
<td>CM fee</td>
</tr>
<tr>
<td>Bond and insurance</td>
</tr>
<tr>
<td>Escalation to bid date</td>
</tr>
<tr>
<td>Construction change order contingency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OWNER’S COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Acquisition</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Cost of property</td>
</tr>
<tr>
<td>Real estate commissions</td>
</tr>
<tr>
<td>Title insurance</td>
</tr>
<tr>
<td>Transfer taxes</td>
</tr>
<tr>
<td>Legal fees</td>
</tr>
<tr>
<td>Surveys</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixtures, Fittings, and Equipment (FF&amp;E)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Loose furniture and furnishings</td>
</tr>
<tr>
<td>Display and storage fittings</td>
</tr>
<tr>
<td>Equipment – fixed and movable</td>
</tr>
<tr>
<td>Signs and signage</td>
</tr>
<tr>
<td>Telephone systems</td>
</tr>
<tr>
<td>Computer systems</td>
</tr>
<tr>
<td>Security systems</td>
</tr>
<tr>
<td>Musical instruments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil borings, geotech, site, and utility surveys</td>
</tr>
</tbody>
</table>
Testing/inspections expenses
Third party commissioning
Permits and associated fees
Professional fees
Reimbursable expenses
Owner management costs
Models, mockups, renderings
Financing expenses
Fundraising
Public relations
Legal fees and expenses
Facility tours
Groundbreaking, topping off, and gala opening expenses
Art allowance
Insurance
Moving
Swing space
Endowment
Overall project contingency

Table 8.2 Simplified Project Budget

<table>
<thead>
<tr>
<th>Construction Cost (Hard)</th>
<th>$1,000s</th>
<th>% of Construction Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building shell</td>
<td>12,500</td>
<td>26%</td>
</tr>
<tr>
<td>Building interiors</td>
<td>8,500</td>
<td>17%</td>
</tr>
<tr>
<td>Mechanical &amp; electrical services</td>
<td>8,000</td>
<td>16%</td>
</tr>
<tr>
<td>Theater equipment and seating</td>
<td>3,000</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Site development</strong></td>
<td>3,000</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Add-ons</strong></td>
<td>35,000</td>
<td>71%</td>
</tr>
<tr>
<td>Design contingency (10%)</td>
<td>3,500</td>
<td></td>
</tr>
<tr>
<td>General conditions, overhead and profit (12%)</td>
<td>4,620</td>
<td></td>
</tr>
<tr>
<td>Bond and insurance (2%)</td>
<td>770</td>
<td></td>
</tr>
<tr>
<td>Escalation to bid date (8%)</td>
<td>2,800</td>
<td></td>
</tr>
<tr>
<td><strong>Total Bid Cost</strong></td>
<td>46,690</td>
<td>95%</td>
</tr>
<tr>
<td>Construction change order contingency</td>
<td>2,310</td>
<td>5%</td>
</tr>
<tr>
<td>Description</td>
<td>Cost</td>
<td>Percentage</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Construction Cost</strong></td>
<td>49,000</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Owner’s Costs (Soft)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land acquisition</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Fixtures, fittings, and equipment (FF&amp;E)</td>
<td>2,940</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Development costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design fees</td>
<td>5,880</td>
<td>12%</td>
</tr>
<tr>
<td>Reimbursable expenses</td>
<td>1,470</td>
<td>3%</td>
</tr>
<tr>
<td>Owner’s management costs</td>
<td>2,450</td>
<td>5%</td>
</tr>
<tr>
<td>Testing, inspections, and other</td>
<td>1,960</td>
<td>4%</td>
</tr>
<tr>
<td>Overall project contingency</td>
<td>2,450</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>14,210</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Total Owner’s Costs</strong></td>
<td>17,150</td>
<td>35%</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td>66,150</td>
<td>135%</td>
</tr>
</tbody>
</table>

particular item is treated as hard or soft. Also, some projects have costs that others do not—for example the cost of acquiring land. A typical listing of cost components is shown in Table 8.1, but keep in mind there are many possible variations.

A simplified project budget for a typical performing arts building is shown in Table 8.2. We’ll look at it line by line to better understand the cost components.

**Construction Cost**

Construction cost consists of building cost, site development cost, and a series of add-ons that are usually budgeted as percentages of the preceding subtotal.

**Building and Site Development Costs**

The building and site development costs may be estimated in several ways.

**Square Foot Estimate**

The simplest way to estimate building cost is to apply a cost per square foot to the estimated gross floor area of the proposed building. There are no reliable published square foot costs for performing arts buildings, but a cost per square foot may be derived from the costs of completed buildings. These costs must be adjusted for any differences in the cost makeup. They must also be adjusted for time, location, and other conditions of construction, as discussed later in this chapter.
Elemental Estimate

An elemental cost estimate is preferred over the square foot approach. To prepare this type of estimate, the cost consultant quantifies the necessary construction elements or systems and applies market pricing. A budget cost for theater equipment and seating is usually provided by the theater planner and incorporated into the cost consultant’s report. An allowance is usually carried for the cost of site development. (Allowance being a polite term for “plug number.”) An elemental estimate can be based on a well-developed program document, before actual design commences.

Unit Cost Estimate

Once design documents become available, the estimate can be based on a careful itemization of the time, materials, and equipment needed to perform the construction and site development work, multiplied by unit costs for each item.

Design Contingency

The design documents will not completely define the building elements until the contract documents are finalized. To account for the unknowns, a design contingency is included in the project budget. This contingency may be as high as 20 percent at the start of design. The contingency is lowered at the end of each design phase, since the documents are more developed and the unknowns are fewer. The design contingency is removed from the budget when the contract documents are 100 percent complete.

General Conditions, Overhead, and Profit

The building and site development costs above are expressed as bare costs—that is, they account for the trade (subcontractor) cost only. A percentage is applied to account for the cost of general conditions—the coordination and supervision, jobsite trailers, temporary power and facilities, and shared equipment provided by the general contractor. This percentage also includes the general contractor’s overhead costs and expected profit.

Bonds and Insurance

The general contractor may be required to carry bonds that ensure performance of its contractual obligations (performance bond) and assure the owner that labor, material, and subcontractor costs are paid (labor and materials payment bond). These bonds are commonly priced as a percentage of the construction cost—though the percentage will vary based on the capacity and history of the contractor. If the contractor is required to provide builder’s risk insurance, that premium will also be included here. If the owner provides builder’s risk insurance, the premium will appear under owner’s costs.
Escalation to Bid Date

The subtotal at this point is an estimate of the bid cost—if bids were received immediately. However, several years may elapse before documents will be ready for bidding. Therefore the subtotal is escalated to account for inflation and other market changes that are expected to occur in the interval.

Construction Change Order Contingency

Finally, to estimate the total construction cost, a contingency (generally three to five percent) is added to the bid cost to cover unavoidable changes to the work. These changes may result from errors, inconsistencies, or omissions in the contract documents or from unforeseen site conditions or market circumstances. This contingency is not for elective changes. Those are covered by the owner’s contingency (overall project contingency) carried in the owner’s costs.

Total Construction Cost

In our example, the bare costs for building and site development represent only 71 percent of the total construction cost. The difference between bare cost and rolled-up cost is especially important when discussing changes or additions to the project budget. For example, the $3 million line item for theater equipment and seating has a rolled-up construction cost of over $4.2 million—once the contingencies, escalation, and other multipliers are added.

Owner’s Costs

The term “owner’s costs” or “soft costs” encompasses a wide range of potential costs that are over and above the construction cost. These costs fall into three big categories—the cost of acquiring land on which to build, the cost of the fixtures, fittings, and equipment that will go into the finished building, and a long list of possible costs related to the development, design, and construction of the building.

Soft costs vary greatly, but total soft costs are typically in the range of 25 to 33 percent of the total project cost. This means that the total project cost could be 133 to 150 percent of the total construction cost. The soft costs in our example budget are on the low end of this range, and the project cost is estimated to be 135 percent of construction cost. Looking again at theater equipment and seating, we have:
So, the total cost to the owner of the $3 million in theater equipment and seating is $5.7 million—190 percent of the bare trade cost. You can see why it’s critical, especially in early discussions about the project, to distinguish between construction cost and project cost.

Moving on to the owner’s costs in our simplified budget:

Land Acquisition

We’ve assumed that the owner in our example already owns the proposed building site, so our simplified project budget does not include land acquisition costs. Land is one of several items that can significantly distort the overall cost of a project—two others are the cost of swing space (temporary quarters for displaced occupants) and funds set aside as an endowment to support building operations. These items must be removed from the project cost when comparing costs between buildings.

Fixtures, Fittings, and Equipment (FF&E)

See Table 8.1 for a list of items typically considered FF&E. These items vary from waste paper baskets to concert grand pianos. The FF&E budget can vary considerably, but in our example we’ve set the FF&E budget at six percent of construction cost. While theater equipment is usually procured under the construction contract, on some projects the loose theater equipment (spotlights and stage draperies, for example) may be considered FF&E. Shop equipment is almost always FF&E.

A handy, mostly accurate definition of FF&E is this—imagine you can remove the roof, turn the building upside down, and shake it. The items that fall out are FF&E. The items that don’t fall out are part of the construction cost.

Development Costs

Again, look back at Table 8.1 for a full list of possible development costs. We’ve included common development costs in the example shown in Table 8.2.

Design Fees
This line item is the cost of the design team’s services, which we have pegged at 12 percent of the construction cost. Design fees are dependent on a number of factors. Fees vary with the complexity of the building type; the Royal Architecture Institute of Canada classifies buildings into seven types from least complex (1) to most complex (7). Performing arts buildings are category 6. (Category 7 includes air traffic control towers, legislative buildings, embassies, and mints.) The size of the project also affects fees, with smaller projects requiring a higher percentage fee. Fees will vary with the number and type of specialty consultants (like theater planners and acousticians) required by the owner or proposed by the architect. Project delivery method is also a factor, and design fees are very subject to market conditions and competitive pressures.

Reimbursable Expenses

Some members of the design team may be national or international firms geographically distant from the job site. This line item covers their travel and related costs. It may also cover printing and shipping design document sets, though today design documents are usually distributed electronically.

Owner’s Management Costs

Except for the very simplest project, the owner will assign personnel (or retain a representative) to monitor and manage the design and construction progress. The owner may retain a firm or individual to act on its behalf, in which case this is clearly a discrete cost to the project. If this work is performed by personnel already on staff (a theater’s production manager or a university facility management department) the cost may or may not be charged back to the project.

Testing, Inspections, and Other

In our example, this is a catch-all category that may include soil borings, site surveys, testing of materials or elements of the work (for example ultrasonic examination of welds), and costs associated with permitting and inspections by the Authority Having Jurisdiction.

Overall Project Contingency

Our final item is an overall project contingency, also called the owner’s contingency, which we have set at five percent of the construction cost. This line item is for unbudgeted expenses in the owner’s costs and also for betterments—that is, discretionary changes to the construction work.

What is a betterment?
The ticketing office at a Midwestern performing arts center in an area of not-insignificant crime was designed with enclosed sales windows and high security features. The entity that would occupy and operate the new arts center had not yet been created, so the design was based on the design team’s judgement, with the concurrence of the owner’s rep and an independent consultant retained to review the design from an operational perspective. However, after the project was under construction, the newly hired executive director decided the ticketing office should have open, concierge-style counters. The ticketing office was redesigned, a change order was issued to the general contractor, and the work was revised. This is a betterment—an elective change requested and paid for by the owner.

This wasn’t the end of the story, however. That executive director left the employ of the owner before construction was even finished, and his replacement was dismayed at the lack of security features in the redone ticketing office. At this point, the owner decided not to issue another change order to revert to the original design, but instead hired another contractor to enclose the ticket office and retrofit the desired security features after the general contractor finished the building.

Cost and the Design Process

Managing and Reconciling Project Cost

As discussed in Chapter 5, the pre-design effort concerns reconciling the six constituent elements of a project—program, quality level, site, schedule, project cost, and operating cost. The pre-design effort should result in a project budget at least as detailed as the one shown in Table 8.2. The owner and design team should not proceed with design until the owner has established the project budget and all agree that the budget is a good faith estimate of the cost of the proposed building. In typical practice, the design team does not guarantee that the building can be delivered for the project budget. Instead, the design team agrees to design to the project budget.

Designing to Budget

What does this mean? If, at any design milestone, the design is estimated to cost more than the budget, the owner can opt either to increase the project budget or to reduce the program and/or building quality to bring the design back to budget. (Of course, the owner also has the option of terminating the project.) If the budget is increased, the design is carried forward unchanged. If the program and quality are reduced, the design team is obligated to adjust the design at no additional cost to the owner.

Parallel Budgeting
Since the risk of exceeding the project budget is a shared one, both the owner and the design team have an incentive to carefully monitor the developing design to keep it within budget. A new estimate is developed at each design phase, and the parties will not proceed to the next phase if the design is not on budget. Interim updates within the design phases may also be performed. On a large project, it’s typical to have two parallel, independent estimates—one prepared by a cost consultant contracted to the architect and one prepared by a construction manager under separate contract to the owner. At each major milestone, the cost consultant and construction manager exchange estimates and collaborate to produce a single reconciled estimate. This approach has several advantages. The cost consultant and construction manager bring separate perspectives, cost research, and independent thinking to the process, which improves the quality of the reconciled estimate. The process also mitigates against disputes between the owner and design team, which can arise when one party questions the validity of a cost estimate prepared by the other. If the owner and design team don’t agree on the cost of the design at hand, it’s impossible for them to agree how to proceed.

**Bid Alternates**

If, during bidding, the lowest competitive bid or negotiated proposal received by the owner exceeds the budget, the owner has the same options described above. The owner can increase the budget and authorize the start of construction, assuming that the extra funds are available or can be raised. Or the owner may reduce the size of the building and direct the design team to adjust the documents accordingly, for no additional fee. Bid alternates are used to help avoid this situation. A bid alternate is a portion of the work separately described in the contract documents and separately priced by the bidders. Alternates are either add alternates or deduct alternates—depending on whether the “base building” is described with or without the alternates. (A document set can also include both add and deduct alternates.) The alternates allow the owner to adjust the size of the construction contract without redesign and rebidding, should the bids come in either higher or lower than expected.

**Chasing the Market**

The construction market is cyclical, following the overall economic cycle. When the market is depressed, many contractors are eager for work and submit low bids. (The Wolfe Center at Bowling Green State University, bid during the Great Recession, came in 20 percent below budget.) When the market is overheated, contractors are busy, and materials and skilled labor may be scarce. Bids may come in significantly above budget, because the economy outpaced the budgeted escalation. The owner and design team may then make significant cuts to the project, and revise and rebid the contract documents. But sometimes the bids for the reduced project are still above budget, because market rates continued to increase while the owner and design team made their adjustments. During the 1990s, after multiple rounds of reductions and high bids, one university simply pulled the plug on their new performing arts building.
Operating Costs

The design team has a specific contractual obligation to design to project cost, but its responsibility for operating cost is not usually written into the contract. Nevertheless, to perform its work ethically and with an appropriate standard of care, the design team must consider the effect of the design on the cost of operating the completed building. Major operating costs include the expense of energy and labor to run and maintain the building, and the cost of replacing building systems and equipment as they wear out.

Theater planners have specific responsibility for operating costs in two areas.

Life Cycle Costing

Almost all performance spaces are configurable to some degree, and the theater planner may be called upon to assess the tradeoff between capital and operating costs when planning these features. To provide a simple and common example, the orchestra pit may be reconfigurable to provide a forestage (apron) extension or additional audience seating. This can be accomplished with modular platforms that are manually adjusted to match the stage or auditorium floor level as needed. This adjustment might require a four-hour call for a four-person crew. Or it can be accomplished with a motorized orchestra pit lift (elevator) that can be quickly raised or lowered to the desired level. This adjustment might take a two-person crew half an hour. The modular platforms have a lower capital cost than the motorized lift, but a higher ongoing labor cost. There is also an opportunity cost associated with the manual system, in the form of lost rehearsal and performance time. However, the motorized lift will have higher maintenance and replacement costs.

All these costs can be quantified or estimated, and the owner and design team may select one design option over the other by evaluating the total cost of ownership. This is just an example; a similar process may be followed for any building feature. The formal process of assessing total cost over the lifespan of the building is called life cycle costing, although decisions may also be made on the basis of less formal or less complete analyses.

Fitness for Use

The phase “fitness for use” or “purpose” is a legalism that implies the guarantee of a specific result. As we discussed in Chapter 3, the design team does not have control over construction and cannot guarantee a specific result, but is obligated to conform to a standard of care in developing the building design. For the theater planner, this means advocating for the ease and economy of operations in the finished building. This issue is less concrete and harder to define than the orchestra pit example above. It concerns the quality of the design that results from the many decisions made by the owner and design team. Room adjacencies, circulation paths, layout of individual rooms, and the smallest detail may affect how quickly
common tasks can be accomplished, the staffing levels required for normal operations, and how well (or even whether) particular events can be accommodated. All have a direct effect on operations—either by increasing operating costs or precluding opportunities for operating revenue.

**Cost Factors and Cost Transposition**

To compare the cost of buildings (or to use historic data to estimate the cost of a proposed building) it is first necessary to determine any differences in cost makeup. Are these construction costs or project costs? Is land, swing space, or any other extraordinary expense included? The costs must also be transposed to the present time and location, and may also be adjusted for other factors.

**Time**

Historic costs can be adjusted for inflation to arrive at the equivalent present-day cost, and published indexes are available for this purpose. One is the Turner Cost Index for non-residential construction, which Turner Construction has published every quarter since 1967. If elemental cost data is available, it may be possible to adjust for more granular and shorter term market conditions, such as spikes in the cost of specific construction materials.

**Location**

The cost of construction varies by geographic region and within regions. Just as historic costs can be adjusted for inflation, building costs can also be adjusted for location. RSMeans publishes a lot of construction cost data including a cost index for nearly 1,000 North American cities.

**Program and Quality**

The architectural program (functions and spaces) and the quality of the building will likely differ between buildings. It may be hard to adjust for these differences, but at minimum they should be noted.

**Construction Conditions**

A number of additional factors must be considered when comparing and determining costs. The project delivery method (discussed in Chapter 4) can affect both the construction cost and the owner’s costs. In climates with distinct seasons, the timing of construction may affect the schedule and cost of construction. The owner or the permitting authority may place extraordinary restrictions on the work—they may, for example, place restrictions on noise and dust or limit operations to certain hours of the day or days of the
week. The size of the job site and the availability (or lack) of layout space affects the ease with which materials can be received and prepared for erection or incorporation in the work. Prevailing wage laws, whether union labor must be used, and even which union has jurisdiction over portions of the work can all affect cost. Finally, the availability of energy, labor, and materials will affect their cost—and ultimately the cost of the building.
Part II
Planning
Chapter 9
Proscenium Stages

With this chapter we turn from the planning process to the design of specific elements within a theater building. We start with the design of the stage — specifically, the proscenium stage, since it is the most prevalent form. After a discussion of concepts, we’ll look at selected precedent theaters. Like much of theater design, the layout of the stage is heavily influenced by precedent—mainly because of the requirements that repertoire places on the size of the proscenium opening and the stage footprint.

Proscenium Opening

The defining features of a proscenium theater are the wall separating the auditorium and stagehouse and the opening in this wall that gives the audience a view into the stagehouse. Terms for this opening include stage opening, proscenium opening, proscenium frame, and proscenium arch. It is sometimes called a picture frame or the fourth wall. Often it is just called the proscenium or pros (pronounced PROSS). The area in front of the proscenium is called the forestage, apron, proscenium zone, or throat, and is the subject of Chapter 10. Before the mid-nineteenth century, the actors performed on the forestage, with only scenery occupying the stage behind the proscenium. With the introduction of Realism, the action of the play moved behind the proscenium into the stagehouse where an illusion of reality was more easily created. In the twentieth century, the performance began to migrate back to the forestage, and today the proscenium and forestage area are often flexible to accommodate multiple staging options.

Opening Width

Types of Performance

The stage opening width is primarily determined by the types of performances that will take place on the stage. Both repertoire and production practices come into play. A venue for ballet needs an opening of 50 feet because many ballets were first performed in European opera houses with openings of about that width—this is the influence of repertoire. A venue for touring Broadway musicals needs an opening of 40 feet because those productions often originate from New York theaters with openings between 38 and 42
feet—this is an example of the influence of both repertoire (Broadway musicals) and production practice (touring). Regional theater companies that co-produce with peer institutions, and opera companies that rent productions, must have stage openings that can receive those productions—an example of production practices affecting the size of the proscenium opening.

**Seat Count**

Opening width is not directly affected by the number of seats in the auditorium. For example, the required stage dimensions for a dance piece are determined by the choreography, whether the auditorium seats 300 or 1,500. A touring version of a Broadway musical will play in venues with 1,200 to 4,000 seats, but the stage opening will remain about 40 feet wide. Stage opening width and auditorium size are somewhat related, but this is due to the interplay of repertoire, aesthetics, and economics, not because of a direct causal effect.

**Other Considerations**

A producing organization with limited resources, perhaps a community theater or a secondary school, may purposely limit the proscenium opening to reduce the amount of scenery required. A smaller stage opening means less scenery, fewer labor hours, and lower expense. At a time when budgets were especially tight, the production manager at one regional theater company taped out a “scenery limit line” and told the visiting designers this was the space they were allowed to design scenery for! However, architecture probably works better than spike tape in putting limits on scenic design.

At the other end of the spectrum, secondary schools with open admission to their music and drama ensembles may increase the stage opening width, simply to fit everyone on stage.

**Opening Height**

The height of the proscenium opening is almost entirely an aesthetic choice, and generally, higher is better. According to lighting designer Gilbert Hemsley, the opening for ballet must be high enough “to do *The Nutcracker* with . . . a 30-foot tree—and do it well!” The opening for drama should be high enough for a two-story set, and for musical theater it must be expansive enough to express the prairie sky in *Oklahoma!* There perhaps are exceptions. A low proscenium opening might be appropriate for a cabaret where intimacy is desired, or for a theater company presenting only social realism—Gorky’s *The Lower Depths*, for example—to express the oppression felt by the characters. But in most cases, it’s best to avoid the very horizontal letterbox shape. This is commonly found in school auditoriums where the opening width is driven by ensemble size and the height is kept low for cost and safety concerns.
The proscenium opening should probably not be more rectangular than the golden rectangle, as shown in Figure 9.1. In a golden rectangle, the ratio of the width ($w$) to the height ($h$) is the same as the ratio of the width plus height ($w + h$) to the width ($w$). That is,

$$\frac{w}{h} = \frac{w + h}{w} = \text{approximately 1.62}$$

Hard and Soft Openings

The proscenium opening is often made adjustable to better suit different types of performances, or to allow more flexibility within a performance type. (In theater terminology, the opening can be “trimmed.”) At the extreme, the architecture flanking the forestage may pivot or track to change the shape and width of the auditorium walls around the stage opening. The adjustable elements could also be architecturally finished panels that track in and out, or even framed scenery or stage drapery that’s not part of the architecture at all.

When a proscenium opening is adjustable or has a decorative frame, a distinction is made between the hard and soft openings. The hard opening matters for building code purposes. This is the opening defined by fire-resistant construction and usually protected by a fire curtain. The soft opening is the decorative or trimmed (adjustable) opening—the opening apparent to the audience.

Stage Footprint

We turn now to the dimensions of the stage behind the proscenium.
Usable Area

Stage dimensions are given as the clear depth ($D$) and width ($W$), as these dimensions define the usable floor area. (This text uses an uppercase $W$ for stage width and a lowercase $w$ for proscenium width.) Pilasters, permanent rigging, stairwells, vestibules, and similar items must be held outside of the clear dimensions. A relatively small obstruction in one corner of the stage can have a big deleterious effect on the use of the stage. For the same reason, the stage walls should be kept orthogonal in plan and section. Curves, diagonals, and truncated corners all compromise the utility of the stage.

Wings

The stage areas to each side of the proscenium opening are called wings, or off right and off left. The wings need not be symmetrical.

**A brief explanation of stage directions:**

In this usage left and right are stage left (SL) and stage right (SR), meaning they are from the point of view of the performer facing the auditorium. Toward the rear of the stage is upstage and toward the auditorium is downstage. The latter terms come from a time when stages were sloped or raked, and the rear of the stage was indeed at a higher elevation than the front.

Plaster Line

The line on the stage side of the proscenium wall from which the clear depth of the stage can be measured is called the plaster line. No fixed obstructions exist between the plaster line and the rear wall of the stage, so it’s the
theoretical line on the stage floor from which the director and production designers are unfettered by architecture. The area between the plaster line and the stage edge (or orchestra pit lift) is called the apron. Since the apron is not within the stagehouse, the opportunities for rigging, lighting, and other production effects are more limited. Therefore the plaster line is an important datum, and all dimensions on stage are taken either from the stage centerline or “from plaster.” The analogous datum in a British theater is the setting line.
Figure 9.3 Acting Area (after Burris-Meyer and Cole)
Source: Author

Figure 9.4 Scenery Area (after Burris-Meyer and Cole)
Source: Author

Figure 9.5 Circulation and Work Area (after Burris-Meyer and Cole)
Source: Author
Burris-Meyer & Cole Formulas

Authors and theater consultants Harold Burris-Meyer and Ed Cole outlined a working concept for stage dimensions in their book *Theatres and Auditoriums*, first published in 1949. They define three theoretical areas and relate the size of each area to the proscenium width \( w \). The acting area is the portion of the stage occupied by the performers.

The scenery area is the portion of the stage within view of the audience and therefore part of the production.

Finally, the circulation and work area is the area needed for circulation, scene changes, and other stagecraft.

Like any theoretical construct applied to the real world, the Burris-Meyer & Cole (BMC) formulas have limitations, but the overall dimensions \( 2w \) by \( 1\frac{1}{4}w \) are a useful guide in thinking about stage footprint. The width of built stages is often about twice the proscenium width, which validates the formula \( W = 2w \).

For most performance types, the depth formula \( D = 1\frac{1}{4}w \) results in a deeper stage than is typically built. The exception is opera houses which typically have stages deeper than \( 1\frac{1}{4}w \). Later in this chapter, we’ll compare actual precedent theaters to the BMC formulas, which will give us a good idea of the usefulness of the BMC formulas as design guides.

**Stage Height**

The volume above the stage floor is called the fly loft, rigging loft, or the fly or flies. The term stagehouse tends to encompass both the stage floor and fly loft, while the terms fly tower and stage tower connote the appearance of the stagehouse from the exterior.

**Fly Loft**

The fly loft may extend over the entire stage footprint or just over the central portion, leaving one or both wings at a lower height. Scenery, lighting, drapery, and other production elements and equipment are suspended within the fly loft on rigging and lowered (flown in) or raised (flown out) as needed. One or more galleries may be provided at the side walls of the fly loft for operating and maintaining the rigging and other stage equipment. Usually, a gridiron extends over the entire upper portion of the fly loft.

**Gridiron**

The gridiron (or grid) is a structural steel frame that supports the rigging equipment and provides
personnel access for operations and maintenance. The walking surface is bar grating or toe-down channels spaced to provide open slots between channels. Typically, seven feet of clear height is provided between the top of the grid channels and the underside of the roof steel. While it is a walking surface, the gridiron is not a floor for building code purposes.

If a stage is not provided with a gridiron, the rigging is attached to the underside of the roof steel or rigging steel provided for the purpose. When the grid is omitted, it’s usually to avoid the extra height and cost. Adjusting the rigging and (most importantly) inspecting it annually become much more difficult and expensive if there is no gridiron.

Some venues, usually opera houses, have so much equipment over the stage that more than one gridiron is provided.

Stage Tower Height

The stage tower height is composed of a string of vertical dimensions. The largest and most critical is the dimension from the stage floor to the gridiron. Ideally, this dimension will allow a full-height scenic drop to be raised completely out of view of the audience. This is sometimes called a full fly. Add to that dimension seven feet of clear working height above the gridiron, about three feet for depth of roof steel and the roof membrane, and two feet for a parapet. This places the roofline of the stage tower about 12 feet above the gridiron.

The height of the stage tower is always a topic for discussion and often a matter of controversy. A number of pressures conspire to keep the stage tower as low as possible. Zoning or other restrictions on building height may come into play. The stage tower is a big volume and an awkward form to incorporate into the building massing. At best, the architect will want to break down or buffer the stage tower by surrounding it with smaller-scale elements. At worst, the architect may pressure the theater planner to lower the stage tower. Cost is often raised as a concern, but in truth the incremental cost for making the stage tower higher is relatively modest.

Determining Grid Height

With all these pressures, how is grid height determined? There’s no single answer. For complete flexibility a full fly is desired. However, the right grid height for any building depends on the needs of the users and the particulars of the project. A partial fly may be appropriate and acceptable given the overall needs of the project. It’s the job of the theater consultant (in particular) to advocate for the best solution—not stubbornly insisting on more height than is necessary nor compromising the intended use of the theater by acquiescing to too low a gridiron. All while trying not to antagonize the architect, especially if he or she is your client!

A useful starting point for a full fly is to apply a longstanding rule of thumb: the preferred grid height (G
is three times the proscenium height \((h)\) and should be no less than 2.5 times the proscenium height \((h)\). That is,

\[
\text{Preferred } G = 3 \times h \\
\text{Minimum } G = 2.5 \times h
\]

To test this number (or possibly to defend it) a section must be drawn, as illustrated in Figure 9.6. Begin with a centerline section of the auditorium and stage. Indicate the trimmed proscenium opening—that is, the highest expected soft opening. In many cases, this will be the same as the hard proscenium opening. Next, draw a backdrop on the rigging set closest to the rear wall of the stage. Finally, draw the sightline from each row of seats to the trimmed opening, indicating the height of the backdrop fully in view of that row. A point of diminishing returns will be apparent, beyond which an increase in the height of the backdrop is visible to too few audience members to be worthwhile. In our example that point results in a 44-foot high backdrop. A higher backdrop would be fully in view of less than 28 percent of the audience, and that number falls off very quickly. The unshaded stage volume in Figure 9.6 is the feasible scenic space, and the 44-foot high backdrop is the tallest scenic element. (Of course, the stagehouse volume above our backdrop will still be visible to a quarter of our audience unless overhead masking drapery is hung—but that’s “just” stagecraft, not theater planning.)

**Figure 9.6** Percentage of Audience with Full View of Backdrop

Source: Author
A grid height of about 90 feet is needed to raise the 44-foot drop completely out of view of the audience—that is, twice 44 feet plus two feet for grid structure and sprinkler piping. This height can be reduced foot by foot, with each reduction resulting in a somewhat less flexible and useful stage. What is the minimum grid height? Again, there’s no single answer. However, one benchmark is the grid height needed for a functioning fire safety curtain.

Fire Safety Curtain

The fire safety curtain automatically descends to close off the proscenium opening in the event of a fire. The bottom of the curtain must be out of the audience’s view when stored, and when deployed the top of the curtain overlaps the top of the stage opening by two feet. Add two feet for grid structure and sprinkler piping (as above) and two feet for extra hardware at the top of the fire curtain. The minimum grid height to accommodate a fire curtain is:

\[
G = 2(h + 2) + 2 + 2 = 2 \times h + 8
\]

If the proscenium opening is 16 feet high \( (h = 16) \) then this formula results in the same grid height as the minimum formula \( G = 2.5 \times h \). For higher openings, the fire safety curtain formula gives a lower value for the grid height. Sometimes even this dimension cannot be provided due to design constraints. If a fire curtain is still required, there are workarounds. One is to provide a split fire curtain that stores in roughly half the vertical dimension of a single-piece curtain, or (for smaller openings) a brail-rigged fire curtain that bunches to store. Another workaround is to rig the fire curtain from the roof steel and to provide a slot in the gridiron through which the fire curtain extends when it’s stored.

50-Foot Dimension

Another benchmark for grid height is a maximum 50-foot dimension from the stage floor to the ceiling or the underside of the roof deck overhead. The *International Building Code* requires stages with heights greater than 50 feet to have walls with a minimum 2-hour fire resistance rating and a fire safety curtain protecting the proscenium opening. Stages that are 50 feet or lower in height must have walls with a minimum 1-hour fire resistance rating, and no fire safety curtain is required. Therefore, dropping the height of the stage tower for a small stage to 50 feet or lower can result in significantly lower construction costs.

**Stage Circulation**
Entrances

Performers and technicians should be able to access the stage at each of the four corners. If this is not possible, access to at least three corners is the minimum requirement. Each entrance should be as close to the actual corner as possible, and should be provided with a vestibule (sound and light lock) to prevent the intrusion of unwanted light and noise onto the stage. One of the entrances might be a double door to accommodate choral entrances and piano movement without use of the loading door.

Loading

A stage needs a loading door in addition to the above personnel doors. The preferred location is on the side wall opposite the rigging. If the door must be on the rear wall, it should be as far offstage as possible, so that it’s not blocked by a backdrop or other scenery. A loading door may be provided with a sound and light lock, depending on the uses of the adjoining spaces. As is obvious, the loading door must accommodate the largest object the users might want to move onto the stage—the trick is guessing the size of that object! If the theater is only for touring shows, a door somewhat larger than the cross-section of a semitrailer will do.

Corridors

A corridor that wraps around the side and rear walls of the stage and connects our four corner entrances is the ideal. This corridor should be wide enough for easy movement of people, musical instruments, costume racks, and road cases. At minimum, a crossover corridor connecting the two rear stage entrances should be provided, so that performers and others can quickly get from one wing to the other outside of the audience’s view. If no crossover corridor is provided, the rear of the stage must be dedicated to this purpose, limiting the effective depth of the stage.

Vertical Circulation

Convenient vertical circulation is also needed. The preferred solution is a stair at each side of the stage that provides ready access to the traproom below the stage and to all raised galleries and the gridiron above the stage. These same stairs should provide access to the technical levels above the auditorium. If the grid is especially high, or the project especially well-funded, then an elevator serving these levels should be provided.

Traprooms

A traproom is the area below the stage into which openings can be created for staircases, trap doors, or
other scenic effects. Both the opening in the stage floor and the cover for that opening is called a trap. A traproom extends the vertical dimensionality of the stage and provides greater artistic flexibility. Not all stages require traprooms. Opera houses and drama theaters are prime candidates for traprooms, but a theater that only houses touring shows probably doesn’t need one, because the tour can’t count on having a traproom at every stop. (Though there is an element of self-fulfillment about that statement.) A stage used primarily for dance should not have a traproom, as the trap structure makes the resilience of the floor uneven and less than optimal for dance.

Location and Size

Since the traproom can be opened to the stage volume, it must be enclosed by the same fire resistant construction as the rest of the stage house. If as proscenium fire curtain is required, the traproom must be upstage of the plaster line or it will breach the fire resistant envelope. If a proscenium fire curtain is not required, the traproom can extend under the stage apron.

If possible, the traproom should be the width of the proscenium (w) by about \( \frac{3}{4}w \) deep. Traproom height can vary from as little as eight feet to more than 20 feet, measured from the traproom floor to the stage floor. A shallower traproom may be appropriate for a school theater, but typically a 14- to 16-foot depth is provided.

Because of its low utilization, the traproom is often a target for reduction or elimination when the cost estimate comes back high. Reducing the traproom footprint becomes a guessing game with no right answer. Where are openings likely to be needed? Some stages have a single row of traps just upstage of the plaster line. Others have a single column of traps along centerline. The plans for one theater showed a plus-shaped traproom until calmer minds prevailed. If the traproom size must be reduced, it’s generally best to stick with a rectangular shape located downstage center.

Construction

The stage floor and structure above the traproom are completely demountable, so that the entire traproom or any portion of it can be opened up to the stagehouse. This structure is designed to span the opening with as few columns as possible. The stage floor consists of modular traps—common sizes are 4′ by 4′, 3′ by 6′, 3’-6″ by 7′, or 4′ by 8′. Conventionally, both the structure and traps are built in place by the building contractor.

Another approach is to use a pre-engineered platform system, the type of product used for demountable orchestra pit covers or audience seating risers. The result is a traproom filled with the structural supports for the platform decks, but since the traproom is not supposed to be used for any other purpose, this should not be a concern.

A third approach is to provide the demountable trap structure, but to run the stage floor continuously
over it. This allows the users to cut traps as needed, but preserves the integrity of the floor for dance—at least until the first trap is cut.

**Precedents**

Since the type of performance and the nature of the producing organization determine the size of the proscenium opening and stage footprint, a look at precedents provides important guidance. The tables in this chapter list the proscenium opening and stage sizes for different performance and venue types, with dimensions rounded to the nearest foot. If the opening is variable, the largest useable size is listed. Where a specific venue is given as an example, its location and year of opening are listed. Four ratios are also listed for each precedent, detailed in Table 9.1.

**Table 9.1 Stage Dimension Ratios**

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Description</th>
<th>Benchmark (Source)</th>
<th>Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w/h )</td>
<td>Opening width to opening height</td>
<td>1.62 (Golden ratio)</td>
<td>A smaller number means a higher opening and more pleasing shape</td>
</tr>
<tr>
<td>( W/w )</td>
<td>Width of stage to width of opening</td>
<td>2 (Burris Meyer &amp; Cole)</td>
<td>A larger number means more wing space</td>
</tr>
<tr>
<td>( D/w )</td>
<td>Depth of stage to width of opening</td>
<td>1.25 (Burris Meyer &amp; Cole)</td>
<td>A larger number means a deeper stage</td>
</tr>
<tr>
<td>( G/h )</td>
<td>Height of gridiron to height of opening</td>
<td>2.5 minimum 3 preferred (Industry rule of thumb)</td>
<td>A larger number means a higher fly loft</td>
</tr>
</tbody>
</table>

**Table 9.2 Broadway Theaters\(^1\)**

<table>
<thead>
<tr>
<th>Venue</th>
<th>Year</th>
<th>Location</th>
<th>Opening</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{Width} )</td>
<td>( \text{Height} )</td>
<td>( \text{w/h ratio} )</td>
<td>( \text{Width} )</td>
</tr>
<tr>
<td>Smallest (Helen Hayes)</td>
<td>1911</td>
<td>New York</td>
<td>29</td>
<td>18</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>Largest (Gershwin)</td>
<td>1972</td>
<td>New York</td>
<td>65</td>
<td>38</td>
</tr>
</tbody>
</table>

Note: 1. Here “Broadway theater” means the 40 New York venues that are Tony Award eligible. This includes both the commercial and nonprofit venues. The Circle in the Square Theatre (1972) is the only non-proscenium Broadway theater, and it is excluded from the data set.

Broadway
Broadway remains the heart of commercial theater in the United States and the source of touring productions that influence the requirements of theaters everywhere. Broadway theaters (Table 9.2) have very consistent proscenium opening sizes. Just over half have opening widths in the 38- to 41-foot range, and two-thirds are in the range of 36 to 45 feet. The three venues with openings above this range are the Vivian Beaumont (1965), Gershwin (1972, formerly Uris), and Lyric (1998, formerly Ford Center, Hilton, and Foxwoods). They are among the newest Broadway theaters and each is a departure from the norm.

The smallest opening of any Broadway theater is 28′-6″ wide by 17′-10″ high at the Helen Hayes Theatre (formerly Little Theatre). At 597 seats, the Helen Hayes has the lowest seat count on Broadway. Built in 1911, it is among the oldest extant Broadway theaters.

The Gershwin Theatre (1972) has the largest opening at 65′ wide by 38′ high and the highest seat count at 1,933 seats. Not counting the Vivian Beaumont (home of the nonprofit Lincoln Center Theater), the Gershwin was the first Broadway theater built since the early 1930s. It’s very much a product of its time and a demonstration of how poorly theater design was understood in the mid-twentieth century. It takes a big show to fill the Gershwin—both stage and house—but some productions have been successful. Harold Prince’s Showboat revival ran for 947 performances in the late 1990s and Wicked has run for more than 5,000 performances to date.

Broadway Theater Seating Capacities

It’s clear from Figure 9.7 that the majority of Broadway theaters have proscenium widths very close to 40 feet, with very few outliers. A similar look at seating capacity (below) results in a spike at 1,100 seats, but the overall distribution is much flatter. And historically, seating capacities on Broadway were more varied than they are now.
Plotting the proscenium width and seating capacity of each Broadway theater produces the scatter chart below. The concentration of proscenium widths at 40 feet is very obvious, and the concentration of seat counts at 1,100 somewhat less so. Despite the Helen Hayes at the lower left and the Gershwin at the upper right, there is no correlation between seat count and opening width. Instead the chart shows a wide range of seat counts and a narrow range of opening widths.

There is a limit to how far seating capacity can be pushed, however. As noted above, touring Broadway productions will play in venues with 4,000 or more seats, but the stage opening will remain about 40 feet wide. The higher seat count helps the economics, but the aesthetic experience can’t match the original Broadway version in a 1,000 to 1,800-seat house.

**Footprint and Height**

Except for the width and height of the Helen Hayes stage, the ratios listed in Table 9.2 are less than our benchmarks. (And the Helen Hayes ratios are helped by its small proscenium opening.) Broadway stages are surprisingly shallow—few are as deep as their proscenium is wide. Most Broadway theaters were
Built on 100-foot-deep lots—two such lots fit back-to-back between Manhattan’s cross streets. Lot widths varied, but many were also about 100 feet wide. Given these limitations, the designers of Broadway theaters favored seat count—and the potential box office revenue—over stage depth. The Lyric Theatre (1998) has the deepest stage on Broadway at 53 feet—and this was only possible because two side-by-side historic theaters were gutted to create the 100-foot by 219-foot volume in which the Lyric was built.

The historic Broadway theaters are of modest overall height, and as a result the average grid height is a relatively low 2.28 times the average proscenium height. Creativity and stagecraft can overcome physical limitations to some extent. The newer theaters are higher—the Vivian Beaumont has a grid height of 90 feet and a ratio of 3.12. The Lyric has a grid height of 80′-6″ and a ratio of 2.58.

Regional Theater

Regional theaters in the United States have individual—even idiosyncratic—production aesthetics. Their venues reflect their individuality, and some regional theater companies do not perform in proscenium theaters at all. Those companies that do perform in proscenium theaters do so in a diverse group of spaces. Four venues representing the range of that diversity are listed in Table 9.3. The majority of such theaters have proscenium openings in the range of 28 to 45 feet wide and 16 to 26 feet high. Stage width and depth vary, but our examples have widths that are roughly twice the proscenium width, and depths that are roughly equal to the proscenium width. Stage heights vary from less than twice the proscenium height at Signature’s Alice Griffin Theatre and South Coast Rep’s Julianne Argyros Stage to almost three times the proscenium height at the Philadelphia Theatre Company. The Griffin and the Argyros are both “second” stages (not those companies’ largest venues) which may be the reason the stage height is comparatively modest.

Dance

Table 9.4 lists venues for both modern and classical dance repertoires.

Table 9.3 Regional Theaters

<table>
<thead>
<tr>
<th>Company Venue</th>
<th>Year</th>
<th>Location</th>
<th>Opening Width (w)</th>
<th>Opening Height (h)</th>
<th>w/h ratio</th>
<th>Stage Width (W)</th>
<th>Depth (D)</th>
<th>Height (G)</th>
<th>W/w ratio</th>
<th>D/w ratio</th>
<th>G/h ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature Theatre Co. Alice Griffin Theatre</td>
<td>2012</td>
<td>New York</td>
<td>26</td>
<td>20</td>
<td>1.30</td>
<td>45</td>
<td>25</td>
<td>34</td>
<td>1.73</td>
<td>0.96</td>
<td>1.70</td>
</tr>
<tr>
<td>Philadelphia Theatre Co. Suzanne Roberts Theatre</td>
<td>2007</td>
<td>Philadelphia</td>
<td>30</td>
<td>22</td>
<td>1.36</td>
<td>72</td>
<td>40</td>
<td>60</td>
<td>2.40</td>
<td>1.33</td>
<td>2.71</td>
</tr>
<tr>
<td>South Coast Rep. Julianne Argyros Stage</td>
<td>2002</td>
<td>Costa Mesa, CA</td>
<td>32</td>
<td>22</td>
<td>1.45</td>
<td>67</td>
<td>29</td>
<td>41</td>
<td>2.09</td>
<td>0.90</td>
<td>1.86</td>
</tr>
<tr>
<td>Goodman Theatre Albert Ivar Theatre</td>
<td>2000</td>
<td>Chicago</td>
<td>45</td>
<td>26</td>
<td>1.69</td>
<td>97</td>
<td>39</td>
<td>65</td>
<td>2.18</td>
<td>0.87</td>
<td>2.47</td>
</tr>
</tbody>
</table>

Note: 1. Regional theaters (or resident theaters) are professional (usually nonprofit) theater companies that regularly produce a season of works. They work in theater buildings they own or operate or in multi-venue arts centers at which they are tenants (resident companies). The League of Resident Theatres (LORT) has 74 professional, nonprofit member theaters. The Theatre Communications Group has more than 500 nonprofit member theaters.
The typical stage opening for Western modern dance is 40 feet wide, and the minimum depth is 32 feet. With 15-foot deep wings and 5 feet of additional depth for lighting or circulation, the minimum stage footprint is 70 feet wide by 37 feet deep. This footprint will also work for international (world, ethnic) dance. Applying the BMC formulas results in a larger stage—80 feet wide by 50 feet deep.

The stage at the Joyce Theater (1982), the premiere space for modern dance presentation in New York, has a 43-foot wide by 21-foot high opening. The stage measures 64 feet wide by 32 feet deep. The Joyce is a converted cinema, however, and its dimensions reflect the constraints of the existing building, not an ideal. The Bessie Schönberg Theater at New York Live Arts (2002, formerly Dance Theater Workshop) has a 42-foot wide by 19-foot high opening. The stage, at 74 feet wide by 35 feet deep, is very close to the minimum typical footprint. Neither the Joyce nor the Schönberg have fly spaces. This is not unusual for modern dance spaces, though the flexibility of a fly loft is desirable.

### Classical
Opening widths for classical dance (ballet) range from 45 feet to 55 feet wide, with 50 feet being a reasonable norm. The typical stage depth is 40 feet. With wings of 20 feet and 10 feet of additional depth for backdrops, lighting, and circulation, the minimum overall stage footprint is 90 feet wide by 50 feet deep. The BMC formulas result in a bigger stage footprint of 100’ by 62’-6”.

![Classical Dance Footprint](image)

New York City Center (1923), home to both the Alvin Ailey American Dance Theater and the American Ballet Theatre, has a 45-foot wide by 38-foot high opening. The stage width matches both the typical footprint and the BMC values. It’s shy on depth (43 feet) and grid height (60 feet)—however, City Center was originally built by the Shriners, who probably didn’t have classical dance in mind!

The David H. Koch Theater at Lincoln Center (1965, formerly the New York State Theater) is home to the New York City Ballet and has a 55′ wide by 28’-5″ high stage opening. The Koch is an opera house, although it no longer has a resident opera company. The opera house form is the traditional theater form for ballet, and Balanchine insisted upon it for the New York State Theater. The stage size is generous, larger than our typical footprint, but the stage depth is still less than the BMC value.

Ballet and opera have long coexisted in opera houses, and almost all of the opera houses listed in Table 9.5 have resident ballet companies.

Table 9.5 Opera Houses
Opera

No form of theater building has been as long-lived and consistent over time as the opera house. Table 9.5 includes historic European halls, the largest American companies by number of annual performances, and recently built American and European halls. The opening sizes are very consistent—about 52 feet wide by 38 feet high.

Opera houses must accommodate productions with elaborate scenery and multiple settings. Some opera houses must additionally meet the intense demands of rotating repertory. Stage widths are consistent
with other venue types (about 2w) but opera houses generally have deeper stages (up to 1 1/2w) and are also likely to have auxiliary stages. The most common configuration of auxiliary stages is a cruciform, with auxiliary stages to the left, right, and rear of the main stage, but some recently built halls have six or nine square configurations. Auxiliary stages are usually as deep as the main stage, but less wide. Stage lift and wagon systems allow complete scenes to be preset for rapid changes of productions or scenes within a production.

Opera houses also have some of the highest grid heights, again due to the demands of multiple settings of scenery and repertory operation. The majority of the halls in Table 9.5 have grid heights more than two and one-half times the proscenium height. The grid at the Civic Opera House in Chicago (1929) is 4.34 times the proscenium height.

**Multipurpose Halls**

Table 9.6 lists four contemporary American multipurpose halls. As described in the first chapter, a multipurpose hall may present symphonic music, opera, musical theater, ballet, and touring productions. The stage opening is often adjustable, and the maximum opening will be determined by the needs of symphonic music. The seating arrangement for a symphony orchestra is about 65 feet wide at the front, but it narrows to about 50 feet wide at the rear. Of the four examples, Bass Hall in Fort Worth, Texas (1998) and Schuster Center in Dayton, Ohio (2003) have narrower openings because half or more of the orchestra is seated in front of the proscenium to better imitate the “one room” design of a concert hall. At Ordway Center in St. Paul, Minnesota (1985) and Overture Hall in Madison, Wisconsin (2004) the orchestra plays behind the proscenium, so their proscenium openings are wider. In all cases, the needs of opera, ballet, and touring Broadway fit comfortably within the maximum opening established by the symphony orchestra.
Figure 9.10 Opera Houses with Dates of Opening and Most Recent Stage Expansion
Source: Author

Table 9.6 Multipurpose Halls

<table>
<thead>
<tr>
<th>Venue</th>
<th>Year</th>
<th>Location</th>
<th>Opening Width (W)</th>
<th>Opening Height (H)</th>
<th>W/H ratio</th>
<th>Stage Width (W)</th>
<th>Stage Depth (D)</th>
<th>Stage Height (G)</th>
<th>W/W ratio</th>
<th>D/W ratio</th>
<th>G/H ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schuster Center</td>
<td>2003</td>
<td>Dayton, OH</td>
<td>56</td>
<td>34</td>
<td>1.65</td>
<td>117</td>
<td>50</td>
<td>92</td>
<td>2.08</td>
<td>0.89</td>
<td>2.71</td>
</tr>
<tr>
<td>Bass Hall</td>
<td>1998</td>
<td>Fort Worth, TX</td>
<td>58</td>
<td>40</td>
<td>1.45</td>
<td>115</td>
<td>57</td>
<td>90</td>
<td>1.98</td>
<td>0.98</td>
<td>2.25</td>
</tr>
<tr>
<td>Ordway Center</td>
<td>1985</td>
<td>St. Paul, MN</td>
<td>64</td>
<td>35</td>
<td>1.86</td>
<td>136</td>
<td>43</td>
<td>80</td>
<td>2.13</td>
<td>0.67</td>
<td>2.32</td>
</tr>
<tr>
<td>Overture Hall</td>
<td>2004</td>
<td>Madison, WI</td>
<td>64</td>
<td>45</td>
<td>1.42</td>
<td>104</td>
<td>55</td>
<td>96</td>
<td>1.63</td>
<td>0.86</td>
<td>2.13</td>
</tr>
</tbody>
</table>

Table 9.7 School Halls
For orchestral performances, the acoustician will want the proscenium opening as high as possible, so that the stage and auditorium respond acoustically as one volume. The other uses will work fine with a proscenium height in the mid-thirties. The variation in proscenium height displayed in the four examples is likely due to the design team balancing the acoustician’s desire for height with other constraints—including budget.

In our examples, the stage widths are generally about twice the proscenium width and the stage depth is about equal to the proscenium width. Grid height is from 2.13 to 2.71 times the proscenium height. Since the proscenium width and height are dictated by symphonic performances, and the actual opening used for other performance types is smaller, we would expect the ratios for this theater building type to be lower than the benchmarks.

### Schools

Proscenium theaters in schools are used for varying purposes, and so their opening sizes vary. The secondary and post-secondary schools in Table 9.7 begin to illustrate this range, although even smaller and larger proscenium openings can be found. Each of these examples responds to particular needs of the school, ranging from a small stage for drama at Westminster School in Simsbury, Connecticut (1990) to the Anne and Ellen Fife Theatre (2013) for touring performances at Virginia Tech.

<table>
<thead>
<tr>
<th>School Venue Use</th>
<th>Year</th>
<th>Location</th>
<th>Opening Width (w)</th>
<th>Opening Height (h)</th>
<th>Opening w/h ratio</th>
<th>Stage Width (W)</th>
<th>Stage Depth (D)</th>
<th>Stage Height (G)</th>
<th>Stage W/w ratio</th>
<th>Stage D/w ratio</th>
<th>Stage G/h ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westminster School Werner Centennial Hall Drama &amp; school assemblies</td>
<td>1990</td>
<td>Simsbury, CT</td>
<td>29</td>
<td>21</td>
<td>1.38</td>
<td>54</td>
<td>36</td>
<td>52</td>
<td>1.86</td>
<td>1.26</td>
<td>2.48</td>
</tr>
<tr>
<td>Vassar College Martel Theater Drama &amp; musical theater</td>
<td>2003</td>
<td>Poughkeepsie, NY</td>
<td>34</td>
<td>20</td>
<td>1.70</td>
<td>61</td>
<td>32</td>
<td>48</td>
<td>1.79</td>
<td>0.94</td>
<td>2.40</td>
</tr>
<tr>
<td>New Mexico State University Medoff Theatre Drama, musical theater, &amp; dance</td>
<td>2013</td>
<td>Las Cruces, NM</td>
<td>38</td>
<td>24</td>
<td>1.58</td>
<td>84</td>
<td>38</td>
<td>60</td>
<td>2.21</td>
<td>0.99</td>
<td>2.50</td>
</tr>
<tr>
<td>Allegheny College Gladys Mullenix Black Theatre Drama</td>
<td>2009</td>
<td>Meadville, PA</td>
<td>40</td>
<td>20</td>
<td>2.00</td>
<td>60</td>
<td>30</td>
<td>42</td>
<td>1.50</td>
<td>0.74</td>
<td>2.08</td>
</tr>
<tr>
<td>Horace Mann School Gross Theatre Dance, drama, musical theater, &amp; school assemblies</td>
<td>2003</td>
<td>New York</td>
<td>46</td>
<td>20</td>
<td>2.30</td>
<td>70</td>
<td>30</td>
<td>48</td>
<td>1.54</td>
<td>0.65</td>
<td>2.42</td>
</tr>
<tr>
<td>University of Maryland Kay Theatre Drama, musical theater, opera, dance, &amp; music</td>
<td>2001</td>
<td>College Park, MD</td>
<td>49</td>
<td>27</td>
<td>1.81</td>
<td>99</td>
<td>38</td>
<td>62</td>
<td>2.02</td>
<td>0.77</td>
<td>2.31</td>
</tr>
<tr>
<td>Virginia Polytechnic Institute and State University Anne and Ellen Fife Theatre Dance, drama, film, symphonic &amp; world music</td>
<td>2013</td>
<td>Blacksburg, VA</td>
<td>58</td>
<td>36</td>
<td>1.61</td>
<td>100</td>
<td>46</td>
<td>79</td>
<td>1.72</td>
<td>0.80</td>
<td>2.19</td>
</tr>
</tbody>
</table>
Chapter 10
Forestage Zone

The forestage is the three-dimensional zone where a proscenium stage and auditorium meet. The forestage geometry may be static or flexible, but it is always a transition zone between performance space and audience space. Very often the forestage has movable parts to create an extension of the stage apron, additional audience seating, or orchestra pits of differing sizes. It may be heavily equipped with rigging, lighting, and audio technology to allow the extension of the production design into the auditorium.

This chapter examines the typical elements and design considerations of the forestage zone, but keep in mind that it’s a rare theater space that incorporates all of the elements described here. We’ll start at stage level, move below the stage to the lowest level of the building, then work our way back up to the roof above.

Apron

The apron is the area of the stage between the house curtain and the stage riser or orchestra pit. It should be deep enough for the performance of entr’actes—short scenes performed in front of the closed curtain—but not deeper than necessary. Our objective always is to keep the first row as close as possible to the plaster or setting line, where the full production capacity of the stagehouse is available.
Apron Entrances

The apron may have entrances on each side from vestibules on the auditorium side of the proscenium wall. (If these aren’t provided, the performers enter the apron from the center split in the house curtain.) The area above these entrances is often used for stage lighting, video monitors for the performers onstage, and other production equipment. If the side loudspeaker clusters aren’t “flown,” then the entrances themselves may be filled with loudspeakers stacked at each side of the apron.

Adjustable Proscenium Opening

If the proscenium width is to be adjustable, this may be accomplished with framed, architecturally finished panels on the apron side of the proscenium wall. These “tormenter” panels are hung on barn door tracks and may also have a guide track in the apron floor. A matching header panel may be used to adjust the height of the opening. All panels are kept to a minimum thickness so as not to increase the distance between the first row and the stage. If the production calls for it, the stage opening may be
further reduced by a scenic portal or draperies on the stage side of the proscenium wall.

Apron Edge

The front of the apron is defined by the orchestra pit opening, or by the stage riser if there is no orchestra pit. At one time, built-in footlights were a common feature of the apron edge, but electric footlights were actually a holdover from the pre-electric age and are rarely used today. (The British term *floats* refers both to footlights and to the apron edge where footlights were once common. It derives from the use of floating candles as light sources.)

Cable Trough

The footlights are gone, but a continuous trough with removable covers is often built into the apron edge. The trough is used to access power and control outlets below the apron edge and to route temporary cabling across the front of the apron.

Front Fill Loudspeakers

The audio designer may specify small loudspeakers built into the apron edge, spaced every four to eight feet or so. These loudspeakers cover the first few rows of seats, an area that the primary speakers overhead may not reach. The front fill speakers also provide localization—that is, they enhance the perception that the sound is coming from the apparent visual source on stage and not from speakers overhead.

Apron Edge Marking

Stage edge markings have been included in recently built theaters as a fall prevention measure. The markings may be tactile or visual, and visual markings might include reflective or luminescent strips or LED lamps positioned so they are (mostly) only visible to the performers. Curbs may be added to prevent wheeled equipment from falling off the stage edge. Yes, this does happen—before his career as a lighting designer, in his first gig as a stage manager, Gilbert Hemsley rolled a concert grand piano into the orchestra pit. If there is an orchestra pit, a netting over the pit is another possible safety measure. A properly designed netting can catch a falling person or a thrown object, but would not have saved the grand piano.

Multiple Apron Edges

If the forestage zone is reconfigurable as described below, the apron may have multiple front edges, and
the features described above may be repeated at each edge. Expensive items, such as front fill loudspeakers, may be designed to be repositioned. Certain features, such as a curb at the apron edge, are not workable if there are multiple apron edges.

**Access from Auditorium**

Movement between the auditorium and stage may *not* be desired in some venues, and the apron will be designed with no direct access from the auditorium. In other venues—a school auditorium, for example—direct access to the stage may be a requirement. When a direct circulation path is provided, the ADA requires a direct accessible route that coincides with or is close to the circulation path. A common solution is to extend the stage apron around the sides of the auditorium to form a level or ramped area at each side of the center seating. These side areas can be developed as boxes or parterres providing wheelchair seating locations with direct access to the stage. The level or ramped areas can extend to a crossoisle, giving access to additional wheelchair seating locations at the center of the orchestra floor. In the latter case, the side areas can be used as caliper stages.

An alternative often seen in existing theaters is to provide steps from the front of the auditorium up to the stage apron. This situation doesn’t satisfy the ADA requirements, unless a wheelchair lift is provided adjacent to each set of steps, and that will not please anyone. For this reason, most theaters built today do not have steps up to the stage apron. One does often see portable steps between the auditorium and stage, sometimes combined with a temporary walkway over the orchestra pit. These are usually placed by the theater operator as a convenience for the cast and crew during rehearsal and work calls. They should be removed for performances and other public events. Unless an adjacent wheelchair lift is provided, these step units are technically in violation of the ADA. However, unlike the architect, an onsite operator is in position to hear and respond to any concerns.

*Pass Door*

Whether stage access is provided within the auditorium or not, all theaters need a pass door providing wheelchair-accessible, non-public access between the backstage and front-of-house. This is usually provided in the forestage zone, but immediately off stage and out of public view. If possible, pass doors should be provided on both sides of the forestage.

*Orchestra Pit*

Early orchestra pits were placed between the apron edge and the first row of audience seating and were completely open to the auditorium volume. Most pits today extend below the apron edge, so that part of the pit is open to the auditorium and part is covered by the apron floor above. The pit configuration is determined by the nature of the performance and by requirements for sightlines, hearing, and
Pit Size

Pit size is largely determined by the largest number of musicians needed for the planned programming. A general rule of thumb is to provide 16 to 18 NSF of floor area per musician. For small ensembles, the unit area may be increased to 20 NSF. In all cases, the pit size and shape should be tested with draft layouts of the expected ensemble sizes.

Broadway

Productions in New York’s Broadway theaters employ no more than 20 musicians, and usually fewer. However, each musician may play multiple instruments, including drum sets, synthesizers, samplers, and associated racks of electronics, so each musician needs more space. Musicals produced by regional companies, schools, and colleges will have more musicians in the pit, usually 25 to 30. A pit with an area of 450 to 500 square feet will work for smaller ensembles with greater space needs and will also accommodate conventional ensembles of up to 30.

Opera

For operas composed in the classical period or later, pit orchestras vary from about 40 to 100 seats. For our purposes, we can group opera pits into three sizes:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mozart</td>
<td>40–45 Seats</td>
</tr>
<tr>
<td>Verdi</td>
<td>60–65 Seats</td>
</tr>
<tr>
<td>Wagner</td>
<td>90–100 Seats</td>
</tr>
</tbody>
</table>

Some quick arithmetic indicates the desired pit size can vary from 600 to 1,800 square feet, depending on the opera. And these are not small spaces—a Wagner-sized pit is as big as a small flexible theater. If the venue also hosts touring Broadway productions, the pit size can vary by a factor of four, from 450 to 1,800 square feet. For this reason, most multipurpose theaters and opera houses use platforms or lifts to adjust the pit size, as discussed further below.

Baroque Opera

The revival of interest in Baroque opera has highlighted the distinct needs of early opera orchestras. Ensembles are not large, the instruments are quieter than modern versions, and the instrumentalists and singers have a greater need to see and hear each other. Therefore, the preferred pit for Baroque opera is shallower and completely open—not surprisingly, quite like the earliest orchestra pits. If enough
Design Considerations

Access

Orchestra pits must be usable by musicians in wheelchairs. Some older theaters have shallow pits accessed via steps from the auditorium, but it takes great finesse to make this arrangement both attractive and code-compliant. The preferred point of entry and exit is below the apron. Here, if a platform lift is needed, it can be outside of the auditorium and stage. Pits with an occupancy of 50 or more require two exits, and these are usually located at the two ends of the pit below the apron. One of these doors might be double-leafed, to facilitate movement of large instruments.

The pit should extend at least five feet upstage of the apron edge, to accommodate the exit doors and provide maneuvering room for wheelchair users.

Figure 10.2 Orchestra Pit Geometry and Sightlines
Source: Author
**Covered Versus Open Area**

The covered pit area can extend up to 16 feet beyond the apron edge, but it’s usually no more than eight feet deep. In theory, the open portion of the pit can extend as far into the auditorium as needed. Acoustician Mark Holden suggests that 75 to 80 percent of the pit area should be open, though of course this figure will vary if the size of the open portion is adjustable. Maximizing the open area will reduce the musicians’ noise exposure (see sidebar), but will make balance between the singers and orchestra more difficult. Of course, it’s imperative to keep the first row of audience close to the performance on stage, not separated by an overly large pit. The pit should be as wide as the geometry of the auditorium allows, so that its depth can be kept to a minimum.

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**Musician Noise Exposure**

Pit musicians are exposed to high noise levels and potential associated health risks. (By “noise” we mean unwanted sound—even music can be “noise” if the sound pressure level is too high, all aesthetic judgments aside.) Exposure varies with venue, repertoire, the instrument played, and the duration and frequency of rehearsals or performances. Time-weighted exposure levels are developed using a stipulated exchange rate—for each doubling of the duration of exposure, the sound pressure level is increased by the exchange rate. An exchange rate of three decibels (dB) is used internationally and is now recommended by the US National Institute of Occupational Safety and Health (NIOSH), but OSHA’s regulations are based on an earlier five dB exchange rate. OSHA stipulates a permissible exposure level (PEL) of 90 A-weighted decibels (dBA) and requires employers to operate a “hearing conservation program” at exposures of 85 dBA or more. The European Union Noise at Work Directive 2003/10/EC requires risk assessment and employee training at 80 dBA, more active measures at 85 dBA, and stipulates a PEL of 87 dBA. Multiple studies have found that musicians are exposed to levels of 80 dBA or higher—a 2004 study of Canadian Opera Company musicians found an average exposure level of 80 dBA, ranging from the trumpet at 84 dBA to the conductor at 74 dBA. Noise reduction has become a more prominent concern as the EU directive has been implemented in member nations.

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**Sightlines and Floor Elevations**

Sightline requirements will affect the pit geometry and, for very small ensembles, may determine the pit size. The audience must be able to see the stage over the heads of the orchestra members. For opera, it is highly desirable that the audience sees the conductor. The conductor must see the stage floor, the dancers’ footfalls, and the singers’ faces. The singers must see the conductor.

Combined with the requirements for pit access above, the sightline constraints place the floor of the orchestra pit eight to nine feet below the stage floor, and require that the conductor stand on a two to
three-foot high podium. An eight-foot floor-to-floor dimension is possible, if the apron floor slab is kept as thin as possible and the minimum code-required head height is provided in the covered portion of the pit. Maintaining the required head height also requires careful coordination of the elements mounted to the underside of the apron slab: sprinklers, lighting fixtures, acoustic absorption, electrical outlets, and probably a video camera focused on the conductor.

The conductor and the instrumentalists must also have line of sight to each other, and each musician’s angle of view to the conductor’s baton and face must not be too steep. One solution to the latter issue is to seat the musicians closest to the conductor on podiums. The next row may be seated on lower podiums, and so on, resulting in a reverse slope within the pit.

Why not set the fixed pit floor lower and build up as needed with adjustable height platforms to provide more flexibility? This is done in some venues, but the difficulty with this approach is maintaining the required wheelchair accessibility.

**Production Video**

Production video is often used in addition to direct line of sight between the conductor and the stage. Images of the conductor are displayed on video monitors above the forestage entrances, as mentioned earlier, as an aid to the performers on stage. The conductor will have a monitor displaying the action on stage, and the images of the conductor and stage action will be distributed throughout the production areas as needed.

Recently, some Broadway producers have moved the orchestra out of the pit entirely. For example, the 18-member “pit” orchestra for *Spider Man: Turn Off the Dark* performed from two rooms in the basement of the Foxwoods (now Lyric) Theatre. Of course, if the conductor and orchestra are located remotely, they and the singers must rely entirely on the audio and video feeds for communication.

**Pit Cover**

For venues with pits, the simplest way to add a measure of flexibility is a pit cover—that is, a demountable platform system that fills the open pit area when it is not needed. The platform can have adjustable or changeable supports, so that the pit floor can be raised to auditorium floor level for additional seating or to stage level to provide an extended apron. Sled-based auditorium chairs or ganged, portable chairs are used for audience seating on the pit cover. The platform system can also be designed to create a smaller orchestra pit or apron extension, with the remaining portion of the pit converted to audience seating. Each configuration will have vertical openings which must be protected by demountable railings or fascias. The advantage of a pit cover is that it provides flexibility at a low initial cost. The disadvantages are the time and labor required to change the pit configuration, the
possibility of injury when changing the configuration, and the need to store system components that are not being used.

Pit Lifts

The mechanized pit lift is another method of adjusting the floor level of the open pit area. A pit lift has a much higher initial cost, but its lower operating cost and greater flexibility make it the preferred method. It consists of a guided, steel-framed lift table supported by lifting columns within a partially open hoistway. In a simple arrangement, the lift table has stops matching the covered pit level (for use as an orchestra pit), the auditorium floor level (for additional seating), and the stage level (for an extended apron).

The lift table can be set at any intermediate elevation, so it can be used to adjust the floor level of the orchestra pit—for example, to create a shallow pit for Baroque opera. Of course, this creates an elevation change between the open and closed portions of the pit and limits accessibility for musicians using wheelchairs.

If more than one lift is provided, the lift tables can be adjusted individually to alter the size of the orchestra pit or apron extension. Or the lifts can be used to create a stepped floor within a larger pit. Many variations are possible. If the project can only afford one lift, the lift can be sized for the smaller pit and a platform system used for the larger pit, on the assumption the larger pit will be used less frequently. A flexible arrangement with multiple pit sizes and a single lift is also possible, as shown in Figure 10.3 and discussed further below.
Lifting Mechanisms

The mechanism that moves the lift table takes up space, requiring a machinery pit about five feet below the lowest usable stop. In older theaters, the lifting columns are probably screw jacks or hydraulic cylinders which extend from caissons sunk below the machinery pit. Most recent installations use either of two clever technologies that do not require caissons. One is a steel chain that forms a rigid lifting column. The other is called a helical band actuator—picture a Slinky combined with a watch spring to form a spiraling I-beam into a column.

Guide Columns

The lift table is stabilized laterally by shoes riding in vertical guide columns. Most lifts require two guides, and their position is dependent upon the shape of the lift table. The shoes are often bracketed down from the lift table, so that the guide columns (mostly) remain out of audience sight.
Service Access

When the lift table becomes disabled at one of its higher stops, the lifting mechanism is accessible from the levels below. This isn’t true if the lift table is disabled at its lowest stop, so a service access hatch is provided outside of the lift table footprint (preferred) or within the lift table itself.

Material Transport

Most pit lifts are not intended to transport people, but they are handy for moving scenery and equipment between the stage and traproom levels. The traproom is almost always lower than pit level, so this use requires an additional stop and a lower machinery pit. Since the pit floor below the apron sits between the lift table and traproom, a portion of this floor must be removable to create a passage. When not in use, this passage is covered over with a removable platform. This arrangement is shown in Figures 10.1 and 10.3.

Seating Wagons

If the lift table will frequently be used for audience seating, then seating wagons are attractive timesavers. A seating wagon (or chair wagon) is a framed, rolling platform on which auditorium chairs are permanently mounted. The wagon is stored on a “shelf” below the fixed audience seating or stage apron. To deploy the seating wagon, the empty lift table is lowered to the storage shelf. The wagon is rolled onto the lift, aisle lights are connected, and the wagon is locked in place. Finally, the lift table is raised to auditorium level. The process is reversed to store the wagon. A small lift may hold a single wagon, but more often the lift area is divided into two or three seating wagons.

High Wagons

Orchestra pits of differing sizes can also be created with high wagons on a single lift, as shown in Figure 10.3. The wagons are designed to match the auditorium level when the lift table is at the orchestra pit stop. This approach saves the cost of multiple lifts, but it provides only one size for the extended apron, as shown in Figure 10.3e.

In many theaters, the very largest pit size—suitable for operas by Wagner or Strauss—is infrequently used. One way to accommodate the few productions that will use a pit of this size is to create a fixed pit extension on the downstage side of the open pit. The auditorium floor over this extension is built up with platforms or seating wagons that can be removed on the occasions when a very large pit is needed.

Air Supply
The “high wagon” approach described above is especially attractive when combined with displacement ventilation in the auditorium. Displacement systems supply fresh temperate air at low velocity through grilles located below the auditorium chairs. The stale air is extracted high in the auditorium. In this approach, the seating wagons function as plenums: they’re fed by ducts from the main plenum below the fixed seating, and they supply air to the patrons seated on the wagons. When the wagons aren’t deployed, the supply air can be diverted to service the orchestra pit through perforations in the lift table.

In a conventional system, cool air is supplied high in the auditorium and extracted low in the room. The patrons on the chair wagons do not require special provisions. Return air grilles in the orchestra pit draw air from the auditorium. Unfortunately, the air reaches the musicians at its stalest. The return grilles in the pit also cause low-lying fog effects to roll off the stage apron into the orchestra pit—this is perhaps good for the audience, but not for the musicians!

Protecting Openings and Edges

For the lift to serve its function, most of its hoistway must be open—that is, not enclosed by walls. This creates multiple vertical openings and edge conditions that must be protected. (For the sake of clarity, the illustrations in this chapter do not show the demountable railings that protect these openings.)

Stage Riser

Vertical openings are protected by fixed railings where possible. For example, the stage riser is Figure 10.3a is formed by fixed railings on the seating wagons, and the stage riser in Figure 10.3e is formed by a fixed fascia panel on the pit lift.

Orchestra Pit Rail

The orchestra pit is separated from the audience by a railing, typically 30 to 36 inches high so that it does not block sightlines and sound. If the pit size is fixed, the railing can be, too—perhaps with removable gates to allow access to seating on the orchestra pit cover. If the pit is adjustable in size, the railing is demountable so it can be placed at the first row—whichever row that is. This railing is a complex design challenge. It must function as a guard to protect audience members from falls. The acoustician may require specific acoustic properties. The sound designer may need front fill loudspeakers built into the railing. The architect will be concerned about the appearance and structural soundness of the railing, while the theater planner will insist it be not-too-heavy to lift and not-too-difficult to move!

Guards at Pit and Wagon Storage Levels

The openings at the orchestra pit and wagon storage levels are protected by utilitarian demountable rails,
sometimes with chain or cargo netting instead of horizontal rails. All shear conditions, where the lift table passes an exposed floor slab, are protected by astragal safety switches. The lift controls incorporate interlocks so that the lift cannot be moved unless the protections described above are in place.

**The “Throat”**

Let’s return to the stage apron and look at the side walls, shown in Figure 10.1. Earlier we noted the forestage entrance, the side lighting position above the entrance, and the seating box at stage level.

**Audience Seating**

Perhaps there are several seating boxes, stacked vertically as in our figure or stepping down from the balcony (or balconies) to the stage. The boxes provide order and scale to the side wall of the auditorium, and place audience members where other patrons can see them. We’ll discuss this more in later chapters, but we note here that seating is one of several functions of the side walls.

**Side Lighting**

Side lighting positions in the auditorium are called “box booms” because, when electric spotlights were first used, they were mounted on vertical poles (booms) placed in the seating boxes. In new facilities, side lighting positions are better integrated and don’t displace audience seating. Often, however, the top level of boxes is not intended for seating but is a technical area.

Rarely is an effort made to conceal the spotlights—or the loudspeakers, infrared transmitters, video monitors, scenic projectors, and other gear that is part of a production. It’s impossible to predict the great variety and quantity of equipment that a production team will bring into the auditorium, and any preemptive attempt at concealment is doomed to failure. Instead, the design team focuses on well-designed accommodation for the production gear, ensuring that the accommodation itself is integrated and unobtrusive.

In addition to the near box boom above the forestage entrance, the stage lighting designer will need side lighting positions further into the house. If side wall geometry won’t accommodate a second vertical far box boom, then each seating box or gallery will incorporate a horizontal spotlight rail.

**Reflective Surfaces**

The acoustician will be concerned with the position and shape of the side walls and the size and treatment of the openings in these walls. Near-parallel, solid walls at the front of the auditorium are
preferred for early acoustic reflections to the center of the main floor seating. The underside of box and gallery floors can also provide useful reflections. Splayed side walls kick sound to the back of the house where it’s buried and doesn’t contribute to the overall room acoustic.

If acoustic music is an important use, the acoustician may argue for large reflective areas of side wall that are uninterrupted by boxes, galleries, or other encumbrances. These open areas promote the multiple reflections between the side walls which develop the reverberant room acoustic. The theater designer will likely prefer audience seating over blank wall, for reasons we’ll discuss in Chapter 14. This is an area where the acoustician and theater designer must balance their respective objectives.

Acoustically reflective surfaces are also needed above the forestage. These could be reflectors hung within the auditorium volume, a hard ceiling of appropriate shape and height, or a utilitarian reflector that is concealed above a perforated metal or other type of sound-transparent ceiling.

**Forestage Rigging**

Many theaters have some form of forestage rigging to suspend loudspeakers, lighting trusses, or scenery downstage of the proscenium wall. In rooms for music, the acoustic reflectors over the forestage may be hung on rigging so that their elevation and angle can be adjusted.

Rigging accommodation over the forestage may be as simple as structural “strong points” designed for attaching chain motors, or as elaborate as a forestage grid. The latter is a walkable, structural steel floor similar to the gridiron above the stage. The forestage grid supports fixed winches for acoustic reflectors, loudspeaker clusters, and similar permanent loads. And it accommodates chain motors or winches for temporary production loads. Multiconductor electric cables may be dropped from the forestage grid to lighting trusses suspended below.

The rigging lines and electric cables must pass through any acoustic reflector or ceiling plane below. If possible, open slots in these surfaces are aligned with the spacing of the forestage grid wells. If slots are not possible, a pattern of holes is created, with each hole accommodating a winch line, chain motor hook, or electric cable.

In some facilities, the loudspeaker clusters can be stored above the ceiling, out of the audience view. This requires an opening in the ceiling and/or acoustic reflector above the forestage, and these openings may have motorized doors. At Overture Hall, this opening in the perforated metal ceiling is closed with a hinged panel, and the opening in the acoustic reflector above the ceiling is closed with a heavy panel that slides horizontally like a car sunroof.
Chapter 11
Other Stage Forms

Thrust, arena, and open stages sit within the audience chamber and are not separated by a proscenium wall. They are primarily, but not exclusively, used for drama. Many of the considerations outlined in the previous two chapters will also apply to these stage forms. Here, we’ll discuss design considerations unique to these types of stages. We’ll also discuss the design of recital hall and concert hall platforms, which also sit within the audience chamber. And finally, we’ll examine the approaches to adapting proscenium theaters to serve as concert halls.

Other Stage Forms

Thrust Stage

A thrust stage extends into the auditorium and is surrounded by audience on three sides.

Degree of Encirclement

The distance the stage extends and the degree to which it’s encircled by audience members vary. The examples in Figure 11.1 are ordered from most to least degrees of surround: a performer standing “down center” in the Chicago Shakespeare Theatre is surrounded by 280 degrees of audience, while at the Overture Center Playhouse a performer is surrounded by 235 degrees of audience.
Shape and Size

Thrust stages come in a variety of shapes—rounded, square, chamfered, polygonal, or irregular. Width can vary from about 16 to about 32 feet, but most thrust stages are between 20 and 24 feet wide. The depth of the stage varies from a little less than the width to about one and a half times the width. Large scenic pieces on a thrust will block audience sightlines, so the floor itself becomes an important scenic element. Scenic designers will often change the size, shape, and height of the thrust to suit a particular performance.

Entrances

A thrust stage is often backed by a proscenium stage, even though the majority of the performance takes
place on the thrust where the full audience can see. The proscenium opening allows movement of people and props onto the thrust, and serves as a scenic background. Since it plays a secondary role, the proscenium stage may be less deep and less well equipped than if it were the primary performance area.

Performers also enter and exit from the downstage edge of the thrust, usually at the two front “corners.” Props and furniture may also be brought onto the stage from these corners. The designer has a few choices in configuring these entrances: The performers can enter down an aisle stair which also serves as access for the audience. This is the simplest approach and is often used. It’s obviously an overlapping of the dramatic space and audience space, but this is not usually seen as problematic.

A second choice is to have the performers enter from a passage cut through the seating bank—a sort of vomitory (or “vom” for short). If the audience enters at the top of the seating bank, it’s possible to separate audience and performer circulation. Or, the audience and performers can share the voms. These passages must be level or a shallow slope (stairs aren’t acceptable) and they must be high and wide enough for costumed performers to enter carrying hand props. These constraints likely mean that the voms will cut through most (if not all) of the rows of seats, creating gaps in the seating plan. See the Ruth Caplin Theatre in Figure 1.3 for an example of a thrust with voms.

Open Stage

An open stage (also called an apron stage) is a different sort of thrust. It doesn’t extend as far into the auditorium and is more likely to be wider than it is deep. As a result, audience encirclement is usually less than 180 degrees. The examples in Figure 11.2 vary from 160 to 130 degrees. There is almost always a stagehouse, and a larger portion of the audience has a good view into the proscenium opening, so the scenic designers can take more advantage of the possibilities offered by an enclosed stage.

In other respects, an open stage is very like the thrust stages discussed above. The scenic designers will treat the floor as an important production element, and they may change its shape and the profile of the stage edge as needed. Downstage entrances are perhaps less critical, but still desired. Without them, it can take an actor ten minutes to walk to center stage, or perhaps it just seems that way.

The distinction between thrust and open stage is not commonly made, and the examples in Figure 11.2 are referred to as thrusts or “modified thrusts.” There are no bright lines between a thrust stage, an open stage, and a proscenium stage with a deep apron—they form a sort of continuum. But there are differences in geometry that affect the ways in which actors and audience gather and interact. If a thrust stage is on the program, the project team should be aware of these differences, and that makes the terminology more than academic.

Arena Stage

The arena stage is easily identified as a distinct form because it is completed surrounded by audience. The design considerations for an arena stage, however, are very similar to those discussed above. Like a thrust, an arena stage can be a square, rectangle, circle, oval, polygon, etc. The dimensions are also similar to a thrust. A reasonable minimum width or depth is 16 feet—a smaller dimension becomes unworkable for any but the most intimate of performances. A reasonable maximum width or depth is about 32 feet. Entrances are required at the four corners (quadrants may be a better term) and more than four entrances may be desired.

The Royal Exchange Theatre (1976/1999) in Manchester, England is an amazingly compact seven-sided, three-level arena stage. It has seven voms shared between performers and audience. Figure 11.3a shows the extent of the open floor at the main level, but this includes circulation to the seats. The typical stage footprint is about 26 feet in diameter.
The Fichandler Theatre at Arena Stage is the iconic American arena stage. It’s shown in Figure 11.3b and also in Figures 1.2 and 14.17. It is a large rectangle with stage vomms in the four corners. The public enters from above and is separated from the performance area by a low railing. The stage dimensions in Figure 11.3a are railing to railing.

**Recital and Concert Hall Platforms**

The design of performance platforms in recital and concert halls is determined by ensemble size, the arrangement of the musicians, and acoustical considerations. As noted in Chapter 1, the terms “recital hall” and “concert hall” are usually determined by the ensemble size that can be accommodated, not the number of seats for audience members.
Size and Shape

A good starting point for instrumentalists is to allow 20 to 24 square feet per musician, plus room for circulation. A recital hall platform will typically accommodate chamber groups with up to 30 instrumentalists and will be about 600 to 800 square feet. A concert hall platform for a symphony orchestra will be 2,000 square feet or more.

Choruses require much less space per person. Seated choruses require about 6 to 8 square feet, and standing choruses require about 3 to 4 square feet. In both cases, this figure only accounts for the space occupied by each person, and doesn’t include circulation.

The typical platform shape is an isosceles trapezoid, except that the downstage edge is often curved. See Figures 11.4 and 11.5 for examples. The down stage edge is the longest—about 40 feet for a recital hall platform and 65 feet for a concert hall platform. A recital hall platform is about 20 feet deep, a concert hall platform 40 to 50 feet. There is much variation, and these are not definitive figures. Platform size and shape should be tested with sample ensemble layouts, also ensuring that a circulation path is provided at the front of the platform.


Source: Author
Platform Extensions

The platform may be extended by a lift or platform system for performances by unusually large ensembles or by combined orchestra and chorus. This platform extension is similar to the stage extensions described in the previous chapter. The platform extension at the S. Mark Taper Foundation Auditorium at Benaroya Hall (1998), shown in Figure 11.5a, is used for combined performances of the Seattle Symphony Orchestra and the 120-member Seattle Symphony Chorale.

Entrances and Anterooms

Recital hall platforms typically have an entrance at each side of the platform. Concert hall platforms are likely to have two on each side, and sometimes a door in the rear wall for percussion instruments. At least one entrance must be large enough for a concert grand piano. This is usually downstage right so
that the piano can be wheeled to “down center” with a minimum of disturbance. The alternative is a piano lift, a small stage lift used to bring the piano up from a storage room below the platform. By convention, the conductor and soloists also enter from stage right.

The areas to the sides of the platform serve as sound locks and waiting areas. Lighting and other performance technology may be operated from there. If space allows, these side anterooms will be connected behind the platform. This U-shaped backstage area functions as a crossover and may provide space for the musicians to prepare their instruments and store their cases.

Orchestra Risers

Orchestras vary in their use of risers. Some perform “on the flat” or with just a few risers. At Benaroya Hall, the Seattle Symphony places only the brass, woodwinds, basses, and the back stand of violins on low risers. When they first moved into the Schuster Center (2003), shown in Figure 11.6b, the Dayton Philharmonic experimented with riser configurations and then settled on risers only for the back stand of violins, the basses, and the harp.

Other orchestras use more extensive riser set ups. The Music Center at Strathmore (2005), shown in Figure 11.5b, is home to both the Baltimore Symphony Orchestra and the National Philharmonic Orchestra and Chorale. The hall has a custom-made, three-tier riser system, roughly in the shape of a half ring. The design places slightly more than half of the orchestra above platform level. These risers telescope to store and can be completely removed from the platform when necessary. The Madison Symphony Orchestra plays on a similar set of risers at Overture Hall, shown in Figure 11.6a.

The platform in a few concert halls is composed entirely of stage lifts shaped to form tiers for concentric stands of musicians. The platform at New World Center in Miami Beach, Florida (2011) consists of 10 such lifts. Each lift is adjustable from the auditorium floor level to 5’-8” above floor level. Platform lifts are a great convenience, but they also limit the ability to vary the seating configuration—unless filler platforms are used, and then this takes away much of the convenience.

Choral Risers

Choral risers are more common than orchestra risers and come in a variety of forms. Risers with 18-inch deep tiers allow only standing, while tiers 3 feet or more in depth allow both sitting and standing. A number of manufacturers offer portable versions of both kinds. A concert platform of a given size can accommodate three to four times as many chorus members as instrumentalists, so room for the chorus alone is almost never an issue. For combined performances of orchestra and chorus, the choral risers are placed at the rear of the platform and the orchestra moves downstage. Often in this arrangement, the orchestra footprint is wider and shallower, and use of orchestra risers is abandoned.

Permanent choral seating may be provided at the first seating tier to the rear (and sometimes sides) of
the concert platform. These seats are sold to audience members for non-choral performances, though one conductor objected that he did not want to see young couples canoodling in the chorus seating! Another, less personal, objection to this arrangement is that it places the chorus too far above the platform for good sightlines and blending. One solution is to design the choral seats to be partly fixed and partly removable. The removable seats occupy the rear of the platform and bring the first rows of chorus closer to platform level. This is the approach taken at Strathmore. The first three rows of choral seating are removable, with two fixed rows behind. The removable seating is on chair wagons, and the wagons sit on a lift that travels to a storage level below the platform—all very similar to the audience chair wagons described in the previous chapter. When the chorus wagons are not used, the lift forms the rear of the orchestra risers. If the platform must be completely cleared, the lift is used to transport the telescoping orchestra risers to the storage area below.

**Figure 11.6** Orchestra Accommodation in Proscenium Theaters. (a) Overture Hall, Madison, Wisconsin (2004, 2,100 seats). Architects: Pelli Clarke Pelli Architects, Potter Lawson, and Flad Architects. (b) Mead Theatre, Schuster Center, Dayton, Ohio (2003, 2,160). Architects: Pelli Clarke Pelli Architects and GBBN. (c) Morsani Hall, Straz Center (formerly Tampa Bay Performing Arts Center), Tampa, Florida (1987, 2,370 seats). Architects: ARCOP and Design Arts Group. Seat Counts are for Symphony Performances. Forestage Lifts are Shown in Light Gray

Source: Author
Flexible Concert Halls

Strathmore hosts a variety of other programming in addition to the symphonies. It is a variant known as a flexible concert hall, specifically designed to support uses other than music. The side walls of the platform open completely to facilitate movement of performers and scenery on and off the platform. The backstage space is more generous, and limited performance rigging and lighting is provided. The room acoustics are adjustable to a variety of performance types.

Accommodations for Music in Proscenium Theaters

No matter how well-equipped, a flexible concert hall cannot receive touring Broadway and other highly produced shows. If a community or institution needs a facility for both symphony and touring productions, they will likely build a multipurpose proscenium theater. An orchestra (or smaller ensemble) can be accommodated in a multipurpose theater in a couple of ways. The conventional approach is to place the ensemble behind the proscenium opening, within a demountable orchestra enclosure that simulates the environment of a concert platform. An alternative is to extend the concert platform into the auditorium, to better emulate the “one room” configuration of a concert hall. This has both advantages and repercussions, as we’ll discuss below.

Orchestra Enclosures

A demountable enclosure can range from a pre-engineered stock item to a complicated and expensive custom-designed solution. We’ll discuss three of the most common approaches.

Pre-Engineered

The pre-engineered approach is the least expensive and by far the most prevalent. The enclosure walls are formed by rolling towers clad in stressed-skin panels. Additional hinged panels on each side of the tower extend the wall surface to three times the tower width. These “wings” fold against the tower sides for storage. The ceiling is formed by two to five panels of similar construction. Each ceiling panel is suspended by rigging and tips to a vertical position to store within the stagehouse. All panels are lightweight, typically about 2.5 pounds per square foot. This means they are not good reflectors of low frequency sound, though the stiffness of the stressed-skin construction somewhat compensates for the lack of mass. Even so, each tower and ceiling panel can weigh several tons. If desired, heavier enclosures can be custom-built using the same geometry.

Concert Hall Shaper
Some recent multipurpose halls (including Bass Hall in Fort Worth, Texas) have been built with concert hall shapers—so called apparently because they acoustically “shape” a proscenium theater into a concert hall. A concert hall is a single room occupied by both audience and musicians, who (more or less) experience the same acoustical environment. In a proscenium theater, if the orchestra enclosure is small in volume compared to the auditorium, the stage and auditorium will function as distinct acoustical environments. The concert hall shaper is a massive demountable ceiling that closes off the top portion of the stagehouse, creating a larger acoustic volume on stage. Reflectors hung below the shaper ceiling provide early, high frequency reflections and help the musicians hear on stage. Lower frequency sound propagates within the entire volume below the shaper ceiling, contributing to the overall reverberant sound.

Unitized Enclosure

Other recent multipurpose halls have been built with unitized orchestra enclosures. A unitized enclosure is a monolithic structure that stores at the rear of the stagehouse and is deployed when needed. The enclosure at Overture Hall, shown in Figures 1.11 and 11.6a, is a version of this approach. The main unit serves both as a pipe organ chamber and the rear wall of the enclosure. The side walls of the enclosure hinge out from the main unit like book covers. The ceiling consists of custom “tip and fly” units that function just as the ceilings of pre-engineered enclosures do.

In its furthest downstage position, the main unit encloses 30 feet of depth within the stagehouse. The Madison Symphony Orchestra typically uses this position, but plays onto the forestage lift, which provides 47 feet of total depth. The main unit can also be positioned further upstage and supplemented with rolling towers. This arrangement accommodates the full orchestra and allows audience seating on the forestage—the extra seats may be desirable when a popular soloist performs with the orchestra. When the forestage is used to extend the concert platform, this setting accommodates performances of the combined orchestra and chorus.

Orchestras on the Forestage

The approach to the orchestra platform at Overture Hall is essentially conventional, in that the majority of the ensemble is behind the proscenium opening. The forestage is limited in depth and its use is optional. The other venues shown in Figure 11.6 are better illustrations of the accommodation of the orchestra on the forestage.

In the Mead Theatre at the Schuster Center in Dayton, Ohio, shown in Figure 11.6b, the concert platform straddles the proscenium opening. The theater has two orchestra pit lifts and a third, short-travel lift that extend the concert platform 24 feet into the house. For non-concert events, the third lift holds two rows of auditorium chairs on seating wagons. For concert events, the lift is raised to the stage elevation and the wagons are stored on stage behind the orchestra enclosure.
Figure 11.6c shows the Carol Morsani Hall at the Straz Center for the Performing Arts (1987, formerly the Tampa Bay Performing Arts Center). The stage apron and three orchestra pit lifts comprise a 2,200-square-foot concert platform that extends 36 feet into the auditorium and is 71 feet wide at its front. The proscenium opening can be closed with a massive “concert wall” that completely separates the stage and auditorium.

**Proscenium Opening**

Moving the orchestra forward can decrease proscenium opening size and/or improve the acoustic coupling of the stage and auditorium. As described earlier, the typical orchestra seating plan is wider at the front—about 65 feet wide—and this often determines the proscenium width in a multipurpose room. Similarly, the ceiling over the orchestra is highest at the front. If the orchestra layout is shifted into the auditorium, it crosses the proscenium at a point where its width and height are smaller, allowing a smaller proscenium opening. Alternatively, a large opening can be retained in order to better couple the stage and auditorium volumes.

The proscenium opening at Overture Hall is 69 feet wide by 45 feet high, dimensions driven entirely by the symphony use. At the Mead Theatre, where half the orchestra is within the auditorium, the opening is 56 feet wide by 42 feet high. Of course, at Morsani Hall the proscenium is closed off, making its size irrelevant.

**Equipment Impacts**

If there are fewer musicians within the stagehouse, then the orchestra enclosure can be smaller, and perhaps less expensive. There is also less need for a shaper ceiling to close off the upper stagehouse.

On the opposite side of the ledger, the number of forestage lifts and the size and number of reflectors over the forestage may increase. At the Mead Theatre, the forestage reflectors deploy in three sections from storage slots above the forestage ceiling. At Overture Hall, where the orchestra is still mostly on stage, the single forestage reflector is not adjustable at all.

**Forestage Access**

If the orchestra plays substantially or wholly on the forestage, then forestage entrances are no longer optional, but a necessity. The entrance at stage right must be wide enough for a concert grand piano.

**Seating and Sightlines**

Shifting the orchestra into the auditorium has a substantial effect on seat count and sightlines.
The obvious consideration is the reduction in seating capacity. Morsani Hall is 2,610 seats at full capacity, but 2,370 for concerts. The Mead Theatre seat count drops from 2,325 to 2,160, and Overture Hall drops from 2,255 seats to 2,100 seats. These are all large halls with seat counts determined by the needs of Broadway tours, not the local orchestra. The reduction in seat count is likely a positive for the orchestras.

The effect on sightlines is less obvious and more concerning. The patron seeing the latest Broadway tour needs an unobstructed sightline to the stage floor at the proscenium opening, but the symphony-goer needs a sightline to the conductor—who is 24 feet downstage of the proscenium at the Mead Theatre and 36 feet at Morsani Hall. Sightlines must be designed for the more stringent condition—the symphony performance—and this makes the seating tiers steeper and the room overall higher than it would otherwise be, resulting in a less intimate room.
Chapter 12
Audience Sightlines

The topic of audience sightlines might appear to be straightforward and technical—the audience must be able to see the performance, and we have mathematical formulas and three-dimensional computer models to accomplish this. But sightlines are far from straightforward. They are an important element of auditorium design, yet decisions about sightlines can be highly subjective, even controversial.

It’s therefore good practice, though seldom followed, to agree upon sightline criteria before design begins. The answer to the question “How many patrons will be able to see what portion of the stage or performance area?” colors everything that follows. Many people see the answer as obvious, “Why, all of the audience members must see all of the performance area!” Theater designer Iain Mackintosh calls this the functionalist fallacy—“the product of confusing the criteria of what makes a good theatre through emphasizing the seeing and hearing by the spectator of the performer to the exclusion of everything else, especially the sense of community and of involvement.” Most traditional auditorium forms provide a sense of community, but not “perfect” sightlines. And many auditoriums designed from the functionalist viewpoint provide excellent sightlines, but not the sense of community and engagement that is critical to live performance.

Definitions

A few definitions will be helpful to start.

Sightline

A sightline (or a line-of-sight) is a straight line extending from a viewer’s eye to the object viewed. Sightlines can be obstructed or unobstructed, though obviously an unobstructed sightline is preferred.

Horizontal and Vertical Sightlines

Before three-dimensional computer modeling, the designer’s primary tools were two-dimensional plan and section drawings. These are still much used, and our terminology for sightlines reflects this two-
dimensional approach. Horizontal and vertical sightlines lie on horizontal and vertical planes, respectively. Or put another way, horizontal sightlines are drawn in plan view, and vertical sightlines are drawn in section view.

Theoretical Versus Actual Sightlines

![Figure 12.1 Seated Spectator](source: Author)

When theater designers talk about sightlines, they almost always mean theoretical sightlines. That is, they’re talking about predictive sightlines based on hypothetical average-sized patrons sitting in typical theater chairs, as shown in Figure 12.1. Actual (real world) sightlines will vary, depending on the viewer’s size and posture, and on the size and posture of the patrons around him or her. And all sightlines exist in three dimensions, although we might limit our predictive sightlines to two dimensions for analysis.

**Setting Sightline Criteria**

Reasonable and achievable criteria depend on the performance type and the venue form.

**Horizontal Sightlines**

In a proscenium theater, horizontal sightlines concern the view of the audience into the proscenium opening. Patrons seated at the side of the auditorium often cannot see the near side of the stage, but may
Dance, drama, musicals, and opera performed on a proscenium stage require a good view through the proscenium opening. A basic rule of thumb is to keep horizontal sightlines for most of the audience within a 60-degree cone, as shown in Figure 12.2. A wider angle is allowable for other performance types and venue forms where a view into the stagehouse is less important. Showrooms for headliners and pop music acts can be 120 degrees or even wider. The important dramatic action on an open or thrust stage takes place in front of the proscenium. The audience can encircle this type of stage by 180 degrees or more. Of course, in the arena form there is no stage opening at all, and horizontal sightlines are only constrained by the other patrons.

As discussed in Chapter 9, the size of the proscenium opening is primarily determined by performance type. Some designers arbitrarily increase the proscenium width in order to allow a wider auditorium within the 60-degree cone, but this approach can only work if the performances can be adapted to wider and shallower staging. These designers are not responding to the program, but rather are expecting that the program will adapt to the architecture.

![Horizontal Sightlines](source: Author)
Vertical Sightlines

As indicated in Figure 12.1, extreme vertical sightlines should be kept within 35 degrees above and below horizontal. In general, sightlines closer to horizontal are preferred.

Vertical sightlines can be “upper” or “lower” as illustrated in Figure 12.3. (These are also called “up” and “down” sightlines, but note that it’s possible for upper sightlines to slope down and for lower sightlines to slope up.) Upper sightlines for patrons seated under balconies are constrained by the balcony edge above them, which may limit their view of the top of the proscenium opening. Upper sightlines from high balconies are constrained by the top of the stage opening, which limits the view into the stage picture.

Lower sightlines are limited by railings and the spectators in front of the patron. These sightlines are the ones most easily subject to mathematical analysis. They are defined in terms of a sight point (also called focus point or arrival-point-of-sight). This is the point in space to which a spectator has unobstructed vision. The sight point is often defined as a point on the floor of the stage or performance area, but it could also be a point above the floor—perhaps the assumed elevation of a raised show deck. The theoretical sight point is stipulated—that is, it’s a judgement call. A reasonable sight point for musicals, opera, and ballet is the stage floor at the plaster line. It’s also desirable, but not critical, to see the head and shoulders of the conductor at the front of the orchestra pit. The sight point for a drama space may be at the front edge of the apron, and if a forestage is used, the sight point will be even further downstage.

Clear sightlines to the stage floor are especially important for dance and drama performances. A dancer’s whole body must be visible. Modern dance and drama may involve performers lying, sitting, or crawling on the stage floor.
Vertical Sightline Formulas

There are two methods of calculating vertical sightlines. The constant rise formula determines a linear seating slope and is frequently used in practice. The second formula is called the isacoustic rise formula— isacoustic meaning.

Example: Winspear Opera House, Dallas, Texas

The building program for the Winspear Opera House (2009) included detailed criteria for audience sightlines, which are excerpted and illustrated below. Note that the criteria apply to 90 percent of the seats. One or more criteria may be eased for the remaining ten percent of the seats in order to accommodate the traditional opera house geometry.

“The criteria to be pursued are for 90% of the audience to see:

- The whole proscenium opening
- 75% of the forestage over the upstage orchestra lift
- The head of the conductor in the upstage orchestra pit configuration
- 100% of the sur-title screen
- 12 feet up a backcloth [backdrop] hung 60 feet from the proscenium line
“equal-hearing.” It’s also called the isodomal rise formula, for “equal-seeing.” This formula produces a parabolic seating slope. It’s less often used directly in practice, but it’s important to understand in theory.

Today, the theater designer probably doesn’t employ these formulas directly, but instead uses drafting routines or other computer modeling software that is underpinned by this math.

### Constant Rise Formula

![Figure 12.4 Constant Rise Sightlines](source: Author)

The constant rise formula is given below and illustrated in Figure 12.4. Units are typically inches or millimeters. Solving for riser height ($r$), the formula is:

$$r = c + s \left( \frac{v + c(N - 1)}{h} \right)$$

where

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c$</td>
<td>head clearance (also called the c-value, we’ll discuss head clearance in depth later)</td>
</tr>
<tr>
<td>$s$</td>
<td>row spacing</td>
</tr>
<tr>
<td>$v$</td>
<td>vertical distance from the sight point to the eye point of the viewer in the first row</td>
</tr>
<tr>
<td>$h$</td>
<td>horizontal distance from the sight point to the eye point of the viewer in the first row</td>
</tr>
</tbody>
</table>
N is the total number of rows.

It’s also possible to stipulate the riser height and solve for one of the other variables.

**Variables**

We can understand the effect each variable has on riser height from its position in the formula. If the variables in the numerator are increased, the riser height will increase and the seating slope will be steeper:

- Head clearance (c)
- Number of rows (N)
- Row spacing (s)—that is, more leg room results in a steeper slope
- Vertical distance to first row eye point (v)—if the stage is not raised above the first row, or if it is raised only a little, then the slope will be steeper. Similarly, the higher a balcony, the steeper its slope will be.

Horizontal distance to first row eye point (h) lies in the denominator, so reducing this dimension by moving the sight point closer to the first row results in a steeper seating slope. Similarly, the closer a balcony is to the stage, the steeper its seating slope will be.

**Constant Slope Characteristics**

The constant rise formula results in a linear seating slope with a uniform riser height. Therefore the formula can be easily applied to the layout of a code-compliant seating bank served by a ramped aisle or uniform aisle stair.

The constant rise formula results in parallel sightlines. The formula determines the seating slope that provides an unobstructed sightline from the last row to the stipulated sight point. Moving from the last row toward the stage, each successive row has a somewhat better sightline than the previous row. It follows that it’s necessary to stipulate the total number of rows when using the constant rise formula. It’s also apparent that, in order to provide an acceptable sightline from the last row, a constant slope provides better sightlines to all other rows.

**Isacoustic or Isodomal Rise Formula**

Our seating slope would be lower if the sightline from every row converged on the sight point. This is an isacoustic (or isodomal) slope, first proposed by John Scott Russell in 1838. It’s determined by the isacoustic rise formula illustrated in Figure 12.5 and shown below. Again, units are typically inches or millimeters. Solving for \( r_n \), the height of riser \( n \), the formula is:
For a given set of variables, the isacoustic rise formula results in a shallower seating slope than the constant rise formula. It calculates each riser height individually, to provide converging ("equal") sightlines, and the calculation is iterative, not dependent on the total number of rows. The formula produces a parabolic result that creates a bowl-shaped seating slope.

The mathematically inclined can derive the isacoustic formula by applying the constant rise formula to each successive pair of rows, where \( N \) is two, and \( v \) and \( h \) are the distances from the sight point to the eye point of the forward row.

**Head Clearance**

The head clearance in the sightline formulas relates to the dimension between eye elevation and top of
A head clearance (c-value) of 5 inches provides unobstructed vision over the heads of the patrons immediately in front of the viewer, as illustrated in Figure 12.6a. This condition is called first row vision or every-row vision. Of course, these are theoretical sightlines based on an average sized human body, and there is much variation in the real world. A head clearance of 5 inches is considered good first row vision, while 6 inches is considered excellent, and 4 inches is considered the minimum.

Second Row Vision

At a head clearance value of 2.5 inches, the viewer has unobstructed vision over the heads of the patrons two rows in front, but the patrons immediately in front obstruct the view. This condition, shown in
Second row vision is acceptable if the auditorium chairs are staggered, that is, offset in plan from one row to the next.

Chair Stagger

Figure 12.7 illustrates three approaches to row layout. Figure 12.7a is without stagger. All of the auditorium chairs are the same width and the rows are aligned at the aisles. This approach gives the auditorium a clean and formal look, but requires first row vision and therefore a steeper seating slope. It is more common in continental Europe and Asia.

In the United States it is typical practice to offset the chairs to allow second row vision and a shallower seating slope. Figure 12.7b shows the simplest approach to providing horizontal stagger. As in (a), all of the auditorium chairs are the same width, but each row is offset from the next by one-half chair width. This is the only way to provide stagger when using stacking or folding chairs, and it’s also used for installations of fixed auditorium chairs. The rows can have the same number of chairs, as shown in Figure 12.7b, or one chair can be omitted from every other row. Either case results in a saw tooth aisle edge which some designers find unattractive. This approach also increases the overall width of the auditorium since the saw tooth aisle is wider.

Figure 12.7c illustrates the most common approach to horizontal stagger. As in (a), the row ends are aligned at the aisles, but differing chair widths are used to create a half-chair offset at the middle of the row. Our example shows a straight row with two chair widths, but curved rows are also possible, and more chair widths can be used. (Common chair widths are 19 to 24 inches, in one-inch increments.) The offset is most critical at centerline. The views from the chairs closer to the aisles become increasingly more oblique, and therefore a half chair offset is less critical.
**Center Aisles**

On a side note, Figure 12.7c also illustrates one of the arguments against center aisles. The viewers seated on the aisle have no effective offset from the chair in front of them. Therefore their view to center stage is mostly blocked by the head of the patron in front. Center aisles are only feasible if the seating slope provides first row vision. And even if first row vision is provided, theater designers tend not to like center aisles, because they occupy space that would otherwise be the “best seats in the house.” The production on stage is usually composed to appear best from the center of the auditorium, so why put an aisle there?

The illustration shown in Figure 12.7c provides only a hint of the complexities involved in varying chair widths to provide stagger. Most designers depend on the seating manufacturers to develop workable stagger when the shop drawings are prepared, but the quality of this work is variable. The designer must evaluate the view from each chair and tweak the stagger as necessary.
Unfortunately, some auditoriums are built with second row seating slopes and no horizontal stagger, or with inadequate stagger. These are unfortunate places with substandard sightlines and presumably unhappy patrons.

**Relationship of Stage to First Row**

How do the formulas outlined above apply to the actual design of auditoriums? Our starting point for this discussion is the stage riser and its relationship to the front row.

**Stage Riser**

The stage riser height is the vertical dimension between the stage floor and the auditorium floor at the first row. An outdoor festival stage or a large music venue with standing patrons may have a stage riser height of as much as five feet. In a small theater there may be no stage riser, and in some circumstances—for example a small arena or thrust theater—the first row of seats may be elevated above the stage floor. The stage riser height is related to the $v$ value in the sightline formulas.

Most venues have a stage riser height under 44 inches—the eye point of our typical seated spectator in Figure 12.1—to enable the patrons in the first row to see the stage floor and the performer’s feet. Many stage risers are between 30 and 42 inches high. A lower riser provides a flatter (more horizontal) sightline from the first row to a performer standing at the stage edge, and some think this promotes the connection between performer and spectator. At the extreme, the sightline from the first row to the performer’s face should be no more than 35 degrees above horizontal.

**Distance to First Row**

The connection between performer and audience is also enhanced by a tight horizontal dimension ($h$ value) between the stage riser and the first row. For this reason, a crossaisle should never be placed between the stage and the first row. And if an orchestra pit is provided, it should be convertible to a forestage and/or audience seating when not in use as a pit.

**Effect on Overall Slope**

It might appear that a low stage riser and minimum dimension plan between the stage and first row are always desired. But we know that a low stage riser (higher $v$ value) and a smaller dimension between the stage and first row (lower $h$ value) both have the effect of increasing the seating slope. In fact, the relationship between the first row and the stage has a big effect on the overall seating rake. Therefore the $v$ and $h$ values must be determined with the overall design of the auditorium in mind.
Figure 12.8 provides an illustration. The shallower seating rake shown in the figure provides sightlines to an actor standing on a raised stage near the first row (location A), but the patrons in the first row have a steep angle of vision to the actor’s face—about 30 degrees above horizontal. The same seating rake provides vision to an actor standing “on the flat” but quite far away (location B). This provides shallower sightlines for all rows, but places the audience far from the action on stage. If the actor moves closer to the first row (location C) the patrons in the rear rows will see only the top half of his body. A much steeper rake is needed to provide sightlines to the actor’s feet at this location. This steeper rake creates steeper sightlines for all rows and increases the prominence of the stage floor as a scenic background. This approach can work for an arena or thrust stage, or for a small endstage—any space with relatively few rows. But a theater with more than a few hundred seats or with multiple seating levels would be unworkably high and steep.

Figure 12.8 Effect of $v$ and $h$ Values
Source: Author

Venues Without Balconies

We look next at the seating slopes of performance venues without balconies. These venues might be called “single level” but most have parterres or terraces which could be considered distinct levels. The salient point is that these venues do not have seating levels that overlap—that is, they do not have balconies.

Usually, patrons reach their seats via aisles. The International Building Code (IBC) permits ramped aisles up to a slope of 1:8, and requires aisle stairs for steeper slopes. This discussion assumes that the slope of radial aisles matches the adjoining seating slope. (A radial aisle is one perpendicular to the rows of chairs.) Older theaters exist where this is not the case, and there is a change in elevation where one enters a row. However, a step or ramp at the row end is tricky for patrons to navigate safely, so in most cases it
is best to keep the seating slope and aisles aligned. An alternative to aisles is continental seating. We’ll discuss ramped aisles, aisle stairs, and continental seating in turn.

Ramped Aisles

*Constant Rise*

Some auditoriums with ramped aisles are designed with a single 1:12 slope (about five degrees) in the mistaken belief that a 1:12 aisle is wheelchair accessible. An aisle with a 1:12 slope cannot be part of an accessible route, because it cannot function as an aisle and comply with the requirements for landings and continuous handrails. Considerations of accessibility aside, a constant 1:12 slope is not a good idea because no one can see properly.

Similarly, some auditoriums are designed with a constant 1:8 slope (about seven degrees), the maximum slope allowed for a ramped aisle. This slope can work satisfactorily, if there are relatively few rows. Figure 12.9b shows a section view of the Forbes Center Recital Hall (2010) with a 1:8 slope in the front of the auditorium.

*Isacoustic Rise*

A better solution for a shallow auditorium is a segmented slope. This is an approximation of an isacoustic rise composed of a sequence of straight line segments—from flat at the stage riser up to a 1:8 slope. The “breaks” between the segments are aligned with the row spacing, and between one and four rows sit on each segment. A segmented slope provides better sightlines than a constant slope over the same elevation. This approach can be used for a small auditorium, and it was common in movie theaters before stadium seating became popular. Often, the front rows of a larger auditorium sit on a segmented slope, before a transition is made to stepped risers. Stage42 in New York (2002) shown in Figure 12.9f is an example. Most of the venues shown in Figures 12.13 and 12.14 also illustrate this approach.

Aisle Stairs

*Constant Rise*

Aisle stairs are required when the slope exceeds 1:8. The minimum riser height for an aisle stair is four inches, and the minimum tread depth is 11 inches. A stepped aisle can be as shallow as 1:9 (about six degrees) with, say, a four-inch riser and a 36-inch tread. Or the slope can be quite steep. In best practice riser heights are no more than seven inches, but the IBC allows up to eight-inch risers for radial aisles and up to nine-inch risers where required to maintain sightlines. The upper terrace of Auditorio Kursaal
in San Sebastian (1999) shown in Figure 12.9g has a slope of 29 degrees, with a 50mm (191/2-inch) rise between rows and a 90mm (351/2-inch) row spacing. Kilbourn Recital Hall at Eastman School of Music shown in Figure 12.9d, built in 1922 under earlier codes, has an upper slope of 34 degrees. The rise between rows is 213/8 inches and the row spacing is 32 inches. Under current codes, a practical upper limit for radial aisles is 21 inches of rise between rows—three risers at 7 inches. With a row spacing of 36 inches (three treads at 12 inches) this creates a slope of about 30 degrees, as illustrated by the Ruth Caplin Theatre at University of Virginia shown in Figure 12.9e.

A drama endstage might have a shallow, stepped floor with a single riser per row. Endstages for dance, and arena and thrust stages, typically have steeper slopes. Figure 12.9a shows the Clarice Smith Center
Dance Theatre with a maximum downward sightline of 19 degrees. Figure 12.9c shows the Fichandler Theatre at Arena Stage with a 21-degree downward sightline. And Figure 12.9e shows the Ruth Caplin Theatre with a downward view angle of 27 degrees. Plans of all three of these examples can be found in Chapter 1. Note that none of them has a stage riser.

**Isacoustic Rise**

Because of the varying riser heights, a “pure” isacoustic rise results in aisle stairs with non-uniform rise and run. Some codes allow a small increment in height from one riser to the next, to allow an approximate isacoustic rise, but this approach is not commonly used in theaters. Research over the past few decades has underscored the importance of uniform risers and treads to the safe use of stairs, especially in an auditorium where the lighting and crowd conditions may not allow a clear view of the stair nosings.

An isacoustic rise can be approximated by a series of connected aisle stairs of increasing slope. One method is to maintain a uniform riser height but to vary the number of risers per row—from a single riser per row, then two risers per row, and finally three risers per row. In best practice, the rise or run is changed only at a landing, parterre rail, crossaisle, or similar transition device. Figure 12.9 provides three examples of this approach: (d) Kilbourn Hall, (f) Stage42, and (g) Auditorio Kursaal. We’ll discuss these transition devices in more detail shortly.

**Continental Seating**

Continental seating is another way to accommodate a steep isacoustic rise. It is distinguished by long, generously spaced rows of chairs that span the width of the auditorium without intervening aisles. The name “continental” comes from continental Europe, where this seating style is still common. Until the late 1980s, the US building codes included detailed requirements for continental seating. The rows were entered at each end from side circulation corridors flanking the auditorium. Every three to five rows were served by a set of doors. Stairs or ramps in the side circulation corridor served each door, and a short aisle stair within the auditorium served the rows at each door. Since there was a separate stair for every few rows and the stairs were not connected, riser heights could be adjusted to approximate a steep isacoustic rake.

A major problem with continental seating, of course, is the need to pass many other patrons to get to or from one’s seat. The absence of circulation within the auditorium also limits audience movement and socializing, and the generous row spacing weakens audience cohesion. When the means of egress codes were updated in the late 1980s, the separate requirements for continental seating were eliminated, and today few auditoriums in the United States use continental seating.

The new egress codes allow a more flexible version of continental seating, with long rows served by aisles at each end. This form of circulation is often used in steeper balconies, as discussed further below.
Transition Devices

Crossaisles, parterres, and terraces can all be used to mark a transition in seating slope or to separate slopes.

Crossaisles

A crossaisle is a walkway that cuts laterally across the auditorium. Crossaisles are sometimes part of the egress path, and they are often used to provide an accessible route to wheelchair seating locations near the centerline of the auditorium. But they are also helpful devices for transitioning the seating slope, with a shallower slope forward of the crossaisle and a steeper slope behind. In addition to Stage42 and Auditorio Kursaal, shown in Figure 12.9, several of the examples in Chapter 1 and elsewhere in this chapter use crossaisles as a slope transition.

A crossaisle may slope in the direction of travel, but in the direction perpendicular to travel it must be flat or have no more than a 1:50 cross slope. The first row behind the crossaisle must be raised or sightlines will be blocked by the rows forward of the crossaisle. See Figure 12.10 for an illustration. The constant rise formula can be used to determine the required rise. Here $N$ equals two, and the $v$ and $h$ parameters are the distances from the sight point on stage to the eye point in the last row forward of the crossaisle. The $s$ parameter is the distance from this row to the first row behind the crossaisle. Unfortunately, it is very easy to find examples of auditoriums with no rise behind the crossaisle—through either ignorance or carelessness on the part of the designer.

![Crossaisle Sightlines](Figure 12.10 Crossaisle Sightlines)
Parterres

A parterre is a slightly raised seating area to the rear or sides of the main level that is separated from the main level by a knee wall called a parterre rail. A parterre provides some breakup or differentiation of the main seating level and it provides an opportunity to improve sightlines from the sides and rear of the main seating level. The Forbes Center Recital Hall has both a crossaisle (which provides access to wheelchair locations at the center of the room) and a parterre (which provides elevated sightlines above the heads of the patrons in wheelchairs). Many of the other venues illustrated in Chapter 1 and in this chapter also have parterres. Whether combined with a crossaisle or not, the parterre rail provides a transition marker for a change in aisle slope.

Terraces

A terrace is similar to a parterre in that it provides a distinct seating area with improved sightlines and it doesn’t overhang the seating below. Unlike a parterre, a terrace is usually not accessed from the seating level below—in this respect, it is similar to a balcony. The rear seating slope at Auditorio Kursaal is an example of a terrace. The Helzberg Concert Hall at the Kauffman Center for the Performing Arts (Figures 1.8 and 14.19) also provides an example of terraced seating.

Balconies

A balcony is a raised seating area that overhangs the seating below. Unlike a parterre or terrace, a balcony is designed to bring audience members closer to the stage, trading steeper vertical sightlines in exchange for proximity. Some balconies are accessed from the main seating level via stairs within the auditorium volume, but most are accessed from outside the auditorium via the front-of-house circulation.

In segregation era United States, it wasn’t unusual for a theater balcony to have a completely separate entrance, box office, and toilet facilities for African American patrons. And some European venues were similarly segregated by class. Discrimination is undeniably part of the history of theater buildings, beginning with the ancient Greeks who relegated foreigners to the extreme sides of their amphitheaters. Interestingly, balconies have been assigned both high and low social prestige at different times and in different circumstances. Commercial producers often express a dislike of balconies and will push for auditorium designs that place as many patrons on the main floor as possible. Ostensibly their concern is ticket revenue, but most first balconies (at least) are priced the same as the main level seats.

A deep balcony overhang can negatively impact both vision and hearing for the patrons below it. The overhang can limit the view of the upper part of the stage picture and diminish the quality of the sound.
that reaches those patrons. The acoustic environment below the overhang can also become decoupled from the main auditorium volume, affecting the quality of the reverberant sound for all patrons. However, these issues are solvable through careful design, and balconies provide an indispensable tool for creating vibrant and intimate performance spaces. They often provide superior viewing angles and proximity to the stage, and are sometimes the seats of choice.

Sightline Formula

The constant rise sightline formula can be used to determine a balcony slope. Variables $v$ and $h$ are simply the distances from the sight point on stage to the eye point in the first row of the balcony. The relationship of the first row of the balcony to the stage affects the balcony slope, just as the relationship between the stage and the first row affects the main seating slope. So, a balcony that is closer to the stage will be steeper, and one farther from the stage will be shallower. Similarly, a higher balcony will be steeper, and a lower balcony will be shallower. The slope of the main floor, the number of rows below the balcony overhang, and the height below the balcony must all be considered when the balcony geometry is determined.

Aisle Stairs

Shallower sloped balconies are typically served by radial aisle stairs of a constant slope. One or two stair risers between rows is typical. A deep balcony may have a crossaisle, and the slope to the rear of the crossaisle may be steeper. The same considerations apply as for a crossaisle on the main floor.

Steeper balconies may have radial aisles with up to three risers between rows. However, a steep balcony aisle can be awkward and uncomfortable to navigate. Alternatively, a steep balcony may have continuous rows of chairs served by aisle stairs at the side walls, with no intermediate aisles. This is a modified form of continental seating, as mentioned above. Patrons typically enter at the bottom of the stair, climb to their row, and walk along the row to their seats. One reason for this arrangement is that it allows the seating rake to be steeper than the aisle stairs. How can this be? The rows of seats are curved, and the side aisles cut across the curved rows, so they are longer and less steep than radial aisles would be.

Oblique Sightlines

Another advantage of this modified continental arrangement is that it allows balconies to be warped in order to improve oblique sightlines. See Figure 12.11 for an illustration. Sightlines are typically solved for the centerline condition, shown as section A. Patrons seated off centerline will have comparable sightlines perpendicular to the rows of seats, noted as section A’. But this view is to the far side of the stage. How good is this patron’s view to the near side of the stage? The effective row spacing for this oblique view
(section B) is greater than for the perpendicular view (section A'). If the vertical rise is kept the same, the patron doesn’t have a clear view of the front of the stage—this is indicated by the shallower seating slope and sightline in section B.

One solution is to warp the balcony so that the rise between rows is greater at the row ends. To accomplish this, the front rows of the balcony are sloped down from center, and the rear rows are sloped up from center. The slope is variable, with the steepest slopes at the first and last rows. The row at the midpoint of the balcony remains level. The overall effect is to increase the rake of the seating as one moves away from centerline toward the ends.

Figure 12.11 Oblique Sightlines
Source: Author

of the rows, and this steeper rake compensates for the oblique view from the ends of the rows. As the steeper slope and sightline in section B indicate, patrons have a clear view of the near side of the stage.

**Venues With Balconies**

We’ve divided venues with balconies into three categories—playhouses, rooms for music, and large
multipurpose rooms. And of course, there are rooms with single balconies and rooms with multiple balconies. Rooms with a large number of seats are likely to have multiple balconies, in order to place as many audience members as close to the performance as possible. However small rooms with multiple balconies are not uncommon. We’ll look at examples of each.

Playhouses

Playhouses tend to have steeper balconies placed closer to the stage. The designers are less concerned about room acoustics for music, and more concerned about proximity to the stage—so deeper balcony overhangs are typical. The Gladys Mullenix Black Theatre at Allegheny College (2009) is a small, 250-seat proscenium theater with a single balcony. As shown in Figure 12.12e, the main floor slope is steep enough to provide good vision to the stage, but shallow enough that the single balcony can be kept low and close to the stage. The result is a compact space with no audience member more than 39 feet from the stage. The Jarson-Kaplan Theater (1995, Figure 12.12g) has a deeper main floor and a second balcony, but none of its 437 seats is more than 51 feet from the stage. Note that both spaces are given some geometric order by vertically aligned balcony and parterre rails.

The Broadway playhouse is an idiosyncratic proscenium form believed to result from the layout of mid-town Manhattan building lots discussed in Chapter 9. Subtracting a 35-foot deep stage (say) from a 100-foot square lot left a wide and shallow footprint for the auditorium. The main floor is kept relatively shallow. The balcony is close to the stage, and as a result is quite steep, with view angles of 25 to 30 degrees for a first balcony. An historic example is the Walter Kerr Theater (1929), shown in Figure 12.12a. The larger Broadway houses have two balconies. The New Amsterdam Theatre (1903/1997) is shown in Figure 12.12f. The balconies have many rows, are close to the stage, and have deep overhangs. The higher balcony is farther from the stage, so it is not as steep as it might otherwise be. The auditorium appears to “lean back” in a relaxed posture.
This theater form is not limited to Broadway, but has been exported worldwide alongside the Broadway musical form. The Kay Theatre at the Clarice Smith Center is an example of a contemporary theater in the Broadway playhouse form—see Figure 12.12b. The Dolby Theatre (formerly Kodak Theatre, Figure 12.12h) is a big multipurpose hall patterned after a Broadway playhouse. The hall was designed for the Academy Awards ceremony and other amplified performances, and acoustic music wasn’t an expected use. As in a Broadway theater, the balconies are (relatively) close to the stage, the overhangs are deep, and each balcony front is set further from the stage than the balcony front below. The hall is also wide like a Broadway auditorium. Note that the Dolby is about as steep as Prudential Hall at the New Jersey Performing Arts Center (1997, Figure 12.14c) but 10 feet shorter, and with 650 more seats! This is the
difference between a hall for amplified events and a hall for acoustic music performance.

The examples above have shallow main floors. Adding a balcony to a steeply raked thrust or arena theater can enhance the dimensionality and intimacy of the space. For sightlines to work, the balcony must be fairly far from the stage and just a few rows deep. The Milwaukee Rep’s Quadracci Powerhouse Theater (1987, Figure 12.12c) is a 720-seat thrust theater with a 3-row balcony. It’s also possible (though less common and less often successful) to design a proscenium theater with a steeply raked orchestra floor and a balcony. The McColl Family Theatre in Charlotte, North Carolina (2005, Figure 12.12d) is an example.

Concert Halls and Opera Houses

University of Houston’s Moores Opera House (1997, Figure 12.13a) is a single-balcony room for opera and symphony performances, and Emory University’s Cherry Logan Emerson Hall (2003, Figure 12.13b) is a single-balcony concert hall. These examples illustrate several typical features of rooms for music. The main floors are shallow. The balconies are held far back in the room, and as a consequence they also have shallow slopes. In Emerson Concert Hall, the height of the opening below the balcony and the depth of the balcony overhang are kept at a 1:1 ratio, so that the volume below the balcony doesn’t acoustically “decouple” from the main volume. At Moores Opera House, this ratio is pushed to about 1:1.5. In both halls, the large open volume between the balcony and the stage is important for the development of reverberant sound. (While our diagrams do not show side wall architecture, in both cases the side seating was kept to a minimum to allow for large reflective areas at the sides of the rooms.) The acoustically ideal seat in these halls is often the first row of the balcony, where the blend of direct and reverberant sound is ideal.

Like its single-balcony counterparts, and for the same reasons, a multi-tier opera house or concert hall will have a main floor with a shallow (not steep) rake and shallow (not deep) tiers held far back in the room. Our examples are two contemporary halls with traditional geometry—Oslo Opera House (Figures 1.9 and 12.13c) and The Music Center at Strathmore (Figure 12.13d).
Multipurpose Theaters

Three of our examples are contemporary multipurpose theaters that borrow from the traditional opera house form. We’ll also look at Chicago’s Auditorium Theater (1889) which was a conscious (if idiosyncratic) rejection of the opera house form.

Bass Hall (Figure 12.14a) is designed to accommodate symphony, opera, ballet, and Broadway tours. Of our examples, it is the most closely patterned on the European opera house. The main floor is kept shallow and the balconies are kept fairly far back—81 feet from the stage. The aligned balcony fronts provide a formal architectural geometry. The balcony overhangs are minimized, although the ratio of depth to opening is not as strict as in earlier examples. The first tier is dedicated solely to box seats, and the second tier has just a few rows. As a consequence, the top balcony is deep and holds 27 percent of the
total number of seats. This is common when one combines high seat count with traditional auditorium geometry in a multipurpose theater. The concern, of course, is that the top balcony may feel remote from the stage and disconnected from the rest of the auditorium.

Overture Hall (Figure 12.14b) makes an interesting contrast to Bass Hall. The uses of each hall are similar. The balcony fronts at Overture are not aligned vertically as in an opera house, but step back similarly to a Broadway playhouse. This feature gives the room a more relaxed feel, and allows the lower balconies to be closer to the stage. The location and geometry of the top balcony, however, is almost identical to the top balcony at Bass Hall.

Prudential Hall (Figure 12.14c) is a very large (2,600 seats) multipurpose room designed particularly for acoustic music. This hall is deeper than Bass and Overture, and it has an additional tier. Each balcony front steps back one row from the level below, relaxing the balcony slopes but keeping an ordered feel.

The Auditorium Theater, shown in Figure 12.14d, is a large and unique venue inspired by the rejection of European forms. It opened in 1889, just 13 years after the Bayreuth Festspielhaus was completed. Dankmar Adler, the primary designer, was influenced both by Bayreuth’s seating plan and by John Scott Russell’s isacoustic sightlines. The main floor has a steep isacoustic slope. In such a large hall, this slope would typically be kept shallower to avoid high and steep balconies. The first balcony overhang is minimal—the building predates the first fully cantilevered balconies in the United States by more than a decade. Like the main floor, this balcony is steeply sloped.
These two levels of the Auditorium Theater are similar in section to Auditorio Kursaal in Figure 12.9g. Like that venue, the main floor and first balcony provide good (although distant) views of the stage. The Auditorium Theater has two higher balconies which now are only occasionally sold. The third balcony is suspended forward of the second balcony, and it’s accessed via an open walkway from the rear of the second balcony. The trip to one’s seat is an experience in itself. Once there, you have a sightline to the stage that is 35 degrees above horizontal. That is, it’s at the absolute limit of the acceptable range.

The Aesthetics of Seating Slope

The seating slopes in Figures 12.9, 12.12, 12.13, and 12.14 illustrate different approaches to the design of auditoriums with varying seat counts and uses. Of course the diagrams do not provide a complete perspective on the design of these auditoriums—they do not indicate the shape or width of the
auditorium, or galleries or boxes at the side walls. But the diagrams do illustrate the impact of decisions about sightlines on proximity and scale, two important qualities of good auditorium design. They help us understand that sightline decisions should not be determined solely on a technical basis, but must result from informed decisions about the auditorium design.

Our examples of venues without balconies, shown in Figure 12.9, mostly have steeper slopes and do not reflect the full variation found in the built environment. Still, they demonstrate quite a range. At one extreme, the last row of the 200-seat Forbes Center Recital Hall is just 6 feet above the stage, with a 7-degree downward sightline. At the other extreme, the 1,800-seat Auditorio Kursaal has a last row that is 57 feet above the stage, with a downward sightline of 22 degrees.

Almost all of our examples with balconies have shallow main floor seating slopes—with sightlines between 5 and 10 degrees. One of the exceptions is the Quadracci Powerhouse Theater, which is a thrust stage, and steep slopes are typical of thrusts. In the other exception, the McColl Family Theatre, the steep main slope was a design choice. We know that, in general, main floor slopes are kept shallow in order to keep balconies low and shallow—and the majority of sightlines as close to horizontal as possible.

The better vision provided by a steeper slope may result in a more intimate connection between the performer and spectator. Certainly it’s easier to feel a bond with a performer you can see! But a steep slope separates adjacent rows from each other and weakens audience cohesion. A patron may still feel connected to fellow patrons on each side, but not to patrons in the adjacent rows. Think of the difference in conversing with the person sitting in front of you on a shallow slope versus a quite steep slope.

As mentioned earlier, a steep main slope emphasizes the stage floor—this may or may not be desirable. A view of the floor may be an advantage in the arena form because of the lack of other scenic elements, and the same may be true in a thrust. In an endstage or proscenium, a frontal view of the scenic picture may be preferred.

A steep main slope places much or most of the audience in the position of looking down on the performer. In dance performances, this view emphasizes patterns over individual performances. Some choreographers prefer a view of the floor while others prefer a view of the dancers in front of the horizon. In drama, some actors find it difficult to “command” the stage when they must “perform up” to the audience. Musicians may find this arrangement more amenable, but a steep slope favors direct sound at the expense of reverberant sound. This is because audience members on a steep rake absorb more energy than a comparable audience on a shallow slope. For this reason, some acousticians object to steeply raked recital and concert halls.

Lastly, one must consider venue form, seat count, seat slope, and whether balconies are desirable in a given design.

A single steep slope can work well for a small drama or dance endstage like the Clarice Center Dance Theatre—say, up to 300 seats. With the added production elements possible with a proscenium stage, the seat count for a single level space can be somewhat higher. At 499 seats, Stage42 is probably near the
upper limit. Its furthest seat is 62 feet from the stage. Of course, introducing a balcony can make a space of any size more intimate. Compare Stage 42 to Jarson-Kaplan (437 seats within 52 feet) and the McColl Family Theatre (550 seats within 56 feet).

An arena or thrust can have a larger seating capacity with relatively few rows, since the audience is wrapped around the performance area. The Fichandler Theatre places all of its 680 patrons in eight rows within 30 feet of the stage. And although the angle of view is 21 degrees, the last patron is seated only 10 feet above the stage floor. Balconies are not a necessity in this form and at this seat count, though the Quadracci Powerhouse Theater provides an example of how a balcony can add verticality and interest.

Steeply raked single level recital halls are not the norm, but they do exist and apparently work satisfactorily. Kilbourn Hall (1922) at Eastman School of Music is an idiosyncratic but surprisingly pleasant recital hall at 444 seats.

For most venue types, once seat count exceeds about 500, a steeply sloped room without balconies can have a distancing and isolating effect on the spectator. Our examples include one such venue, Auditorio Kursaal, a 1,800-seat concert and opera hall. This auditorium is a technically fine solution to the “problem” of perfect seeing and hearing. Unfortunately, it doesn’t provide reasonable proximity to the performance, nor does it possess a human scale.

The section consists of three straight line seating slopes that approximate a single isacoustic rise. The last row has a 22-degree sightline to the stage—roughly the same angle of sight provided by the second balconies at Bass Hall, Overture Hall, and the Music Center at Strathmore. The last row is 148 feet from and 57 feet above the stage. Strathmore has about 200 seats behind its concert platform, so it has roughly the same number of seats in front of the stage. For comparison, its last row is 131 feet from and 60 feet above the stage. Bass Hall has 250 more seats, and the most distant is 144 feet from the stage. Overture Hall has 450 more seats, and the most distant is 138 feet. With fewer seats but no balconies, Auditorio Kursaal has a greater distance to the last row than Bass, Overture, and Strathmore.

The seating rows are rigidly straight. They don’t provide the connection fostered by line of sight to patrons seated to the left and right. The steep slope also increases the sense of detachment between rows. These features, and the large undifferentiated banks of seats, isolate the individual patron in a sea of similarly isolated patrons. This may all be intentional—Richard Wagner designed the Bayreuth Festspielhaus with the explicit intention of isolating the individual patron and focusing his or her attention solely on the performance being presented. Like Bayreuth, Auditorio Kursaal solves the functional problem, but profoundly misses the larger point—that theaters are spaces in which individuals gather in community.
Chapter 13
Audience Seating

This chapter introduces the technical aspects of seating layouts and circulation. Together with the discussion of audience sightlines in Chapter 12, it forms the practical basis for the design of auditoriums. In Chapter 14 we’ll discuss a theoretical basis for auditorium design.

We start the current discussion with the audience member seated in the auditorium.

Auditorium Seating

Most patrons in most auditoriums sit in chairs fastened to the building. A few patrons will use wheelchairs or other mobility devices, and a few may sit in loose armchairs in the boxes. In flexible or informal spaces, the audience may sit on movable chairs that are ganged into rows. And there are many other seating variations including benches, banquettes, sofas, and stools of varying heights. We’ll look in detail at the two most common types of seating, fixed auditorium chairs and wheelchair spaces. Both are shown in Figure 13.1.

Fixed Auditorium Chairs

Auditorium chairs are field assembled from component parts, usually standard cataloged parts. Even with no customization, the available parts, colors, and fabrics present a wide range of options. Custom fabrics and colors can also be ordered. Other chairs might be wholly custom—designed and fabricated for a specific project. As you can imagine, the cost can vary greatly.
Components

The primary parts of the chair are the back and the seat pan. The back may be molded plastic, metal, laminate, or wood—with or without padding and upholstery. The back may have a square, rounded, or more articulated silhouette. The upholstery can entirely wrap the back, or cover only the forward face, with or without reveals or tufting. The upholstery fabric can be a woven textile or leather.

The seat pan is molded plastic, metal, or wood—again, with or without padding and upholstery. The seat pan is hinged and self-rising, either by means of springs built into the hinge or by gravity acting on a counterweight built into the back of the seat pan. Gravity-action seats are both quieter and more reliable, but only available on higher end chairs.

In most cases, the back and seat pan mount to a pair of upright brackets called standards. Every two adjacent chairs share a standard, which is fastened either to the floor or to the seating riser. Variations are possible—each chair can have its own pedestal mount, which sometimes has a built-in air diffuser, or several chairs can be mounted to a horizontal beam supported by pedestals. Chairs designed to be
removed, perhaps to clear space for patrons in wheelchairs, will have two standards and a sled base.

An armrest of wood, laminate, or molded plastic fastens to the top of the standard. Like the standard, the armrest is shared between adjacent chairs—creating a potential source of annoyance and disagreement. The standard at the end of the row is slightly different in construction, and end standards that are visible are usually dressed with a panel of wood, metal, or laminate. Or the end panel might be wrapped in the upholstery material, especially if the upholstery is leather. End panels often have integral aisle lights.

**Chair Width**

Chair backs and seats are manufactured in a range of widths used to create horizontal stagger between successive chair rows, as shown in Figure 12.7 in the last chapter. Width is measured as the centerline-to-centerline dimension between adjacent standards, so the actual width of the back or seat part is a few inches less than the nominal width. If the row is curved, the standards will be splayed, and chair width is measured along a theoretical arc called the “chair size line” or “setting out line.”

Chair widths grew gradually through most of the twentieth century: in 1900 the typical range was 18 to 20 inches, and by about 1990 it was 19 to 21. Since 1990, the rate of change has increased, and the current range is 20 to 24 inches.

**Back Pitch**

Back pitch is the angle of the chair back, which is set when the back is fastened to the standards.

Back pitch ranges from 12 degrees (which provides an upright posture for balcony seating with downward viewing angles) to 22 degrees (which provides a relaxed posture for orchestra seating where sightlines are closer to horizontal). Theater chairs almost always promote a more upright posture and have firmer padding than cinema chairs, which are heavily padded and sometimes recline. Unlike cinema, live performance depends on an alert and engaged audience.

Back pitch affects two critical dimensions—chair envelope and back over hang.
Figure 13.2 Fixed Auditorium Chairs on (a) Steep Slope and (b) Shallow Slope.

\( a \) = aisle accessway; \( b \) = chair envelope with seat up; \( b' \) = chair envelope with seat down; \( s \) = row spacing; \( d \) = back overhang; \( a \) = back pitch

Source: Author

Chair Envelope

Chair envelope is simply the front-to-back dimension of the chair, measured “plumb line to plumb line.” Chair envelope may be measured with the seat down or with the seat up. If the seat is self-rising, the “seat up” dimension is used for code calculations. This dimension, labeled \( b \) in Figure 13.2, is usually between 18 and 22 inches. Because back pitch is set in the field, the same set of chair components can be assembled with different chair envelopes.

Back Overhang

The back overhang is the distance between the chair size line and a plumb line at the rear of the chair back. This is dimension \( d \) in Figure 13.2. Again, this dimension varies with back pitch—so it’s larger for chairs at the orchestra level and smaller for balcony seating. Because the chair back overhangs the riser face, up to 12 inches of extra depth must be allowed at the last row.
Wheelchair Spaces

Number

The required number of wheelchair spaces varies, with proportionately more spaces required in smaller auditoriums. Table 13.1 indicates the minimum requirements according to the 2010 ADA Standards for Accessible Design.

Table 13.1 Required Number of Wheelchair Spaces

<table>
<thead>
<tr>
<th>Seating Capacity</th>
<th>Number of Wheelchair Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 25</td>
<td>1</td>
</tr>
<tr>
<td>26 to 50</td>
<td>2</td>
</tr>
<tr>
<td>51 to 100</td>
<td>4</td>
</tr>
<tr>
<td>101 to 300</td>
<td>5</td>
</tr>
<tr>
<td>301 to 500</td>
<td>6</td>
</tr>
<tr>
<td>501 to 5,000</td>
<td>6, plus 1 for each 150, or fraction thereof, between 501 through 5,000</td>
</tr>
<tr>
<td>5,001 and over</td>
<td>36, plus 1 for each 200, or fraction thereof, over 5,000</td>
</tr>
</tbody>
</table>

Size

Individual wheelchair spaces must be at least 36 inches wide, while two side-by-side spaces must each be a minimum of 33 inches wide. It’s a good idea to provide both single and double spaces. The required depth is 48 inches for a space approached from the front or rear, and 60 inches for a space approached from the side. A single wheelchair space takes up almost the same footprint as four fixed auditorium chairs—two adjacent chairs in two successive rows. Wheelchair spaces must be level or sloped no more than 1:48. These requirements for size and floor slope make integrating wheelchair spaces within the seating rake a challenge.

Wheelchairs and other mobility devices come in different sizes and configurations, and some will not fit within the minimum dimensions described above. Auditoriums for live performance depend upon high seating density to promote audience cohesion and responsiveness, and therefore minimum-sized spaces are usually provided. It’s good practice, however, to provide some locations that can accommodate larger mobility devices. Crossaisles and boxes can usually be designed to provide more room for a wheelchair user with little or no need for on-the-spot adjustments to adjacent seating.

Wheelchair spaces must not overlap circulation paths that are required by the building code or ADA. So, for example, a wheelchair space at the end of a row cannot block a required egress path for other patrons in that row. This requirement also means that access to a wheelchair space cannot be through another wheelchair space. But, if a circulation path is wider than required, a wheelchair space can overlap the excess width.
Additional Requirements

The seating layout must satisfy several additional objectives with respect to the wheelchair seating. Wheelchair spaces must be integral to the seating plan; must offer choices of locations, viewing angles, and sightlines; and must offer viewing angles and sightlines that are substantially equivalent to those from the general seating. These diverse (and sometimes conflicting) objectives are all achievable. The design challenge is greater in smaller auditoriums, where proportionately more wheelchair spaces are required but there are fewer seating areas in which to incorporate them. For any size auditorium, it’s best if the requirements for wheelchair spaces are considered when the auditorium concept is first developed.

**Integrity**

The wheelchair spaces cannot be segregated from the other seating, and must enable patrons in wheelchairs to sit “shoulder to shoulder” with their companions. This means the wheelchair space must be on the same floor level as adjoining seats, and the size and position of the wheelchair space must allow the patron to sit next to patrons in adjoining seats.

**Dispersion**

Except in auditoriums seating 300 or fewer, the required number of wheelchair spaces must be dispersed both horizontally and vertically to allow choices of location, viewing angle, and sightlines. Once the required number of spaces has been dispersed, however, further dispersion is not required by the ADA. For example, if six wheelchair spaces are required, then patrons in wheelchairs need not be offered more than six distinct seating choices.

Horizontal dispersion means that spaces are distributed across the width of the auditorium or around the perimeter of a thrust or arena stage. Vertical dispersion requires wheelchair spaces at varying distances from the performance area. Spaces are required in at least 20 percent of all boxes and in each balcony or mezzanine that is located on an accessible route.

The dispersion requirements in the 2015 IBC are slightly different than the ADA requirements. The IBC requires wheelchair spaces on the main floor level and on one of every two additional levels, except that if the second level has fewer than 25 percent of all seats, or fewer than 300 seats, all wheelchair spaces can be at the main level.

**Substantial Equivalency**

The wheelchair spaces must provide sightlines and viewing angles that are comparable to or better than
the sightlines and viewing angles provided to the general public. For example, wheelchair spaces cannot be provided only at the front of cinemas, where viewing angles to the screen are least desirable. Similarly, in spaces for live entertainment, it’s important to provide spaces on or near the centerline of the auditorium. If one divides the width of the auditorium into four equal segments, at least some wheelchair spaces should be within the center two segments.

The wheelchair spaces must provide sightlines over the heads of standing spectators if patrons are expected to stand during events. Satisfying the latter requirement while providing integrality and a feeling of intimacy is a significant design challenge. A few seating locations (for example, front rows and boxes) provide uninterrupted sightlines when other patrons stand, but a design that places all wheelchairs in these locations would not satisfy the requirements for dispersion.

Most case law concerning “standing sightlines” has involved sports stadiums or racing venues, where standing is common, and the application of this requirement to performing arts and live entertainment spaces is not clear. It is generally understood that the requirement does not apply to standing ovations, the only time spectators stand during traditional performing arts events. However, standing may be acceptable at other times during popular music concerts and other types of live entertainment.

Means of Egress (MOE) Components

We now have a sense of the space occupied by each fixed auditorium chair or wheelchair. How did our patron get to his or her chair or wheelchair space, and how do they leave after the show? They use the means of egress. “Egress” of course is a fancy name for exit. (The museum-goers who followed P. T. Barnum’s “This way to the egress” signs right out of the building learned this by experience.) In technical terms, a means of egress is a continuous path of travel from any point in a building to a public way. It consists of three parts—the exit access, the exit, and the exit discharge. In code terms, an exit is just one part of a means of egress system.

Exit Access

An exit access is a path from anywhere in a building that leads to an exit. In an auditorium, it’s the travel route from each chair or wheelchair space to one or more exits. It is a concept very relevant to the design of seating layouts, since the spaces between the rows of chairs, the aisles, and most open floor areas within the auditorium are all part of the exit access.

Exits

What constitutes an exit? Conceptually, the simplest exit is a door that leads directly to the exterior. Enclosed interior stairs, ramps, and corridors can also be exits, as can exterior stairs and ramps. Perhaps
the most arcane of exits is the horizontal exit. This is a passage that brings you “horizontally” across a fire barrier into a “safe area.” “Horizontally” meaning without a significant change in level, and “safe” meaning protected from fire and smoke spreading from the area you just left!

**Exit Discharge**

You’ve probably guessed that exit discharge is the path from the terminus of an exit out to a public way or street. Since it is exterior to the building, the exit discharge does not affect the seating layout, and we won’t discuss it in detail.

**Accessible Routes and Egress**

Not all means of egress components are usable by persons with impaired mobility. As defined by the ADA and the building code, the term “accessible route” refers to a circulation path usable to persons with impaired mobility, including persons in wheelchairs. The building code goes on to define requirements for accessible means of egress. We’ll look at both accessible routes and accessible egress later in this chapter.

We concern ourselves with these definitions because the ADA and the building code are full of special names and specific requirements for every part of the means of egress system, and the exit access requirements (especially) determine the basics of theater seating layouts. What follows is a general overview. The reader is cautioned to research the specific requirements in his or her code jurisdiction.

**Aisle Accessway**

The space between rows of chairs is part of the exit access and is called the aisle accessway. It’s the plumb-line-to-plumb-line dimension between the back of one chair and the front of the next. If the seats are self-rising, the accessway is measured with the seat up. This is dimension $a$ in Figure 13.2. The minimum required width of the accessway is 12 inches. This width is adequate for a row of 14 chairs if the row has aisles on each end, or a row of seven chairs if the row is served by only one aisle. For the row served by two aisles, the required width increases by 0.3 inches for each seat above 14. For the row served by one aisle, the required width increases by 0.6 inches for each seat above seven. The maximum required width is 22 inches—once this figure is reached, the row can have additional chairs with no increase in the accessway width. These incremental formulas were one of the changes to the means of egress requirements made in the late 1980s, and they accommodate the flexible version of continental seating described in the last chapter.

**Row Spacing**
Row spacing, shown as dimension $s$ in Figure 13.2, is the sum of the aisle accessway and the chair envelope.

**Hypothetical Range**

By adding the minimum 12-inch aisle accessway to a tight 18-inch chair envelope, we arrive at a hypothetical minimum row spacing of 30 inches—much too tight for comfort! In this case, the building code specifies egress width, not patron comfort. If we add the widest required accessway of 22 inches with a generous chair envelope of 22 inches, we arrive at a “maximum” row spacing of 44 inches. We’ve described a hypothetical range of 30 to 44 inches.

**Practical Range**

In actual practice, row spacing falls within a smaller range, say 34 to 42 inches. At the low end, 34 inches provides an acceptable level of comfort on a shallow slope, but 36 inches is preferred, and larger spacing is sometimes provided. On a shallow slope, the space below the chair in front is available as leg space, allowing a tighter row spacing. To maintain the same level of comfort, row spacing must increase as the slope increases, because the back of the chair in front limits leg room. As noted in the last chapter, balconies often have longer rows, and this requires wider accessways. Between the requirements for leg room and egress width, row spacing in balconies usually ranges between 38 and 42 inches.

**Comfort Versus Density**

In all cases, the tradeoff between comfort and seating density must be considered. Wider chairs and generous row spacing provide increased creature comfort and more “personal space.” Increased row spacing makes it easier for patrons to travel along the accessway, especially past patrons who are already seated. But increasing the average chair width and row spacing also reduces the density of the seating and the cohesiveness of the audience. An auditorium of a given footprint built today will hold just half the number of seats as the same size auditorium built in 1900. The difference in capacity is largely due to increases in seat width and row spacing, and has a significant and detrimental effect on the responsiveness of the audience and the liveliness of the performance.

**Aisles**

Aisle accessways lead to aisles, the next portion of the exit access. The code regulates the width of aisles in two ways. It specifies capacity—that is, the required width of an aisle based on its slope and the number of persons it serves. It also specifies minimum width, based on location, configuration, slope, and the number of rows or seats served.
Capacity

Aisle capacity varies with slope: aisles may be level, ramped, or stepped. A stepped aisle is also called an aisle stair. (We covered the details of aisle slopes in the last chapter.) An aisle that is level or has a slope less than 1:12 has a capacity of one person for every 0.2 inches of width. A ramped aisle steeper than 1:12 has a capacity of one person for every 0.22 inches of width. And an aisle stair has a capacity of one person for every 0.3 inches of width. (The code also contains adjustment factors for certain dimensions and for smoke-protected seating, but the capacities listed above apply to most circumstances.)

Catchment Areas

The required capacity of an aisle depends on the number of seats it serves. To determine this, each level of the auditorium is divided into catchment areas that assume proportionate use of the means of egress capacity. Figure 13.3 shows a simple example—a single level auditorium with 500 seats is served by four doors of equal width. We assume one quarter of the audience will exit through each of the four doors, so the portion of aisle leading to each door must have a capacity of 125 people. If the aisles have a slope greater than 1:12, the width required is 125 times 0.22 or 27.5 inches.

Figure 13.3 Catchment Area Example (after NFPA)
Source: Author
Note that in making this calculation we don’t assume that audience members will tend to exit through the main entrance, nor do we assume that audience members will exit through the door closest to their seat.

**Minimum Width**

The actual width of aisles is often determined not by the capacity calculation, but by a separate code requirement for minimum width. Table 13.2 lists minimum aisle widths according to the 2015 edition of the IBC.

The aisles in our example from Figure 13.3 are sloped aisles with seats on only one side, serving more than five rows. According to Table 13.2, their minimum required width is 36 inches. The minimum required width is significantly larger than the width required by the capacity calculation, which is quite common in smaller auditoriums.

**Uniform Width**

If egress is possible in either direction, as in our example in Figure 13.3, then the aisle must be uniform in width.

<table>
<thead>
<tr>
<th>Table 13.2 Minimum Aisle Widths per IBC 2015 in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seating on Both Sides of Aisle</td>
</tr>
<tr>
<td>No limit to number of seats or rows</td>
</tr>
<tr>
<td>No limit to number of seats or rows</td>
</tr>
<tr>
<td>Level or Ramped Aisle</td>
</tr>
<tr>
<td>Stepped Aisle</td>
</tr>
</tbody>
</table>

**Longitudinal and Radial Aisles**

The most common aisles are longitudinal (also called parallel) and radial. Longitudinal aisles are parallel to the centerline of the auditorium, and radial aisles are perpendicular to curved or faceted seating rows. As Figure 13.3 indicates, the same aisle can transition from radial to longitudinal. Smaller auditoriums will have two or four aisles. Larger auditoriums may have multiple seating banks separated by multiple longitudinal or radial aisles.

As discussed in the last chapter, center aisles are rarely used. They are feasible only if the seating slope
provides first row vision, and they take up space that would otherwise provide prime viewing positions.

Crossaisles

Crossaisles connect longitudinal or radial aisles to each other or to doors leading out of the auditorium. If egress paths converge at a crossaisle, then the capacity of the crossaisle must be not less than the combined capacity of the converging aisles. Requirements for minimum width also apply.

It’s possible to have a crossaisle, or portion of a crossaisle, that is not part of the exit access. Figure 13.4 shows a single-level auditorium divided into four equal catchment areas, each served by an exit door. Unlike our previous example, this auditorium also has a crossaisle. The patrons in catchment area C follow either aisle C or C’ to the crossaisle at E, which leads to exit C. The capacity of the crossaisle at E must equal the capacity of the converging aisles C and C’. Since the auditorium is symmetrical, the same analysis applies to catchment area D and the crossaisle at G. But note that the crossaisle at F doesn’t serve any of the four catchment areas and is not part of the egress system. (Because the auditorium in this example is so small, all of the aisle widths are actually determined by the requirements for minimum widths found in Table 13.2.)

Figure 13.4 Catchment Area Example with Crossaisle

Source: Author
**Dead-End Aisles**

Normally, both ends of an aisle must lead to a crossaisle, door, or other means of egress. Aisles C and D in Figure 13.4 are examples of dead-end aisles. One end of the aisle leads to the crossaisle and exit, but the other end terminates at the front of the stage. Dead-end aisles like this are allowed if they are no more than 20 feet in length.

But if you examine Figure 13.4, you’ll see that aisles C and D are longer than 20 feet. (The aisles serve nine rows. Even if the row spacing were 30 inches, the aisle length would be 270 inches or 22.5 feet. If row spacing is a more reasonable 36 inches, then the aisle length is 27 feet.) Dead-end aisles longer than 20 feet are allowed under an exception in the code that acknowledges that exiting patrons often cross the auditorium by walking along the aisle accessways. Dead-end aisles longer than 20 feet are allowed if the seats at the “dead end” (that is, the seats past 20 feet) are no more than 24 seats from another aisle along an aisle accessway that has a clear width of 12 inches plus 0.6 inch for every chair above seven.

**Accessible Routes and Means of Egress**

Most of the exit access components described above are not usable by patrons in wheelchairs. Wheelchair seating areas within the auditorium must be served by an accessible route and accessible means of egress. In addition, if a circulation path directly connects the general seating area to the performance area, then an accessible route must directly connect at least some of the wheelchair spaces to the performance area.

**Accessible Routes**

The concept of an accessible route is defined by the ADA and the building code, and may include walking surfaces with a slope not steeper than 1:20, doorways of certain dimensions, ramps with a slope not steeper than 1:12, elevators, and wheelchair platform lifts. As much as possible, the accessible route provided for patrons in wheelchairs must be coincident with the main circulation path. However, circulation components that do not serve accessible areas do not have to be accessible. This is important because much of the circulation within the auditorium is not accessible. Making the entire auditorium accessible would fundamentally alter the nature of the space and the performances taking place there, and the ADA does not require this.

The ADA and the building code include many detailed requirements for the components of accessible routes. Generally, routes must have at least 36 inches of clear width, and if a person in a wheelchair must turn around, a 60-inch-clear circle is required. There are additional requirements for passing space and clear areas around doors and fixtures. Walking surfaces with slopes between 1:20 and 1:12 are considered ramps, and must meet requirements for landings and handrails. Slopes greater than 1:12 are not allowed. Note that auditorium aisles with slopes less than 1:12 are not usually accessible routes, because they do not comply with the requirements for ramps and railings.
Platform lifts are allowed only to provide access to certain areas, including performing areas and wheelchair spaces within the auditorium. (They may also be used to provide wheelchair access to non-public spaces serving five or fewer occupants, which covers most control rooms.) Whenever possible, accessible routes should provide universal and equal (not segregated) access. Platform lifts are obviously separate accommodation for persons in wheelchairs, and their use should be kept to a minimum. Also, to be accessible and usable, platform lifts must be maintained in working order, and too often they are not.

**Accessible Means of Egress**

The building code requires that all accessible spaces have one or more accessible means of egress. An accessible route can serve as part of an accessible means of egress. In addition, elevators, platform lifts, horizontal exits, ramps, and stairways may be part of an accessible means of egress—if they meet certain detailed requirements. Areas of refuge (spaces protected from smoke and fire where a person unable to use the stairs can await instruction or assistance) were once a common feature of accessible means of egress, but now they are required in just a few circumstances.

**Exits**

By definition, exits are at the perimeter (or outside of) the auditorium, but some code requirements for exits affect the seating layout.

**Number**

Two exits are required for seating levels designed for 50 to 500 people. This increases to three for levels with 501 to 1,000 people, and above 1,000 the requirement is four. Note that the same exit (say, an enclosed stair) can serve multiple seating levels, as long as it has sufficient capacity.

**Location and Capacity**

If an auditorium seats more than 300 and has an identifiable main entrance, then that entrance is considered the main exit, and it must have a capacity sufficient for at least half of the auditorium occupants. This requirement is based on the observation that most patrons attempt to leave the auditorium by the way they entered. All other exits combined must also have a capacity for at least half of the occupants.

**Exit Remoteness and Common Paths**

Exits must be remote from each other, to offer a choice of egress paths. In an auditorium with two exits,
the distance between the exits must be greater than one-half of the diagonal measurement of the auditorium. If the building is sprinklered, the requirement is one-third of the diagonal.

“Common path of travel” is a related concept. It’s the travel distance from any seat or wheelchair space to a point where the person exiting has a choice of two paths of travel to two exits. In most cases this distance must be no more than 30 feet, but it can be 75 feet in areas that seat fewer than 50 people.

**Travel Path**

The total length of the exit access may not exceed 200 feet in a non-sprinklered building and 250 in a sprinklered building. This distance is measured from each seat, along the rows of seats, and down the center of each aisle to the nearest exit. In most cases travel distance is not a limiting factor when laying out the seating. By way of comparison, the footprint of the auditorium at the Dolby Theatre (the largest venue illustrated in Chapter 1) is 140 feet deep and 120 feet wide.

Note, however, that the actual exit can be well outside of the auditorium. A door at the perimeter of the auditorium isn’t an exit unless it leads directly to the exterior or to an exit corridor or stair. If instead the door leads to an exit access corridor or to the lobby, then the patron will not reach the actual exit until he or she has traversed this space and exited to the exterior or into an exit stair or corridor.

**Railings**

The building code contains means of egress requirements for two types of railings—handrails and guards. The requirements for railings within auditoriums differ from the general requirements.

**Handrails**

Handrails are required on ramps and stairs for the safety and convenience of building occupants, including on ramped aisles and aisle stairs. However, handrails are not required on ramped aisles when there are seats on both sides of the aisle. Where there are seats on both sides of an aisle stair, a series of “hairpin” handrails can be provided at each side of the aisle. The gaps between these handrails must, of course, allow ingress and egress from each row. The alternative is a handrail along the center of the aisle. This type of handrail must also have gaps to allow patrons to cross from one side of the aisle to the other. Gaps of at least 22 inches and not more than 36 inches must be provided at least every five rows.

**Guards**

Guards provide protection from openings in walls and floors and from changes in floor elevation exceeding 30 inches. Guards in auditoriums must be 42 inches high, unless they interfere with sightlines,
in which case they must be at least 26 inches high. Minimum 26-inch high guards are typically required in front of seating in balconies, galleries, boxes, and parterres. This is also the minimum required height at orchestra pits, voms, and along crossaisles. Guards required to be at least 26 inches high will typically be designed to be as high as sightlines allow, and the height of railings in front of boxes and parterres and at the orchestra pit is usually about 30 inches.

If a balcony aisle terminates at the balcony front, the guard at the end of the aisle must be at least 36 inches high and the diagonal dimension between the top of the rail and the nosing of the nearest tread must be at least 42 inches.

Theaters are one of the few building types where the public encounters guards that are less than 42 inches high, and the height of guards in theaters, especially in upper balconies, is often raised as a concern. A guard less than 42 inches high is perceived as unusual, and it makes some patrons feel uncomfortable or unsafe. We can sympathize and acknowledge that they feel unsafe, without concluding that the environment itself is unsafe. In a review of this issue for the American Society of Theatre Consultants, Paul Sanow concludes that “falls from theatre balconies are simply not common” and the issue is one of “perception of risk.”
Chapter 14
Auditorium Design

All assembly spaces must provide audience sightlines as described in Chapter 12 and accessibility and egress as described in Chapter 13. Auditoriums intended for live performance must provide more—they must support and enhance the communal act of performance that takes place within them. This chapter discusses these distinct requirements of spaces for live performance. To frame our discussion, we’ll first address two related topics: the nature of live performance and the role of precedents in the design of auditoriums.

Nature of Live Performance

Live performance is a shared act between performers and audience that takes place at a particular time and in a particular space. We tend to take this simple truth for granted, so much so that we are often blind to its implications.

Space

Physical space is one of the requirements of live performance, and the space becomes part of the performance. Anyone who has followed a production or concert from rehearsal room to theater, or between theaters, knows this reality. Space is so intrinsic to the performance that the pioneering French theorist Anne Ubersfeld wrote that “the theater is space.”

Performers

Live performance requires the presence of the performer, of course. We too readily take the performer for granted, which makes the reaction of a young child first experiencing “actual, real live people up on the stage” both delightful and somewhat disconcerting. And those real people are usually working hard! Theater director and theorist Jerzy Grotowski wrote that theater is “an act carried out here and now in the actors’ organisms, in front of other humans . . . We can thus define the theatre as ‘what takes place between spectator and actor.’”
Spectators

Indeed, there is no performance without the spectator, and his or her role is an active one. Director Tyrone Guthrie noted that when the French say they are “attending” a performance, the literal translation is “assisting” at a performance. The concept of performance as a shared act of creation is not limited to drama (or to the French), but extends to all types of live performance. Writing about the performance of music, which he calls “musicking,” Christopher Small says it “establishes in the place where it is happening a set of relationships, and it is in those relationships that the meaning of the act lies.” In her writings, theater historian and theorist Lynne Conner stresses the role of the audience as co-authors of meaning across the spectrum of the performing arts.

Performers and spectators interact in relationship, and so together create the performance. In his 1968 treatise *The Empty Space*, Peter Brook wrote “The science of theatre building must come from studying what it is that brings about the most vivid relationships between people.” We know that successful spaces for live performance enhance the interaction between performers and audience, and that other spaces stifle this interaction. We have no scientific way to measure this interaction, but we can observe and study it, as Brook advises.

The Role of Precedents

This brings us to the question of using precedents—that is, using existing theaters for inspiration or guidance when designing a new space.

Design of the Stage

Each of the performing arts has an inherited repertoire and traditional modes of presentation. These factors strongly influence current practice, particularly regarding the size and configuration of the performance area, so precedents clearly have value in the design of the stage.

Design of the Auditorium

Historically, precedents have also played an important role in the design of the auditorium. In the absence of quantifiable factors, it makes sense to model a new building on a successful existing one. Until the early twentieth century, the fields of theater design and acoustics were both disadvantaged by a limited ability to quantify the factors that lead to successful auditoriums, and so both were equally dependent on precedents. With his experiments at Harvard on the effect of absorptive material on room acoustics, Wallace Sabine created the modern discipline of architectural acoustics. Since then, the ability of acousticians to mathematically describe and predict the behavior of sound has increased dramatically. Acousticians still use precedents, but the field is much less dependent on them. This ability to measure...
and predict acoustic qualities has allowed experimentation with the form of performance venues; a notable example is the development of the vineyard concert hall.

Theater designers have not had similar success in forming a mathematical basis for good auditorium design, in part because they do not agree on what constitutes good auditorium design. We can explain this disagreement by defining two schools of thought: we will call them the functionalists and the relationists. The reader should keep in mind this is a simplification, and to some extent caricatures of two extreme positions.

*Functionalist School*

In Chapter 12 we introduced the functionalist school, for whom excellent conditions for seeing and hearing are paramount. These are measurable factors. For the functionalists, good auditorium design can be reduced to a math equation, and therefore precedents are of little value. The use of precedents may even be harmful, since so many historic theaters do not provide good conditions for seeing and hearing.

An additional influence on some members of the functionalist school is a distaste for certain architectural forms, based on a rejection of the social structures associated with those forms. This position has legitimacy. In Chapter 12 we noted the association between balconies and racial segregation in the United States. The box tiers of late Renaissance opera houses usually had inferior sightlines, but were acknowledged as socially superior to the orchestra seating. The box tiers themselves were strictly subdivided by social hierarchy: in Vienna, possession of boxes in the first and second ranks was restricted to the “high” aristocracy by law. In response to this history, a segment of the functionalist school promotes “democratic” theater design and rejects any vestiges of the socially or racially stratified auditorium.

The functionalist school has roots in the mid-nineteenth century, the rise of Realism which demanded frontal sightlines into a picture frame proscenium, and the efforts of Wagner and others to exert control over the audience experience. It was influenced in the early twentieth century by the rise of the movie theater. Many early movie “palaces” had stages for live performance, but the movie screen allowed only frontal sightlines. The functionalist school is also associated with the Bauhaus and Modernist architecture. While never fully embraced by theater practitioners, it was the dominant theater design philosophy following World War II, and it is still influential.

The main criticism of the functionalist school is that it misunderstands the nature of live performance, and therefore has too limited a view of what makes a good theater. And, taken to the extreme, the functionalist approach results in vast, single-level auditoriums of an inhuman scale.

*Relationist School*

For the relationists, a successful auditorium is one that promotes “vivid relationships between people.”
Our ability to measure the design factors that make for vivid relationships is limited, and therefore the examination of precedents is of great importance to the relationist school. Through observation and study, the relationist hopes to understand the design qualities and features that support interaction between performers and audience.

The contemporary relationist school developed in the 1970s, fed by works such as Brook’s and by growing unease with the vast, democratic halls produced by modernist architects. The emerging preservationist movement led to efforts to save and restore historic theaters. This led to a rediscovery of the knowledge and craft of the pre-World War II theater architects, arcana that was largely lost due to the war, its aftermath, and the influence of Modernism. Probably not coincidentally, the development of the relationist school paralleled the growth of Post-Modernism in architecture and the reexamination and reuse of historic styles and forms. A major criticism of the relationist school is that it is too dependent on precedent, and reluctant to experiment with new approaches. It’s true that, if not rigorously grounded, the relationist viewpoint can result in superficial reproductions of historic theater forms, just as bad Post-Modern design can result in trite and meaningless architecture.

Recently, theater design has been influenced by a new emphasis on audience sovereignty—that is, the desire of audiences to curate and control their experiences. Fewer arts consumers wish to sit passively in darkened auditoriums, and attendance at traditional performances has declined as Americans search for more meaningful ways to engage with the arts. This is a much larger issue than the design of auditoriums, but at a minimum our arts facilities should bolster, not further erode, the relevance and appeal of the live arts and entertainment. Successful experimentation with new environments and new modes of performance will require both an understanding of traditional theater architecture and a mastery of the technics of seeing and hearing. That is, we can’t afford to ignore the relationist’s precedents or the functionalist’s math.

**Four Qualities**

This brings us (finally!) to a discussion of the qualities that distinguish spaces for live performance. We can articulate four qualities that enhance the interaction between performers and audience—proximity, cluster, scale, and place—and we can identify design elements that embody these qualities. This framework is adapted and developed from ideas expounded on by a number of theater designers, performance practitioners, and theorists.

The four qualities are interrelated, as we shall see, and design elements often embody more than one quality. We’ll discuss each quality in turn and attempt to relate the qualities to precedents drawn from the history of theater architecture.

**Proximity**
The first quality is proximity. The design of the auditorium must place the members of the audience in close proximity to the performance and to each other. Nineteenth century European theater architects Fellner and Helmer described this quality succinctly and somewhat humorously in their “rules” for theater design:

1. The aim is to get the audience as close as possible to the stage.
2. It is important for the art of theatre to see the actor’s eyes and mouth.
3. Create an auditorium as small as possible, leave out any unnecessary spaces. The audience is happiest in an intimate space, even at the cost of the architect’s feelings.

Seat Count

Seat count is related to proximity, since fewer seats mean shorter distances to the stage. As discussed in Chapter 1, there is a practical upper limit to seat count for each entertainment form. Economics aside, a lower seat count is almost always preferred as it results in a more satisfactory experience for performer and audience. Seat count should be a carefully considered number, as excess seats that mostly sit empty are an unwelcome burden. They increase capital and operating costs and are detrimental to the overall quality of the performance experience.

Seating Density

Seating density is determined by row spacing, seat widths, and the circulation within the auditorium. Higher seating density increases proximity by placing more audience members closer to the performers, and closer to each other. Seating density is limited by the building code and by the need to provide patrons with a comfortable experience.

Since the turn of the twentieth century, row spacing and chair widths have increased as Americans have gotten taller and heavier, resulting in decreased seating density. The desire for increased comfort and personal space is also a factor, and the Americans with Disabilities Act has increased the amount of required circulation in auditoriums. Overall seating density has fallen by about half. That is, for a given size auditorium, roughly half as many individuals are “assisting at” the performance.

Audience Cohesion

Seating density affects the number of individuals available to respond to the performance, but it also affects audience cohesion—that is, the degree to which those individuals form a collective entity called the “audience.” Director and theorist Herbert Blau noted that the audience “does not exist before the play but is initiated or precipitated by it; it is not an entity to begin with but a consciousness constructed.” The physical space affects the transformation of individual spectators into an audience, and seating density is one factor. Increased seating density promotes audience cohesion while decreased seating density
discourages it. So, row spacing and chair widths should be no larger than necessary for code and comfort. The benefits of extra circulation within the auditorium should be weighed against the effect on proximity. For example, crossaisles decrease proximity, but they also increase audience mobility and provide an enhanced sense of “place” within the auditorium.

Figure 14.1 Typical Seating Density in (a) Early Twentieth Century Auditorium and (b) Early Twenty-First Century Auditorium
Source: Author

Raised Seating Areas

One of the theater designer’s most powerful tools for promoting proximity is the raised seating area that overhangs the seating below. We discussed this topic at length in Chapter 12. Balconies allow seats that would otherwise be at the rear of the auditorium to be moved closer to the performance, but at a higher elevation. Boxes and galleries serve a similar function at the sides of the auditorium.

Shallow Galleries

Overhanging seating areas were not a feature of auditoriums until the Renaissance. Shallow galleries and
boxes were developed first, and we know from illustrations of Renaissance performances that at least some private court theaters had raised seating galleries.

The Hôtel de Bourgogne in Paris (1548) and Blackfriars Theatre in London (1596) were interior courtyards formed by column-supported audience galleries on three sides of a rectangular room. The Globe Theatre in London (1599, 1997 reconstruction shown in Figure 14.2), and the Corral de Comedias in Almagro, Spain (1628, Figure 14.3) were open air versions. These and similar spaces are where Moliere, Shakespeare, Lope de Vega, and Calderon de la Barca produced some of the greatest works of western culture. The Georgian Theatre Royal in Richmond, England (1788) has essentially the same geometry. Contemporary examples of this form are the Cottlesloe (now Dorfman) Theatre at the Royal National Theatre, London (1977) and the Polonsky Shakespeare Center at Theatre for a New Audience in Brooklyn, New York (2013).

![Figure 14.2 Globe Theatre, London. Original: 1599, about 3,000 seats. Reconstruction: 1997, 1,557 seats, architect: Theo Crosby. The 1599 Globe Theatre was the first of two Elizabethan era structures with that name. The drop in seat count from an estimated 3,000 in 1599 to 1,557 in 1997 is a dramatic illustration of loss of seating density over time Source: Photo courtesy of Gill Griffin under CC BY 2.0](image)

Elevated galleries were also a common feature of the early concert halls. The historic halls known as the “Holy Trinity” for the esteem in which they are held—the Grosse Musikvereinssaal in Vienna (1870), the Concertgebouw in Amsterdam (1888), and Symphony Hall in Boston (1900, Figure 14.4)—all have such
galleries. And galleries are still used today, as illustrated by the

Figure 14.3 Corral de Comedias, Almagro, Spain (1628). The theater is the only corral de comedias still existing and in use

Source: Photo courtesy of Santiago Lopez-Pastor under CC BY-ND 2.01
Figure 14.4 Symphony Hall, Boston (1900, 2,625 Seats). Architect: McKim, Mead and White. Wallace Sabine was the acoustician.

Source: Photo courtesy of Joseph Sohm/Shutterstock.com
Schermerhorn Symphony Center in Nashville (2006, Figure 14.5) and the Philharmonic Hall in Szczecin, Poland (2014, Figure 14.6).

**Box Tiers**

Rings of box tiers, each supported by the floor below, date at least to the 1580s when they appeared in commercial theaters built in Venice to house *Commedia dell’arte* performances.

It appears that the need to house as many paying customers as possible was a factor from the beginning. Historian Simon Tidworth also ascribes this motive to Benedetto Ferrari, who used an arrangement of box tiers in the Teatro San Cassiano in Venice in 1637. According to Tidworth, boxes that stepped down toward the stage *en escalier* to improve sightlines were first used in 1640 at Teatro Formagliari in Bologna. A diagram of Teatro Falcone in Genoa (1653) which also featured boxes *en escalier* is included in Figure 14.25. For examples of box tiers in later opera houses, see Teatro Argentina in Rome (1732, Figure 14.7), the Paris Opera (1875, Figure 14.8), and Teatro Colon in Buenos Aires (1908, Figure 14.9).

**Column-Support Balconies**
Deeper galleries, still supported by columns, were a later development. Ford’s Theater in Washington, DC (1863, Figure 14.10) is an example. Chicago’s Auditorium Theater (1889) had partially cantilevered balconies, but was still dependent on columns. As can be seen in Figure 14.11, the Auditorium Theater also had box tiers, though much reduced in number and importance.

*Cantilevered Balconies*

The first theater with fully cantilevered, column-free balconies was the Royal National Opera House (1891, now the Palace Theatre) in London’s West End. The first Broadway theaters with this distinction were the New Amsterdam Theatre (1903) and the Lyceum Theatre (1903, Figure 14.12). The first such theater in Boston was the Majestic Theatre (also 1903). Apparently the new technology spread rapidly. By 1915 Cedar Rapids, Iowa had its first cantilevered theater balcony. In the United States, the first cantilevered balcony engineered in reinforced concrete was at the Million Dollar Theatre in Los Angeles which opened in 1918.

The use of galleries and balconies results in more compact rooms with more seats closer to the stage. The main tradeoff for this proximity is steeper sightlines for the spectators seated there. Deep overhangs affect room acoustics.
Figure 14.8 Paris Opéra (Palais Garnier), Paris (1875, 2,130 Seats). Architect: Charles Garnier. Compare to the Bayreuth Festspielhaus in Figure 14.20 which opened only a year later.

Source: Photo courtesy of Frederic Legrand—COME/O/Shutterstock.com

Figure 14.9 Teatro Colon, Buenos Aires, Argentina (1908, 2,487 Seats). Architect: Francesco Tamburini
Figure 14.10  Ford’s Theater, Washington, DC. Originally opened 1861, destroyed by fire 1862, reopened 1863, rehabilitated and reopened 1968. This is the theater in which Abraham Lincoln was assassinated

Source: Photo courtesy of Everett Historical/Shutterstock.com

Figure 14.11  Auditorium Theater, Chicago (1889, 4,200 Seats). Architect: Adler and Sullivan. The Auditorium Building, as conceived by Ferdinand Peck, had a social as well as artistic agenda. Peck and his architects were influenced by the Bayreuth Festspielhaus and rejected
the European opera house form as elitist
Source: Photo courtesy of Nagel Photography/Shutterstock.com

Figure 14.12 Lyceum Theatre, New York (1903, 922 Seats). Architects: Henry Herts and Hugh Tallant. The Lyceum Theatre was one of the first on Broadway to have fully cantilevered balconies. It is also the oldest continuously operating Broadway theater
Source: Photo courtesy of Wikimedia Commons

and sightlines for the patrons below the overhang, but these are manageable design challenges. Raised seating levels, whether cantilevered or not, require additional structure and circulation, and these come at an additional cost. However, if the budget can afford it, almost any size room will benefit from a balcony.

Of the four qualities, proximity is the most easily measured. Auditoriums are often described in terms of the distance between the stage and the most remote seat. A median distance would be a more useful measure, and could be readily calculated. Seating density, an indicator of proximity, can be quantified by dividing the total floor area of the auditorium by the number of seats.

**Cluster**

The quality of cluster is harder to measure, but it has observable features. One is encirclement, or the enveloping of the performance area by the audience seating. Cluster is also developed by placing spectators where they have a close connection to the performance, and placing spectators where other audience members can see them. These design features enhance the intangible phenomenon often described as the “exchange of energy” between the performers and audience.
Encirclement

An audience gathered around a performer in an open area, a plaza or a park, will naturally form a circle. Early arrivals will place themselves a comfortable distance from the action. Later arrivals will begin to form a ring around the performer, trading oblique views for unobstructed sightlines. Only when the circle is completed will it grow deeper, with spectators jostling and craning for a view. Small children might duck between the adults to the front of the ring where they can sit on the ground to view the action. An enterprising person may find a high vantage point, like the men on the shop roofs in Pieter Balten’s painting of a Medieval scaffold stage in Figure 14.13.

The performance spaces of prehistory are thought to have been open spaces in the shape of circles. Encircling or enveloping auditoriums appear throughout history, starting with the theaters of ancient Greece (Figure 14.14) and Rome (Figure 14.15). The Renaissance attempts to revive the ancient theater forms used encirclement, as illustrated by Teatro Farnese in Parma (1618, Figure 14.16). The Globe Theatre (Figure 14.2) and other Elizabethan

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Figure 14.13 Detail of a Medieval scaffold stage from the painting *A Performance of the Farce 'Een Cluyte van Plaeyerwater' (A Clod from Plaeyerwater) at a Flemish Kermis* by Pieter Balten, c. 1540–c. 1598

Source: Courtesy of the Rijksmuseum
Figure 14.14 Theater of Epidaurus, Greece (3rd or 4th Century BCE, About 15,000 Seats). The upper tier was a Roman addition.

Source: Photo courtesy of Erik Drost under CC BY 2.0
Figure 14.15 Roman Theater at Aspendos, Pamphylia, (Modern Turkey) (2nd Century, About 7,000 Seats)
Source: Photo courtesy of Shutterstock.com

Figure 14.16 Teatro Farnese, Parma, Italy (1618, About 3,000 Seats) Architect: Giovanni Battista Aleotti. Possibly the first theater with a permanent proscenium arch. However, at least some performances extended into the central area within the U-shaped seating
Source: Photo courtesy of Bradley Griffin under CC BY 2.0

Figure 14.17 Fichandler Theatre, Arena Stage, Washington, DC (1960, 680 Seats). Original Architect: Harry Weese. 2010 Renovation: Bing
theaters did as well. Enveloping theater forms were again revived in the twentieth century by theater directors and designers such as Zelda Fichandler at Arena Stage (1960, Figure 14.17) and Tyrone Guthrie and Tanya Moiseiwitsch at both Stratford, Ontario (1957) and Minneapolis (1963). Architect Hans Scharoun created the first enveloping vineyard concert hall, the Berliner Philharmonie, in 1963 (Figure 14.18). Encircling forms continue to be popular—two recent examples are the Ruth Caplin Theatre at the University of Virginia (Figure 1.3) and Helzberg Hall at the Kauffman Center for the Performing Arts in Kansas City (Figures 1.8 and 14.19).
The Renaissance interest in perspective scenery and the development of the proscenium arch placed an emphasis on frontal sightlines, but a form of encirclement continued in the use of box tiers and side galleries. It wasn’t until the rise of Realism, the development of illusionistic scenery, and the retreat of the performer behind the proscenium arch that side seating was eliminated from (some) auditoriums. Wagner’s Bayreuth Festspielhaus (1876, Figure 14.20) is an early example. Encirclement is a way to increase proximity, bringing more audience members closer to the performers. But its persistence in theater design indicates it is attractive in itself, because it strengthens the interaction—the exchange of attention and energy—between the performers and the surrounding audience. Let’s examine this more closely.
The Spectator/Spectator Look

Live performance is often described in terms of looking and seeing. The word *theater* comes from Greek *theatron* meaning place of seeing, and *spectator* comes from the Latin “to see.” (Though curiously, *auditorium* and *audience* derive from the Latin root “to hear.”) In her book *Space in Performance*, Gay McAuley posits that the “play of looks” is an essential component of live performance, and she observes “there seems to be a number of different kinds of looking going on.” She and other theorists discuss the actor/actor (character/character) look, the spectator/actor look, the actor/spectator look, and the spectator/spectator look. Aside from the actor/actor or character/character look, all of these transactions facilitate the exchange of energy between audience and performer. The spectator/spectator look does so by reinforcing and amplifying individual responses into a coherent group response.

The spectator/spectator look operates in multiple ways, and it can distract from as well as reinforce the performance on stage. Live performance is inherently a social act. The opportunity for social display and voyeurism were primary motivations for attendance in certain historic periods, and their appeal continues today. The Elizabethan playwright Ben Johnson complained of audiences that come “to see, and to be seen. To make a general muster of themselves in their clothes of credit: and possess the stage against the play” While this social aspect cannot be discounted, neither should it obscure the other ways in which audiences interact. Recall the performance of *A Lesson from Aloes* described in Chapter 1. It’s the physical presence of the other audience members—palpably intent on the drama of Steve, Gladys,
and Piet—that reinforces our own focused response and also reminds us that we are not in Port Elizabeth, but that we are attending (assisting at) a performance in New Haven. As Grotowski might say, the act of performance is carried out in the audience’s organisms too.

**Ripple Seats and Side Seating Areas**

Laurence Olivier told the design team for the National Theatre in London that “actors demand proximity to the nearest seat. This is where the ripple starts which infects the house.” At one time, seats in the first rows of the National’s three auditoriums were sold as discounted “ripple seats” the morning of the performance. The premise was that customers willing to show up at the box office in the early morning to purchase tickets were eager to see the performance, and their enthusiasm would ripple throughout the auditorium.

The ripple effect can be communicated by laughter or sighs, but a spectator’s facial expression, posture, and overall demeanor more effectively communicate his or her emotional response to the performance. The back of one’s head is not an expressive feature! Therefore the ripple effect is more powerful when patrons are seated at the sides of the auditorium where they are close to the performance and visible to the rest of the audience. The raised galleries of the courtyard form ([Figure 14.3](#)), the side galleries of shoebox concert halls ([Figures 14.4, 14.5, and 14.6](#)), and the box tiers of opera houses ([Figures 14.7, 14.8, and 14.9](#)) are substitutes for complete encirclement. The cascading boxes of American playhouses discussed below ([Figures 14.21 and 14.22](#)) serve the same function. All of these devices place spectators where others can see their response to the performance.
Figure 14.21 Well’s Theatre, Norfolk, Virginia (1913, 1,650 Seats) Architect: E. C. Horn and Sons. The theater was racially segregated, the top balcony having its own entrance and box office

Source: Photo courtesy of Pixabay.com
Objections

Cluster is important to developing an active, engaged, and cohesive audience, but some clients and theater designers object to some or all forms of cluster. A primary objection is that side seating areas do not provide good sightlines. Many forms of side seating require active sightlines—that is, the spectators at the sides of the room cannot sit passively but must lean on the box or gallery rail, or otherwise position their bodies, in order to gain a view of the performance on stage. For the relationist, this is an advantage. Active sightlines promote engaged audience members—again, recall Grotowski’s idea that performance is carried out in one’s body—and by telegraphing their engagement, these spectators improve the quality of the performance experience for everyone.

The functionalists, for whom excellent conditions for seeing and hearing are paramount, view active sightlines as a failure. This led to the development of the “ski slope” box or gallery with fixed chairs oriented toward the stage, instead of loose chairs in a box or gallery oriented toward the auditorium. An early (perhaps the first) example of ski slope boxes is the Modernist Malmö Opera (formerly Stadsteater) which opened in 1944 (Figure 14.23). A more recent example is McCaw Hall in Seattle (renovated 2003,
Figure 14.24). The problem with this “fix” is that it isolates the side seating and all but removes the spectators seated there from the view of the other audience members. Compare the examples above with the Shubert Theatre in New Haven, Connecticut (Figure 14.22).

For some critics of cluster, the historic connection between box tiers (to give just one example) and discrimination based on social class or race is so strong that it outweighs any advantages the seating form may provide. Others, like Ben Jonson, object to social displays that distract from the performance. And some people simply don’t like to be seen! Side seating doesn’t appeal to everyone, and it may not be appropriate for every auditorium. In the absence of all other forms of cluster, the theater designer should at least provide curved rows of seats, so one can look down the row and see the friends one took to the theater.

Scale

Scale is a quality of all architecture. In its simplest form, scale simply means size, but scale is also developed through the use of proportion, repetition, order, light, and shadow. Scale can be used to minimize the stature of the
Figure 14.24 Marion Oliver McCaw Hall, Seattle, Washington. Originally opened 1928 as Civic Auditorium, renovated and reopened 1962 as Seattle Opera House, renovated and reopened 2003 in its present form with 2,900 seats. Architect for 2003 renovation: LMN

Source: Photo courtesy of Matt Lamb Photography/Seattle Center

Individual. Medieval cathedrals (which exalt God over humanity) and communist party plenary auditoriums (which exalt the party over the individual) are clear examples of this use of scale. Theater designers work in the opposite direction, using scale to support the performer and enhance the performance. On a movie screen the performers’ bodies can be magnified many times. In real life and in live performance, the performers’ bodies are only so big. Therefore, the theater architecture must assume a human scale.

Almost every design element has an effect on scale. We’ll discuss some examples of common auditorium features that affect scale.

Side Wall Architecture

The treatment of the side walls of an auditorium can profoundly affect the scale of the room. If the room has side seating, the side walls can be organized in repeated human-scaled elements. Closely spaced box tiers or galleries provide horizontal banding, and columns (if they are present) provide a vertical order to the wall elevation. Most of the examples previously given demonstrate this side wall treatment. Figure
illustrates several approaches to side walls and their effect on scale.

In the playhouse form just a few seats are placed at the side walls, but they remain an important architectural feature that provides both cluster and scale. The classic English playhouse featured stacked boxes on each side of the proscenium opening, and this is still a common motif in many types of theaters. Ford’s Theater (1863, Figure 14.10) and the Lyceum Theatre (1903, Figure 14.12) hint at this arrangement. Overture Hall in Madison, Wisconsin (2004, Figures 1.11 and 14.26) provides a more fully developed example, though it is not a playhouse.

A uniquely American playhouse form with side boxes that “step” or cascade down from the balcony to the stage was developed in the early twentieth century on Broadway. In 1903 architects Henry Herts and Hugh Tallant opened both the Lyceum Theatre (with boxes that would be at home in an English playhouse) and the New Amsterdam Theatre (with the new form of cascading boxes). Well’s Theatre in Norfolk, Virginia (1913, Figure 14.21) and the Shubert Theatre in New Haven (1914, Figure 14.22) illustrate the American playhouse form in full flower. The Kay Theatre at University of Maryland (Figure 1.5) and the Dolby Theatre (Figure 1.12) are recent examples of this form.

Figure 14.25 (facing page) Five Approaches to Side Wall Architecture. (a) Teatro Falcone, Genoa, Italy (1653, about 1,000 seats). Architect: G. A. Falcone. An example of boxes en escalier. (b) Teatro alla Scala, Milan, Italy (1778, 2,030 seats). Original architect: Giuseppe Piermarini. 2004 renovation: Mario Botta. An example of classic box tiers. (c) Paris Opéra (Palais Garnier), Paris (1875, 2,130 seats). Architect: Charles...
The elimination of side seating led to the problem of how to treat the side walls. Wagner and his designers at the Bayreuth Festspielhaus opted for a colonnade. This gives the room order and some sense of scale, as illustrated in Figure 14.25d. Colonnades have been used in this way since Roman times. See the Roman theater at Aspendos in Figure 14.15 and Teatro Farnese in Figure 14.16.

The modernist movement ushered in a series of auditoriums with unadorned and barely articulated side walls. This approach dominated much mid-twentieth century theater design and is unfortunately still prevalent today. Some early examples are the Malmö Opera (Figure 14.23), Eero Saarinen’s Kresge Auditorium at MIT (1955), and the O’Keefe (now Sony) Centre in Toronto (1960, Figure 14.25e). These walls often are a single surface extending from the proscenium to the rear wall of the auditorium, and from the orchestra floor up to the ceiling or roof deck. They dwarf the human stature, and while they offer protection from the elements, they don’t provide a sense of enclosure or intimacy.

Other theaters have side walls that aren’t blank, but are articulated in ways that do not provide a human scale or a sense of enclosure. The walls of Melbourne Theatre Company’s Sumner Theatre (2009) are covered with quotes from the great plays, the letters formed by LED backlit holes in the black walls. The side walls (and ceiling) of the concert hall in Szczecin, Poland (Figure 14.6) are distorted geometric shapes with a semi-specular finish. This is not to say the walls in these examples aren’t interesting or striking, but that they do not support the performance by providing scale.
**Figure 14.26** Overture Hall, Overture Center, Madison, Wisconsin (2004, 2,250 Seats). Architects: Pelli Clarke Pelli Architects, Potter Lawson, and Flad Architects

Source: Photo © Eric Oxendorf

**Gallery and Balcony Placement**

Scale is also affected by the placement of the galleries or balconies in relation to the main floor and the stage. Lower, closely spaced galleries and balconies keep the room at a more human scale and do a better job of connecting the spectators in the raised seating areas to the audience on the main floor. Keeping balconies as low as possible also allows them to be shallower and/or closer to the stage. Audience cohesion is much improved if galleries or boxes on the side walls physically connect the balconies to the stage. Compare the O’Keefe Centre in **Figure 14.25e** to Overture Hall in **Figures 1.11** and **14.26**. The O’Keefe has a high balcony, remote from the stage and disconnected from the main floor. The side walls, blank except for acoustic articulation, do nothing to link the balcony to the main floor or stage. Overture Hall has three balconies and is a taller volume than the O’Keefe, but it has side seating elements that physically link each of the balconies to the stage opening. It creates a ring of humanity linking one side of the stage to the other.
Inner and Outer “Walls”

A further advantage of raised seating areas is that the front faces of balconies, galleries, and boxes narrow the apparent width and depth of the room. A parterre railing can function in the same way. The perceived room size is defined by these faces, not by the outer walls, resulting in a smaller and more intimate scale. This is most effective when the balcony fronts are illuminated and the outer walls are allowed to retreat into darkness. The opposite effect is achieved if the outer walls are brightly lit and the balconies are perceived in silhouette.

Differentiated Seating Areas

Dividing the seating into areas or “neighborhoods” positively impacts scale. For example, subdividing the main floor into orchestra and parterre sections allows the orchestra to be a smaller, more intimate seating area at times when the auditorium is not full. The parterre rail provides a sense of enclosure (as discussed above) and it creates an additional “front row.” Part of the appeal of vineyard concert halls (Figures 14.18 and 14.19) is the subdivision of the seating into terraces. The opposite effect is produced by the vast undifferentiated banks of seats found in Modernist auditoriums and sometimes still encountered today.

Ceiling Forms
Ceilings are critical to providing a sense of place, as we’ll discuss further below. It’s possible to design a satisfactory small room without a finished ceiling, but larger rooms require a ceiling to provide a sense of intimacy and enclosure. Ceilings can also help scale the auditorium. We’ll look at two common approaches—the dome and the extended proscenium.

**Domed Ceilings**

Many historic and a few contemporary auditoriums have domed ceilings. The dome is never placed equidistant from the outside walls of the auditorium. It is centered within the inner walls—that is, within the balcony and gallery faces—where it completes the sense of a smaller, more intimate “inner” room. (The dome may actually not be centered over the inner room, but placed a bit closer to the stage so that it’s visible and more “present” to more of the audience.) The Paris Opera ([Figures 14.8 and 14.25c](#)) is an excellent example. As can be seen most clearly in [figure 14.25c](#), the architect Charles Garnier provided both order and scale by organizing the auditorium around a central dome supported by four double columns.

**Extended Proscenium**

Another approach might be called the extended proscenium, as illustrated by Teatro Colon ([Figure 14.9](#)) and the Shubert Theatre ([Figure 14.22](#)). In these examples, the side wall architecture and the ceiling combine to extend the shape of the proscenium opening into the auditorium. The effect is to bring the proscenium closer and to connect the auditorium to the stage picture.

At Teatro Colon the extended proscenium is framed by two pilasters flanking the forestage boxes. The upstage pilaster forms the proscenium opening and the downstage pilaster provides the spring point for the box tiers. A dome centered within the box tiers completes the architectural order. The extended proscenium at the Shubert Theatre is deeper. It encompasses the side wall boxes and provides the spring point for the two balcony faces. In the Broadway playhouse form, the balcony curvature is flatter and the balconies are closer to the stage, so the extended proscenium forms the ceiling over the entire “inner room.”

A variation on the extended proscenium motif is illustrated by the Auditorium Theater ([Figure 14.11](#)) and Radio City Music Hall (1932, [Figure 14.27](#)). In these examples, the extended proscenium takes the form of overlapping arches that span the width of the auditorium. At the Auditorium Theater, the arches extend out over the front half of the room. At Radio City Music Hall, the arches extend all the way to the rear wall of the auditorium.

We should note that the effect of the extended proscenium is the opposite of the effect achieved at Bayreuth Festspielhaus ([Figures 14.20 and 14.25d](#)). That auditorium has a second proscenium separated from the actual proscenium by a void space called the “mystic gulf.” The intended result is to distance the auditorium and the audience from the world of illusion created on stage.
**Place**

The quality of “place” describes architecture that is stimulating, pleasant, and meaningful to its inhabitants. In *Towards a New Architecture*, Le Corbusier put it this way—“You employ stone, wood, and concrete, and with these materials you build houses and palaces. That is construction. Ingenuity is at work. But suddenly you touch my heart, you do me good, I am happy and I say: ‘This is beautiful.’” More succinctly, Richard Pilbrow says a theater with “place” is “A room you would want to have a party in!”

Environment psychologists use a theoretical model to study the response of individuals to their environment. They use the term “information rate” to describe the amount of information (stimuli) present or perceived in the environment. The model places the individual’s response into the dimensions of arousal (also called activation) and pleasure. Sometimes a third dimension, dominance, is used—meaning feelings of autonomy or restriction in behavior. Information rate is a direct correlate of arousal; that is, a pleasant environment with high information rate causes activation and invites active participation in the environment. A low information rate causes passivity. However, too much stimulation produces an agitated response and too much pleasure results in boredom, so a middle ground is desired.

What characterizes an auditorium with low information rate? We can describe it as follows:

- Dark colors or a monochromatic color scheme
- Blank side walls and no finished ceiling
- Large uniform seating banks with long rows of chairs
- Restrictions on mobility and lack of view of other spectators
- Down lighting (to the exclusion of lighting of faces and surfaces)
- Control of lighting and sound (the auditorium is darkened so the only focal point is the stage, and the only source of sound is from the stage)
- The stimulus (that is, the stage) is distant

We could be describing the set up for a psychology experiment, but this is, unfortunately, also a good description of many theaters built in the 1960s and 1970s and of a few built today. We can expect such an environment to produce a passive audience.

What are the characteristics of an auditorium with high information rate that supports an active and engaged audience? We’ve already touched on many of the characteristics in our discussions of proximity, cluster, and scale. This room might be characterized by:

- Vivid and varied colors
- Articulated side walls and finished ceiling
- Multiple and distinct seating areas and levels
- Seating served by aisles and crossoairs to provide some measure of mobility
- Lighting on the room surfaces and faces of spectators
• Multiple, close focal points and sources of sound
• Views of other spectators

Obviously, auditorium design is not as simple as a checklist, and many aspects of successful design are less easy to pin down. We would expect designs that are perceived as familiar and recognizable to produce low arousal and passivity. (Here “recognizable” means that the space looks like what it is.) However, the public more readily attaches meaning to spaces that are familiar and recognizable, and meaning is important to the quality of place. We would expect novel and unexpected design elements to increase arousal and activation, but if the design is too novel or unexpected, activation is decreased. Similarly, greater complexity and diversity in the design increase arousal, but too much complexity or diversity becomes overstimulating.

One framework for thinking about design is in terms of order and variation. A good design requires both order and variation. Too little order results in chaos, while too much is perceived as rigidity. Too little variation is dull, but too much is overstimulating. Compare, for example, the Neo-Classicist Schermerhorn Symphony Center (Figure 14.5) with the Deconstructivist Szczecin Concert Hall (Figure 14.6). The Schermerhorn is immediately recognizable as a concert hall—its affinities to Boston Symphony Hall in Figure 14.4 are readily apparent. The Szczecin Hall has the same shoebox geometry, but it is less readily recognizable because the architectural treatment is so different. Schermerhorn is very ordered. Does it have enough variation within its order to activate the audience? Szczecin is novel and varied. In fact, while the side walls appear to have a pattern, the ceiling appears random. Does the Szczecin Hall have enough order to contain this variation, or will the effect be overstimulation and passivity? These questions do not have simple answers, but they are at the heart of creating spaces with the quality of “place.”
Chapter 15
Technical Elements

This chapter discusses the technical elements required in and around auditoriums for live performance—control rooms, sound mix positions, followspot rooms, and positions for spotlights. The types and sophistication of these accommodations will vary depending on the venue type and the anticipated performances.

Control Rooms

Control rooms (also called control booths) are enclosed spaces, usually at the rear or sides of the auditorium, used to house production equipment, the equipment operators, and other running crew. Most performance spaces will have at least one control room, and some spaces will have several dedicated to specific uses.

Uses

The primary purpose of a control room is to provide an acoustically isolated space in which the crew can operate production effects and ancillary services during the performance. The most common production uses are control of lighting, audio, and projection. The stage manager (who provides overall coordination of the performance) may operate from a control room or from the stage. Ancillary services performed in control rooms include surtitling (also called supertitling), recording, broadcast, captioning services for the deaf, and audio description of the visual elements of a performance for the blind. Venues designed for highly produced shows, such as a Cirque du Soleil spectacular, may have additional control functions: show automation (or show control) for the control of rigging and other stage machinery, moving light control, and control of special effects including air, mist, fog, smoke, flame, or pyrotechnics. Typically, each function or service occupies a dedicated work station outfitted with the needed infrastructure and equipment. These stations may be combined into one control room or distributed among multiple control rooms.

At the other end of the spectrum, some concert and recital halls do not have a control room at all, and the production elements are instead controlled from a position offstage of the concert platform.
Size

The width of each work station should be sized for the equipment required, but a minimum of four feet per work station should be provided. A room depth of 12 feet is desired, and 10 feet should be considered the minimum.

In addition to the run-time uses, most control rooms will also function as workrooms and storage areas, and control rooms in an educational setting are often used as classrooms. These secondary uses may require more floor area than the primary use.

Location and Access

The control room must be accessible from the back-of-house circulation outside of the audience’s view, and if possible it should also be accessible from the auditorium, for convenience during rehearsals. The location should provide sightlines to the performance area for both sitting and standing crew members, and these sightlines should not be blocked by standing spectators. In addition, the control room must be accessible to persons in wheelchairs.

Given these parameters, the most prevalent location is at the rear of the main level of the auditorium. The control room is often inserted between the lobby and the auditorium, with access from the auditorium sound and light locks. To provide adequate sightlines, the room is usually a few feet higher than the last row of seating, and this often requires a platform lift, since a ramp would take up too much room. If the auditorium has multiple levels, the upper sightlines from the control room may be limited by the first balcony overhang. This location has another potential disadvantage, especially if the building site is constrained: there may be pressure to reduce the control room depth, so that this dimension can be used instead for more rows of orchestra seating, a deeper stage, or a bigger lobby.
It therefore sometimes makes sense to place the control room at an upper level, where sightlines to the performance area may be improved and a larger footprint may be possible. The main disadvantages of a higher location are that the room is less convenient to the auditorium, and upper sightlines into the stagehouse may be constrained. In a very few theaters the control room is located in a back-of-house area where it doesn’t have a direct view of the stage and the operators are dependent on audio and video monitors.

**Configuration**

A performance space with modest needs may have a single control room. This allows one operator to perform all required functions for a simple performance.

If many workstations are required, it’s likely that the control room will be subdivided or that multiple control rooms in different locations will be provided. The advantage of a subdivided room is that all functions and personnel are in one location and circulation can be shared. Subdivided rooms can be acoustically separated so that a sound operator, say, can work with an open window into the auditorium.
while the stage manager can work with a closed window. Providing vision panels in the partitions that subdivide the room allows for nonverbal communication between operators, which can be helpful. The advantage of multiple rooms (as opposed to one, subdivided room) is that they may be better located for their specific functions and there may be more floor area available if the rooms are distributed.

Sightlines

![Figure 15.2 Control Room Sightlines](source: Author)

The observation window into the auditorium must be located and sized to provide sightlines for an operator seated at a control desk. Often this means the sill must be lower than a typical counter height. If the control room is at a high elevation, and the sightline is steep, it may be necessary to orient the control desks perpendicular to the observation window in order to maintain sightlines. Sightlines should also be provided for a standing crew member, and the combination of this with a low sill may require the window to be quite large.

When closed, the observation window must provide reasonable acoustic separation from the auditorium, to allow the operators to give and respond to verbal cues. The window should also be operable, to allow communication between the control room and the auditorium without dependence on monitor and intercom systems. This is especially helpful during rehearsals and work calls. The window of the sound control room must be operable to allow, as much as possible, the sound operator to experience the aural environment within the auditorium. At minimum, the sound operator should have a 4-foot by 4-foot open window. For live mixing and other demanding tasks, the sound operator will be placed within the auditorium in an open mix position.
Sound Mix Position

If live audio mixing is an important part of the performance, it will be performed from an open position (or cockpit) within the auditorium, rather than from an enclosed control room. Concert halls, multipurpose theaters, and venues intended for musical theater almost always have live mix positions, and many other types of venues do as well.

Use

The mix position houses the audio mixing console and any related outboard equipment in a location that exposes the operators completely to the aural environment of the auditorium, so they can better perform the sound mix. In some venues, the mix position may house additional functions—for example, a moving light console, show automation, teleprompters, broadcast control, or cameras.

Location

Locating the mix position is a question of balancing competing priorities. The sound operator’s preferred location is within 75 feet of the stage, on or near the auditorium centerline, and within range and view of the main loudspeakers. Locations close to a side wall or under a balcony overhang are not desirable, as they may distort the operators’ perception of the sound. A prevalent location is at the center rear of the orchestra seating, just in front of the balcony overhang (if there is one). A mix position here will displace highly desirable seats, however, and could disrupt the enjoyment of patrons seated nearby. For these reasons, there is sometimes pressure to move the mix position further back, under the balcony overhang, or to the side of the room.

Size

The position is sized to accommodate the mixing console and its outboard gear and to provide room for the operators. Depending on the needs of the venue, the mixing console may have a footprint as large as 6 feet wide by 4 feet deep. Touring productions will bring their own mix console, and it will likely be necessary to remove the house console in order to provide space for the touring console. Providing space for both would result in a very large mix position. Of course, if other equipment and operators will use the cockpit, then space must be provided for them too. A starting point for a concert or touring venue is to provide a mix position that is at least 12 feet wide by 10 feet deep. This displaces about three rows of seven chairs for a total loss (or “seat kill”) of 21 chairs. A good starting point for a drama venue is to provide a space that’s 9 feet wide by 6 feet deep. This displaces about ten chairs.

Access
Discreet access to and from the mix position is desirable, but personnel access is usually through the public circulation within the auditorium. Access for equipment is of greater concern. In addition to being large, mixing consoles can weight up to 500 pounds, so moving consoles is not an easy task. Touring venues must have a path from the loading dock to the mix position that does not have steps, steep ramps, or tight turns. Sufficient space must be provided at the mix position to allow the console to be set in place without damage to nearby auditorium chairs, for example.

Sightlines

The equipment operators within the cockpit must have clear sightlines to the performers and to the main loudspeakers. Audience members seated behind the mix position must have clear sightline over the operators’ heads. This is often accomplished by depressing the floor of the mix position, and having the operators stand or sit on high stools. If the mix position is immediately in front of the parterre rail, the first row of the parterre can be elevated sufficiently to provide audience sightlines over the operators’ heads.

Of course the mix position itself is within the view of the audience members behind it, and light and noise from the mix position can distract from the performance. A permanent mix position can be separated by knee walls, and temporary positions are often draped in black velour, to minimize the distraction.

Configuration

The sound mix position can be permanent, demountable, or provided with a lift and wagons.

Permanent

Some venues opt for a permanent sound cockpit. This has the advantage of being always available, and it can be better integrated into the design of the auditorium, with knee walls, railings, or other millwork as appropriate. The disadvantage is that the seats displaced by the position are not available for those performances that don’t require a live mix, so the venue forgoes this potential income.

Demountable

A demountable position allows the sound cockpit to be transformed into audience seating when a live mix isn’t needed. A platform system is used to cover the pit recess, and sled-mounted auditorium chairs are brought in and fastened to the platforms. The disadvantages of this approach are the ongoing labor costs to change over the position, the need to store the platforms, chairs, and equipment items when they are not in use, and the wear and tear on these items and the area surrounding the mix position.
Lift and Wagons

The best solution is to provide a lift and wagons for the sound mix position, similar in configuration to the orchestra pit lift and seating wagons discussed in Chapter 10. See Figure 15.3 for an illustration. In this option, a sound cockpit lift travels between the auditorium level and a storage and work level below the auditorium. Two wagons are provided—one for seating and one for the house mix console and its auxiliary gear. The changeover between uses involves lowering the lift, removing one wagon, moving the other wagon into place, and raising the lift back into position. The wiring can even be arranged so the house console does not have to be unplugged and replugged. When a touring company arrives, the touring console is brought to the level below the auditorium. Both wagons are moved to storage, and the touring console and related gear are set up on the lift table and raised into place. Of all the options, this has the highest first cost, but given the ongoing expense of the demountable solution and the lost ticket revenue of the permanent solution, it may have the lowest lifetime cost.

Figure 15.3 Sound Cockpit Lift and Wagon Arrangement. (a) Section showing audience seating wagon in place. (b) Section showing sound cockpit wagon in place. (c) Half plan at auditorium level with seating in place. (d) Half plan at wagon storage level

Source: Author
Followspot Rooms

Use

A followspot is a large spotlight that is manually directed at a performer, and a followspot room (spot room, spot booth) is an enclosed and acoustically isolated space for followspot operation. Not all venues have followspots, and not all followspots are operated from acoustically isolated rooms. The most common use is in musical theater and many forms of popular entertainment, where followspots are used to provide front light. They focus attention on the lead performers, and are not meant to provide naturalistic lighting.

Location and Access

For this use, the spot room is located on the centerline of the auditorium, at a distance and height that provides an angle of light between 30 and 40 degrees above horizontal to a performer standing at the plaster line. Placing the room on centerline means each of the followspots housed there can provide the same coverage and angle of light, since the distance between the spots is negligible relative to the throw distance. The required lighting angle means that most followspot rooms are located at an elevation higher than the general building circulation, and it’s typical for a spot room to be accessible only from the technical catwalks above the auditorium. Followspot rooms are considered “limited access spaces” under the ADA and are not required to be accessible. A reasonable loading route must be provided for the equipment, however. Like audio mix consoles, followspots can be bulky and heavy.

Size

The room should accommodate at least three followspots—one each for the hero, heroine, villain—and more if the intended performances will require them. The space should be provided, even if the followspots are not, as it’s common practice to rent followspots for specific productions. The floor area needed will depend on the size and type of followspot, and this depends primarily on the throw distance to the stage. A good starting point is to provide 6 feet of width and 12 feet of depth for every followspot.
Sightlines

The followspots must have a range of motion and unobstructed sightlines allowing each spot to light any part of the performance area. At a minimum, the lower sightline should reach the conductor in the orchestra pit, and the upper sightline should reach 12 feet above the stage floor on a backdrop hung 24 feet from plaster line. These sightlines are illustrated in Figure 15.4, and the corresponding plan is shown in Figure 15.6.

To provide these sightlines, the observation window typically consists of large panes of glass, about 5 feet high by 6 feet wide, with silicon butt joints. Mullions are avoided if possible. Each pane is single-thickness, low iron, tempered float glass. Laminated glass is not used. The glass extends almost to the floor of the room—it’s useful to have enough space for an electric wireway at the base of the window. Provision should be made to allow cleaning both sides of the glass.

Other Uses

In opera and some other productions, soft-focus followspots may be used more subtly to both highlight and provide three-dimensional modeling of the performers. In addition to the front followspots, additional units may be located at the sides of the auditorium or above the stage, but these additional followspots are seldom in enclosed rooms.
Front-of-House Lighting Positions

In addition to a followspot room and the side lighting positions discussed in Chapter 10, the stage lighting designer and electricians will need positions in and above the auditorium for mounting spotlights to light the stage. The positions integrated with the auditorium ceiling, or hung below the ceiling, are called by various names, including beam, cove, slot, and catwalk. We’ll use catwalk for simplicity. The positions incorporated on the front faces of the balconies are called balcony fronts or balcony rails. Collectively, the catwalks, balcony fronts, and side lighting positions are called the front-of-house (or FOH) to distinguish them from the lighting elements on and over the stage.

Catwalks

Front light is typically organized in zones that span across the width of the stage, with each zone lit by multiple spotlights. When planning the catwalks, our first concern is the vertical angle of the lighting. Each zone, from the apron edge to the rear wall, should be lit from approximately the same angle above horizontal. At the front part of the stage, this angle is dependent on the number of catwalks and their locations.

Locations

To determine the optimal locations, a centerline section of the auditorium is drawn, as illustrated in Figure 15.5. To begin, set the center of the first zone four feet back from the stage riser. Draw a work plane (the surface to be lit) five feet above the stage floor. This will focus the light on the head and upper torso of the performer. Next draw lines from the center of the zone at the desired front lighting angles. The most important angle is about 45 to 50 degrees above horizontal. (If the project can only afford one catwalk, it should be located to provide this angle of light. But, feeling confident we can afford multiple catwalks, let’s continue our exercise.) The next most useful angles are bracketed above and below the first angle, say at 25 to 30 and 60 to 65 degrees above horizontal. If we’re feeling really confident about the budget, we might also draw a top light, at 80 to 85 degrees above horizontal.
Next, draw these angles for a second zone centered about eight feet upstage of the first. We don’t need to draw a third upstage zone, as that will be covered by the lighting battens above the stage. But if there is an orchestra lift or a demountable forestage, we need to draw a forestage zone about eight feet downstage of our first zone. We now have three zones and potential locations for nine catwalks. This is clearly too many! If we have a sketch from the architect of the proposed ceiling profile, we can overlay our diagram on the sketch and begin to work out catwalk locations that rationalize the lighting angles and work with the ceiling design.

Figure 15.6 illustrates the end result of this process. We have located four catwalks that together provide three lighting angles to each of our three zones. (Note that the fourth catwalk isn’t continuous, as it’s interrupted by the followspot room. Also, the steepest angle to the upstage zone is actually provided by the first lighting batten over the stage.) The angles are consistent within a tolerance of ± four degrees—an acceptable level of compromise.
Width

We now turn our attention to the lighting angles in plan. A catwalk that is the width of the proscenium opening may be adequate for straight-on front light, often called a “wash.” A wider catwalk is needed for “area lighting”— this is front light from each side, typically at a 45-degree angle from the centerline. Catwalks should extend across the full width of the auditorium in order to provide consistent lighting angles to the full width of each zone. If this is not enough width to provide a 45-degree lighting angle to the near side of the stage, then those spotlights are moved to a side lighting position instead.

Contour

We’re also concerned about the contour of the catwalks in plan and elevation. A catwalk that is level and perpendicular to the auditorium centerline functions best, but catwalks must often be shaped differently to accommodate the ceiling design. The slight curve in our example is not problematic, and tighter curves and reverse curves are possible. Catwalks may also slope up toward the auditorium centerline, or both
curve and slope. In these cases, the theater planner and architect collaborate to ensure that the catwalks are safe to use and provide the necessary range of lighting angles.

Balcony fronts

Each balcony face presents another opportunity for a front lighting position. Of course, the balcony locations aren’t determined by the needs of the stage lighting designer, and their utility as lighting positions will vary. The front of the first balcony is used most. For Broadway and other heavily produced shows the entire width of the balcony face may be filled with spotlights, scenic projectors, video cameras, and other equipment.

Elevation

Equipment mounted to the face of the first balcony affects both the upper sightline for the patrons on the main floor and the lower sightline for patrons in the balcony. The spotlight mounting rail is located so that the potential obstruction is centered between these two sightlines. Sightlines from higher balconies are steeper, and the mounting rail usually must be lower on the balcony face in order to keep the spotlights from interfering with views of the stage. A lower mounting rail can place the spotlights out of reach, however, making it difficult or impossible to service the spotlights.

Width

Architects sometimes prefer to minimize the width of the balcony front mounting rail, and for venues with modest needs, a 10 to 12-foot railing at the center of the balcony can be adequate. Other architects prefer a continuous mounting rail that can be incorporated into the balcony front design, and from a functional viewpoint this approach is preferred.

In some venues the mounting rail is continued along the faces of the galleries or boxes at the sides of the room, providing a side lighting position. If the balcony has a tight curve or the room is narrow, this mounting rail may obstruct sightlines from the ends of the balcony rows and from the galleries or boxes. If this is the case, the center rail is cut short, and the side rails are moved below the gallery or box fronts.
Chapter 16
Public Spaces

So far in Part II we’ve focused on the design of the audience and performance areas. In these last two chapters we turn to an overview of the public spaces (also called the front-of-house) and the non-public preparation and work spaces (called the back-of-house). This chapter discusses typical public spaces and their design considerations. The actual makeup of the public spaces depends on the owner’s needs and can vary widely.

First Impressions

The impresarios are correct: the show starts on the sidewalk, or in the parking lot, or even sooner. The patron takes away the totality of his or her experience, perhaps beginning with the purchase of a ticket, and including the trip to the theater, the ease of parking (if that trip was by private car), the lines at the restroom, the service at the bar, the appearance of the building exterior, public areas, and auditorium, and so on. There’s another equally true but less well known aphorism: people come to see shows, not buildings. It’s a pithy reminder that everything described in this chapter is peripheral to the performance itself.

Building Exterior

The most public aspect of any building is its exterior, and theater buildings can vary greatly in this regard. Prior to the eighteenth century, theaters were tucked away in palaces or other buildings, or had unpretentious forms that were simple reflections of their function. Frederick the Great’s Berlin opera house (1741) may have been the first modern theater building with a monumental appearance and prominent site. Such buildings are signifiers of the importance of the arts and their patrons, and are still common, as discussed in Chapter 1.

Theaters in an urban setting may be part of a streetscape and may present only a façade—or, as architect Robert Venturi described it, a “two-dimensional screen for propaganda.” In some twentieth century theaters the façade was not actually part of the theater, but fronted a long passage that brought patrons to an auditorium buried within the block or fronting on another street entirely. In New York, the American Airlines Theatre (formerly Selwyn, 1918) and the Lyric Theatre (1998), although actually
Some theaters have no or a very modest public face. The entrance to the Whitney Theater on the Yale University campus is a single door accessed through a parking lot. Washington DC’s Synetic Theater is housed in an underground shopping mall, rendering it practically invisible.

All of these theaters send messages by their appearance. The public receives these messages even before entering the building, and indeed these messages may prevent some portions of the public from ever entering the building.

Arrival

Patrons may arrive at the theater by car, taxi, public transportation, or on foot. School children and tour groups may arrive by bus. The location (urban, suburban, or on a campus) and the availability of services will determine which methods are most prevalent, but provision must be made for each. In the United States, much travel is by personal car and much emphasis is placed on the availability, ease, and cost of parking. Entire projects have been shelved over lack of nearby parking. In this context, “nearby” is a relative term—apparently, the appetite for walking from one’s car to the door of the theater varies between cities and regions.

A drop off location for arrival by vehicle is usually provided, and the ADA requires provision of accessible parking spaces. Local zoning ordinances may require a minimum number of parking spaces based on the auditorium seat count, and this figure can range from one parking space for every three to six seats. In addition to these requirements, the owner may wish to offer valet or other VIP parking.

Circulation

Once inside the building, the patron’s next challenge is wayfinding. Many performing arts buildings are unfortunately difficult to navigate. Two factors especially complicate the design of front-of-house circulation: the multiplicity of needs and the great variation in the number of occupants.

Performances

The peak demand on circulation is in the half hour prior to a performance, during intermissions, and
immediately after the performance. Prior to the performance a patron may need or want to meet up and socialize with companions, pick up tickets at the “will call” ticket office window, check a coat, use the restroom, grab dinner (or a snack or a drink), pre-order refreshments for intermission, purchase a program, browse the merchandise on sale in the lobby, and visit the gift shop or bookstore. Eventually, the patron and his or her companions will have their tickets scanned or torn, receive playbills, enter the auditorium, and find their way to their seats. The patrons’ needs and desires are similar during intermission, although constrained to a 15 to 20-minute period, making the crush even greater. In the United States, there is usually a mad dash for the coat check, exits, and parking lot immediately after the performance. But in some venues the lobby bars and restaurants will remain open after the performance, encouraging the audience to linger.

Non-Performance

During other, non-performance times the number of occupants and the demand on circulation is much less. There will be daytime visitors to the ticket office or administrative offices. In a public facility there may be a steady stream of visitors to the lobby bar, restaurant, or shops. On a college campus, the front-of-house often serves as a hub for the academic program, with areas for study and meetings, and possibly a café.

The building may also be open for special functions—business meetings, trade expos, classes, weddings, receptions, dinners, and other catered events—when the auditorium itself is not open. The public attending these events have similar needs to the patrons attending a performance, so the building layout must ensure the required amenities are available even when the auditorium is dark.

Service

The front-of-house circulation must accommodate deliveries of playbills and similar printed material; mail and packages to the offices; supplies and merchandise to bars, restaurants, and shops; and floral, linen, and catering deliveries. Trash and recycling must be taken out of the building. A connection between the front-of-house and back-of-house is needed for staff circulation, but also so that grand pianos and road cases of show merchandise can be easily moved from the loading dock to the lobby. It’s likely that caterers will be moving food in and trash out during performances, so this circulation must not overlap with critical back-of-house circulation.

Lobby and Support Spaces

Lobby
The previous discussion has hinted at some of the various uses of the lobby. When a show is in the house, the lobby is the area in which the audience gathers and socializes before the performance and during intermissions. It provides access to the auditorium and to patron amenities. The lobby may provide queuing space at the ticket office windows, coat check, and concessions. It’s often used for the sale of programs and other show merchandise. At other times, performances may take place in the lobby itself, or it may be used for a range of non-performance events—banquets, weddings, exhibits, and conferences.

Lobby size will depend on which of the above uses are intended. Lobby size can also vary depending on the site parameters and building configuration. Refer back to Figure 6.18 for an illustration of how three different ways of organizing the building place different demands on the lobby area.

Lobby size is defined in terms of net area per seat, assuming 100 percent occupancy of the auditorium, and this unit area is usually based on the total lobby footprint. When comparing lobby sizes, one might wish to distinguish between the total footprint, which includes circulation and queuing areas, and the actual footprint available for socializing. Analysis of each design is needed to determine the “socializing” area, and even then it may be difficult to distinguish areas for socializing, circulation, and queuing. An analysis of five recently built venues concluded that roughly half of the total floor area was “available for patron socializing without interrupting traffic flow.” In another one-fourth of the total area, patron socializing was possible but would “imped[e] traffic flow.” Interpreting these numbers is complicated by the fact that patrons do stand and socialize in places where they impede traffic flow, for example on the landings of open stairs. And this is not a bad thing, since it is one way in which the public spaces of a building are animated—that is, filled with energy and imbued with life.
One way to illustrate what lobby size means to the actual patron experience is to cut a few carpet squares of the proposed unit area and invite people to stand on the squares. This exercise can also be shown graphically. Figure 16.1 illustrates a 20 by 24-inch (about 2.5-square foot) body ellipse. This is the area required by an average standing adult, including a minimal personal buffer zone. Figure 16.2 illustrates this body ellipse centered in an area of 10 square feet, our substitute for a person standing on a carpet square. Figure 16.3 illustrates lobby densities ranging from 20 square feet per person (shown as two persons standing in a 40-square-foot area) to 2 square feet per person (shown as 20 persons standing in the same footprint).
In an article for Auditorium News, John Fruin, a researcher and specialist in pedestrian movement and crowd management, provides us with perspective on Figure 16.3:

In waiting areas, 20 square feet per patron will allow relatively free movement; 10 square feet, movement on an “excuse me” basis; and 5 square feet, standing without touching others—but with little ability to move freely. This is about the occupancy level that you see in most normal waiting situations, such as approaches to a busy escalator or stair. At approximately 3 square feet per person, involuntary touching and brushing against others will occur, a psychological threshold that should generally be avoided in most public situations. Below 2 square feet per person, potentially dangerous crowd forces and psychological stresses may begin to develop.

An historic Broadway theater has a lobby area of less than three square feet per seat. This is too small, as Fruin states and as any New York theatergoer can attest. At the other extreme, the Myerson Symphony Center in Dallas (1989) has a lobby area of 24 square feet per seat. The disadvantage of such a large lobby is that it may not feel animated even with a full house. The lobbies of most recently built theaters fall within a tighter range, between five square feet per seat (a reasonable minimum for comfort and safety) and 15 square feet per seat (a generous size, but not so large that it does not feel animated and exciting).
Ticket Office

The technology used for ticketing has changed dramatically in recent years, and it continues to change, but the ticket office (or box office) remains an important point of personal contact between the patron and the arts organization. Ticket office designs range from the highly secure, with bulletproof sales windows, to open counters similar to a hotel registration counter. The trend is perhaps toward open counters, as the exchange of cash at ticket windows declines and many arts organizations attempt to improve the experience of their customers.

The ticket office is usually located near the public entry to allow convenient access for daytime visitors. The location must allow space for patrons to queue at the sales stations without disrupting the flow of other patrons in and out of the building. At some venues, ticketing is handled elsewhere, and the ticket office is only open immediately before the performance. At other venues the ticket office is a workplace that is open daily, even when the auditorium is dark. This type of ticket office may have extensive nonpublic areas such as a manager’s office, workrooms, and call centers. These non-public spaces are sometimes located on the floor directly above or below the sales area, with a private connecting stair. This avoids a large footprint at the main floor of the building while preserving both security and the desired adjacencies.

How and when tickets are purchased depends on the nature of the organization, the type of performance, and the audience. There are performances for which the majority of tickets are sold the day of the event. A good starting point for determining the number of sales stations is to provide one for every 300 seats. At minimum, two stations should be provided so that current sales and “will call” (pick up of already purchased tickets) can be separated. If the climate allows, exterior sales windows can be provided. These are sometimes asked for (or required) by urban design commissions that are seeking to animate the streetscape.

Concessions

Showrooms and other popular entertainment venues may provide food service within the auditorium, and most venues provide some form of food and beverage concession in the lobby, including alcohol if it is appropriate. A starting point for sizing lobby concession areas is one sales station for every 120 seats. Lobby concessions work best if the sales points are distributed, especially in larger facilities, although storage and preparation facilities are often centralized. The sales points should be located so that queues do not interrupt circulation. Concession areas can clutter up a lobby design, and some architects resist providing permanent facilities. A look through a catalog of portable concession stands should convince them to design permanent stations.

Coat Check
Coat check services are sometimes provided, but they are not widely used. A rough rule of thumb is to provide space for one checked coat for every three or four seats. In the United States, few operators seem willing to provide the numbers of staff needed to prevent a long wait to retrieve one’s belongings after the performance. As a consequence, patrons going to a performance are likely to bring their coats into the auditorium. (This can have a side effect of increasing the acoustic absorption in the room and lowering the reverberation time, which can be problematic in concert venues.) Patrons attending an event (instead or in addition to a performance) are more likely to check items. Of course, climate also affects the need for coat check facilities.

Restrooms

Restrooms are most heavily utilized immediately before and after the performance and during intermissions. Providing an acceptable level of service, especially during a 15 to 20-minute intermission, requires more fixtures (water closets and urinals) than code requires. A very high level of accommodation is one fixture for every 20 seats, and a reasonable level of accommodation is one fixture for every 40 seats. Most new venues fall in the range of one fixture for every 25 to 30 seats.

The building code requires gender-specific restrooms. The recommended split between women and men is 2:1, with twice as many fixtures provided for women. All-gender restrooms are beginning to appear, especially on college campuses.

In multi-tier facilities restrooms should be provided at each level in proportion to seat count. And in larger facilities, of say 1,000 seats or more, it’s desirable to have restrooms on each side of the auditorium to avoid long travel distances. Rooms for men and women should be located together, both to improve wayfinding and to avoid separating couples at intermission. The possibility of queues and the noise of plumbing should also be taken into consideration when locating restrooms.

Family assist restrooms (also called single-user or accessible restrooms) are required by the building code. Ideally, a family assist restroom should be provided near every pair of gender-specific restrooms. At minimum, each floor level with restrooms should have one family assist restroom.

Service Spaces

The front-of-house may include service spaces in addition to the public spaces, though the extent of these spaces varies with the type of organization and the needs of the operator. Typical spaces include an office for the house manager, locker rooms for ushers and other FOH staff, and storage for playbills, furniture, housekeeping supplies, concessions, and liquor.

Function Rooms
Many venues have one or more front-of-house spaces for pre-performance functions or for other events. These rooms can be roughly divided into public reception rooms and rooms for VIPs. In addition to supporting the organization’s programming, both types of rooms may be critical to revenue generation—the reception rooms by providing rental income and the VIP rooms as an aid in developing long term contributors.

Public Reception Rooms

Public reception rooms might be used for receptions, meetings, banquets, educational programming, rehearsals, or performances. A larger building may have multiple rooms, varying in size from a few dozens to several hundred occupants. The capacity of a function room will depend on how it’s used: for example, a 40-foot by 50-foot room can accommodate a reception for 200 persons, a banquet for 100 persons, an intimate drama performance for an audience of about 100, and rehearsals for a 50-person chamber orchestra. These uses may not be compatible, however. Rooms are typically planned for a relatively narrow range of activities, and they are sized, finished, and equipped to suit those uses.

The function rooms must be conveniently accessed from the public building entrance, with access to the coat check and restrooms, even when the main auditorium is dark. Most function rooms also need a back-of-house connection, for food service or for production elements and personnel.

The need for support spaces depends on the intended uses. In our example above, the banquet requires a kitchen (either full production or warming) and a space near the function room for preparation and plating. The drama performance may require control and equipment rooms. To support the multiple uses, storage is also needed—for banqueting tables and chairs, seating risers, production equipment, musicians’ chairs, and music stands.

VIP Rooms

VIP rooms are, by definition, more exclusive than the public reception rooms. They are usually smaller and more intimate, and may have a higher finish level. We can distinguish four types: donor rooms, sponsor rooms, front-of-house greenrooms, and retiring rooms.

Donor Room

A donor room (or lounge) is a reception room available to donors to the arts organization (or other VIPs) before and after the performance and during intermission. A donor room is usually equipped with its own bar, pantry, restrooms, and coat room—providing access to these amenities without the crush or wait experienced by the general public. The room is often located to be easily accessible to the box tier (if there is one) or to other preferred seating areas. The room may be available to donors for receptions and dinners at other times, sometimes for an additional fee. Many arts organizations provide “tiered”
membership levels, with more or better amenities at each level. These organizations may have multiple donor rooms, with access to a more exclusive room available at a higher level of financial commitment.

**Sponsor Room**

A sponsor room is an exclusive function room made available to a corporate sponsor to provide hospitality to guests or employees in connection with a performance underwritten by the sponsor. It is similar to a donor room in configuration and location, and differs mostly in how it is programmed.

**Front-of-House Greenroom**

A front-of-house greenroom is an intimate reception room used by principal performers for “meet and greet” functions before and after performances. (The term “greenroom” is also used to describe the informal performer lounge found in the back-of-house, sometimes leading to confusion.) The FOH greenroom may be located at the juncture between the front and back-of-house to facilitate access by both the public and performers. For example, the Audubon Room at the Overture Center is at the level of the first tier, the preferred seating level, and is accessible on one side from the front-of-house circulation. On the opposite side, the room leads to a dressing room suite and the back-of-house circulation.

**Retiring Rooms**

A retiring room is a small anteroom connected with a private seating box, available only to the patrons of that box. Access to the box is through the anteroom, allowing the box patrons to enter or leave discreetly. Some retiring rooms are closet-sized and allow no more amenity than a place to hang one’s coat. Others are larger and may contain comfortable furniture and a service bar.

**Other Public Amenities**

Other amenities are sometimes incorporated into the front-of-house of performing arts and entertainment venues. Eating and drinking establishments, retail spaces, and exhibition spaces (museums or galleries) are the most common additions. These amenities may be offered because they are not otherwise available nearby, or the motive may be to entice patrons to spend more of their evening (and dollars) at the venue. Often the intent is simply to bring more of the public into the building and to activate the building when it would otherwise be dark. If any of these amenities is proposed as a significant component of the project, then a specialty consultant—in food service, retail, or galleries—will likely be retained to help with the programming and planning.
Food and Drink

Food and drink are the amenities most commonly offered, either as enhancements to the lobby concessions or in the form of cafés, full-service restaurants, or bars open to the general public. Operations can vary widely, and the required space and support vary with the type of operation.

Little extra is needed to offer upscale concessions, but a production kitchen (whether it is servicing banquets, a restaurant, or both) has a large footprint and distinct needs for loading, circulation, and building services.

The possible range of clientele, menus, and hours of operation is illustrated by the following four examples. All four offer bar service, but they are otherwise different in scale and character. The Claire Tow Theater bar at Lincoln Center Theater in New York provides an example of limited hours and simple fare. It’s open to ticket holders one hour before curtain and after the show, offering bar service and “small plates.” Also in New York, “The Library” at the Public Theater is open to the public nightly for full dinner service and cocktails, while the Signature Center Café and Bar is open longer hours (noon until midnight) but offers lighter fare. At the other end of the spectrum, “The Cut” at the Young Vic Theatre in London is open to the public 15 or more hours daily and serves breakfast, lunch, and dinner. It’s a popular nightspot that appears to have a clientele that is largely distinct from the Young Vic’s audience.

Retail

The lobbies of touring facilities must provide space and power for multiple points of sale for show merchandise. These sales stations are sometimes permanent, but more often they are portable themed kiosks that travel with the show. The most common permanent retail space is the gift shop, which can vary from a small volunteer-run space to a sophisticated and highly-profitable extension of a corporate entertainment brand. Additional retail spaces may be added to attract daytime visitors, often with a tie-in to the performance programming. For example, in addition to its café and bar, the Signature Center has a bookstore that features works by its playwrights-in-residence.

Museums and Galleries

The impulse to add an exhibit component to a performing arts facility is most common in educational settings. Sometimes the motivation is to combine functions to avoid building both a lobby and a gallery space—two large and seemingly underutilized spaces. The lobby is a potentially underutilized space, and at first blush exhibition seems like a compatible use. Informal exhibition of artworks or objects of modest value is compatible, but if the items are of more than modest value (or if they are on loan) then obstacles arise. The organization’s insurance policy (or the terms of the loan) will likely require that the items be displayed in a secure, climate-controlled environment, and it’s difficult to reconcile these requirements
with the other uses of the lobby. Designing common space that meets the requirements for exhibits while being open and accessible enough to function as lobby would be a serious challenge. If the design challenge is solved, there are still operational issues to consider, such as coordinating the exhibit hours and staffing with performance times, or how to keep theater patrons with food and drink away from the artwork! Sometimes a separate gallery with the necessary security and climate control is included in the building as a complementary amenity, but it must occupy additional floor area, not space shared with the lobby functions.
Chapter 17
Back-of-House Spaces

The makeup of the non-public preparation and work spaces depends upon the entertainment or performing arts form, the type of presenting or producing organization, and the specific needs and resources of the owner. The back-of-house can be completely unoccupied except for short periods when a touring company is in the building, or it can be the daily workplace of hundreds of people. This chapter outlines typical back-of-house elements, starting with circulation needs and then discussing stage support, performer support, and production areas in turn. Only a very large facility will have all of the elements described. The administrative and building service areas of performing arts buildings do not have any unusual requirements and are not discussed.

Circulation

Efficient backstage operations depend on the proper arrangement of individual spaces and the circulation paths between those spaces. The personnel entering the building have differing needs and destinations depending on their roles, and arriving materials and equipment are moved to different areas of the building depending on their use. The circulation in an academic building that includes both a performance space and teaching areas may be organized so the performance space can be open and occupied while the remainder of the building is secured and unoccupied. Similarly, the circulation in buildings with multiple venues may be organized so that each venue can be operated securely and independently of the others.

Performers

In professional settings, performers enter at the stage door, which provides them access to rehearsal rooms, dressing rooms and other preparation areas, the performer lounge, and the stage or concert platform. In educational settings, the public and back-of-house circulation may overlap, and performers and production crew are likely students who enter through the public areas of the building.

Production Elements
In a touring house the physical production elements (scenery, properties, wardrobe, and lighting, sound, projection, and other equipment and materials) arrive at the loading dock. Popular music acts and national touring productions of Broadway shows will arrive in multiple 53-foot semi-trailers. Large acts and shows may tour with 20 or more trailers. Much material will be moved directly onto the stage, wardrobe cases will go to preparation areas backstage, and merchandise cases may go directly to the lobby. Other road cases will be stored along the walls of the backstage corridors, which are usually a minimum of eight feet wide to accommodate this practice. Concert halls may receive touring orchestras, popular music acts, and other productions, and they have the same loading and circulation needs as other touring houses.

If the organization is a producing house (that is, if it mounts its own productions) then the materials needed to build scenery, properties, and costumes must be moved from the loading dock to the scenery, property, and costume shops. Once complete, these production elements must be moved to the stage or to preparation areas backstage. If the shops are not in the building, then the completed production elements arrive at the loading dock as in a touring venue.

Production Crew

The technical staff and crew may enter at the stage door. They need access to the crew lockers, technical work areas, and the stage or concert platform. Depending on the nature and culture of the organization, the backstage may be organized to keep the crew spaces and circulation largely separate from the areas used by the performers. Often this means arranging crew spaces on one side of the stage, probably on the loading dock side, and the performer spaces on the opposite side of the stage. In an educational setting, where performers and crew are students who enter through the same public areas, this separation is probably not provided, and indeed may not be desirable.

Food Service

As discussed briefly in the last chapter, food service has its own back-of-house operation, which can be sizable. If meal prep is onsite, then the raw materials arrive at the loading dock and are moved to a production kitchen or to storerooms. Prepared meals are moved from the kitchen to plating areas or directly to dining areas. Catered meals may arrive at the loading dock and go directly to plating areas. Used dishes are moved to washing areas or out of the building, and trash is moved out of the building. All of these circulation needs, from loading dock to dining room, must be independent of the performer and production circulation.

Other Personnel

Access to the administrative areas may be through the stage door (more likely in professional
organizations) or through the public lobby (more likely in educational settings). Very large organizations may have one or more employee entrances for administrative, front-of-house, food service, housekeeping, and maintenance staff, providing each with access to their work areas.

Front-of-House Connection

As noted in the last chapter, connections between the front-of-house and back-of-house circulation are critical. Routes are needed to move sound mix equipment and followspots from the loading dock to the auditorium, and to move pianos, merchandise cases, and other large items from the loading dock to the lobby. Crew members need quick access from back-stage to control rooms, and performers need access to the front-of-house greenroom.

Stage Support

Stage support spaces are those immediately adjacent (or in close proximity) to the stage or concert platform they serve.

Quick Change

A quick change room is a space immediately offstage for costume changes. It usually holds no more than two people, the performer and dresser, but there are exceptions—the quick change room at Radio City Music Hall accommodates 36 dancers, their costumes, and their dressers! Very often a quick change room is not included in the building program, and draperies are used to create an offstage changing “booth” when one is needed.

Crew Rooms

In commercial settings the crew rooms are often closer to the stage than the performers’ dressing rooms. They may include a common waiting area and lockers, toilets, and showers for men and women. Almost always the waiting area is called a “ready room,” apparently because “lounge” sends the wrong message.

Even when the crew rooms and dressing rooms include toilets, one or two offstage toilets are provided for immediate needs.

Scenery and Loading Docks

The scenery dock (or scene dock) is a large, high-ceiling loading, staging, and storage area adjacent to the
The loading path for scenery and equipment coming from the loading dock (or from the scenery shop) is usually through the scene dock. In many facilities the loading dock and truck bays open directly into the scene dock. This is desirable, especially in touring houses, because it makes load-in faster and reduces the number of crew members required. In other facilities the loading dock may be distant from the stage, even on another floor level, and connected by a wide corridor. This arrangement may require two crews—one at the loading dock and one at the scenery dock.

Workshops

Workshops are typically small spaces (under 250 square feet) that serve repair and maintenance needs. They are not fabrication shops, which are larger spaces described later. If the fabrication shops are in the same building as the performance venue, they may serve the repair and maintenance needs, and no workshops are provided. However, touring venues usually do not have fabrication shops, so they almost always have workshops.

Workshops in a theater may include scenery maintenance (which may double as hand tool storage), a property shop (which may include a kitchen for preparing prop food), and shops for lighting (often called electrics), sound, and projection. A concert hall may have any or all of these shops and may also have a shop for the care of musical instruments.

These workshops often double as storage areas for related equipment and supplies, or storage might be provided separately. If the venue is a “union house” the department heads (carpentry, properties, electrics, and maybe sound) may use their respective workshops as offices. In some venues separate head-of-department offices are provided.

Offices

The offices of the stage management and technical staff are usually located near the stage. Touring houses and concert halls provide temporary office space for visiting productions and visiting orchestras. These may take up more space than the offices for the house staff, up to 1,000 square feet or so.

Storage

The stage support category includes storage for equipment and supplies used on the stage. Other storage (for example, long term storage of scenery, property, and costume inventories) is outlined later.

Stage storage may include rigging, lighting and electrics, sound, projection, and drapery (called “soft goods”). Special storage may be required for pyrotechnics, paints, flammables, and prop weapons. A piano storage room is very common, and some venues will have more extensive musical instrument storage rooms. Finally, as large a room as feasible will be provided for general storage—items such as
choral risers, dance floors, personnel lifts, and ladders.

**Performer Support**

Performer support spaces include the stage door, dressing rooms, wardrobe rooms, and preparation spaces.

**Stage Door**

The stage door is the backstage entrance for the performers and other production personnel. The exterior stage door leads to a secure waiting area overlooked by reception or security personnel who control access to the building.

**Dressing Rooms**

Dressing rooms vary in occupancy, size, level of finish, and amenities. Somewhat simplifying the possible range, we’ll discuss single occupancy rooms, small rooms, and large rooms.

**Single Occupancy**

Single occupancy rooms are called star dressing rooms, principal dressing rooms, soloist dressing rooms, one-person dressing rooms, or sometimes “one to two-person” rooms to acknowledge the possibility of doubling up. A conductor’s room is another type of single occupancy dressing room. The various names may indicate different features: A star or principal room may have space for comfortable furniture, or even a separate salon for relaxing or socializing. Soloist dressing rooms and conductor’s rooms may have pianos. What they share in common is generous space (a minimum of 180 square feet), a makeup station for one or two persons, and en suite restroom with water closet, lavatory, and probably a shower.

A typical, minimum complement of single-occupancy rooms is five. This provides individual rooms for the leads of most dramas, for a piano quintet, or four soloists and the conductor. Some venues, often in educational settings, have no single occupancy rooms at all.

**Small Rooms**

We’ll classify rooms for four to eight persons as “small” rooms. Rooms of this capacity have more floor area per person (about 60 square feet) and a higher ratio of toilet fixtures to occupants than larger rooms. These rooms will have a chair and a 36-inch wide section of makeup counter for each performer, and one
or two fixed or rolling costume tracks. (Rolling racks are convenient for moving costumes between the dressing rooms and wardrobe.) Restrooms will be en suite, with one or two water closets, lavatories, and showers resulting in a ratio of one fixture of each type for very four to eight performers. Drama theaters often have a complement of small dressing rooms rather than a mix of principal and chorus rooms.

**Large Rooms**

Large rooms (also called group or chorus dressing rooms) serve between 12 and 24 performers. These provide about 40 square feet per person without en suite restrooms, slightly more if restrooms are included. Often, an odd number of large rooms is provided and restrooms are kept separate, which allows flexibility in assigning dressing rooms by gender. Each performer has a chair and a section of makeup counter. Often these are along opposite walls with rolling costume racks down the center of the room. The ratio of restroom fixtures to performers is typically no more than one fixture of each type for every eight performers. The exception is lavatories (hand basins) which may be provided in greater number within the dressing room itself.

**Musicians’ Rooms**

Musicians’ needs are different. A resident orchestra typically has changing/locker rooms that provide about 15 square feet per person. Changing rooms for a pit orchestra may have a higher unit area because the lower number of occupants means some loss of economy in the layout. Restrooms, showers, and instrument uncasing and layout space are in addition.

**Other Approaches**

Dressing rooms and changing rooms have a very low utilization rate, even in a busy facility, yet they are planned and equipped so specifically that it is difficult to identify compatible shared uses. One way to reduce the dressing room footprint, most common in educational settings, is to provide smaller changing rooms segregated by gender and a common room for applying makeup and styling hair. The common room can also serve as the performer lounge, a classroom, or possibly a rehearsal room. Another approach is to build as few permanent dressing stations as feasible, and to turn a rehearsal room into temporary dressing stations when they are needed. Some touring companies travel with their own dressing stations built into road cases for this purpose.

**Wardrobe**

The wardrobe department assists performers with costuming, wigs, makeup, and prosthetics and maintains and cleans those items. The wardrobe facilities are usually located in close adjacency to the dressing rooms. Many schools and community theaters do not have wardrobe facilities, and instead
costumes are laundered and cared for offsite.

**Wardrobe Workroom**

The wardrobe workroom is used for the care and maintenance of costumes, for minor repairs, and in a union house it may serve as the office of the head of the department. It typically provides a work surface, sewing machine, steam iron, and storage for supplies and the costumes under care. If the costume fabrication shop is in the same building as the performance space, and not too distant, it may serve the wardrobe functions, and a wardrobe room will not be provided.

**Laundry**

Laundry facilities vary from a single washer and dryer to as many as four washers and four dryers. A utility sink, work table, and storage are also needed. Sometimes the laundry and wardrobe workroom are combined. Production laundry must be separate from housekeeping laundry. If they share a room, at least different machines must be used for each purpose.

**Wigs and Makeup**

A large operation will have one or more additional workrooms in which dressing staff prepare performers prior to the show and clean and care for wigs and prosthetics between performances. In smaller or simpler operations, the wardrobe workroom may accommodate these functions.

**Physical Therapy Room**

A production that emphasizes physical performance, such as a Cirque du Soleil show, will have a physical therapy room. A touring production will travel with the equipment needed to set up a temporary physical therapy room in a vacant dressing room or small rehearsal room.

**Performer Lounge**

A performer lounge is sometimes called a greenroom, and in a concert hall it will likely be called the musicians’ lounge. It is not a “meet and greet” reception room, but a space for resting and socializing backstage. The root purpose of a performer lounge is to provide a space in which performers can wait when they are not performing on stage. For this purpose, the lounge should be located in proximity to both the dressing rooms (or musicians’ rooms) and the stage (or concert platform).

Performer lounges tend to accumulate other uses and activities, often reflecting the particular culture of
Production

The two main categories of production spaces are rehearsal rooms and fabrication shops.

Rehearsal

The numbers and sizes of rehearsal rooms vary with the needs of the organization. Touring houses should have at least one large rehearsal room available for the use of touring companies. Producing organizations need at least one rehearsal room sized to match the stage or concert platform of their largest performance space.

Theater productions and dance and music concerts usually start in rehearsal rooms and move into the performance space for a limited period before performances begin. For theater and dance rehearsals, the rehearsal room must match the performance footprint so actors can rehearse the stage movement (called “blocking”) and dancers can rehearse the choreography. Typically, the scenery ground plan is “taped out” on the rehearsal room floor, and room for circulation and seating around the ground plan is desired. The rehearsal room must provide enough space around the performance footprint to ensure that dancers can safely enter and exit. Musical ensembles require a footprint large enough to accommodate the ensemble layout, and extra space on all sides is desired, not only for circulation but also to keep the players away from close acoustically reflecting surfaces.

Additional rooms of this size may be required, depending upon the number of productions in rehearsal at one time or the number and frequency of ensemble rehearsals. In addition to the large rehearsal rooms, smaller ones may be desired for scene work, sectional rehearsals, or smaller ensembles. More spaces of all sizes may be needed in educational settings, to meet the academic needs in addition to the production needs.

All rehearsal rooms should have nearby storage, for rehearsal furniture, properties, tables, chairs, music stands, mats, and similar items. Rehearsal rooms used for small performances might have a control room, and some rooms have connected offices or vocal coaching rooms.

Shops and Storage
Producing companies will have shops for the fabrication of scenery, costumes, and other production elements, and places to store items from past productions. Opera companies may keep entire productions in storage, and may rent them to other companies or revive them in future seasons. More commonly, companies will retain selected scenic elements, furniture, hand props, and costumes in inventory. At some future date, these items are pulled from inventory, reworked, and used in new productions.

Fabrication shops and storerooms can take up a large footprint. In professional settings these spaces are often distant from the theater building, located where real estate is less expensive and a more utilitarian building can be provided. In educational settings, the shops probably also serve as instructional spaces, which means they cannot be remote from the students’ other classes. Long term storage, however, can be remote in both settings.

Shop spaces may include scenery, properties, paint, costumes, lighting/electrics, sound, and projection. Each type is described below as a discrete space, but the adjacencies between shops affects both economy and efficiency. For example, if the properties shop is near the scenery shop, then duplication of some tools can be avoided. If the scenery and paint shops are adjacent, then fabricated scenic pieces can be more readily moved to the paint shop for finishing.

**Scenery Shop**

The scenery shop is usually the largest of the shops and may have an area of several thousand square feet. Shop size is affected by the size of the proscenium opening that must be filled with scenery, the size of the production budget, the number of productions under construction at once, and the types of materials used. A complete shop may include fabrication areas for wood and metal scenery, set-up space that approximates the size of the scenery area on stage (refer back to Figure 9.4), machine shop, automation shop, office and locker space, tool storage, and storage for raw materials and hardware.

**Property Shop**

A property (or prop) shop is much smaller, since the items being made range from small hand props to furniture pieces. A prop shop has a fabrication area, crafts area, upholstery room, office, tool storage, and material storage. If the scenery shop is not nearby, the property shop will need its own table saw.

**Paint Shop**

Prior to the early twentieth century, the prevalent method of scene painting was “painting up” with the scenic backdrop stretched on a vertical frame. In this method either the “paint frame” is moved past the floor or gallery on which the scene painters stand, or the painters work from a gallery that moves. This arrangement requires height but only a limited footprint. It is rarely found in newer theater buildings. The dominant style of scene painting today is “painting down” in which the backdrop is stretched out
horizontally on the shop floor. This method doesn't require extra height, but it does require a large footprint, and this is not always feasible or affordable. If the paint shop is not large enough to accommodate a backdrop, it might be stretched out on the stage, in a rehearsal room, or in the setup area of the scene shop. Obviously, this precludes other uses of those spaces while the drop is being painted.

If an area for “painting down” is not provided, the paint shop will be used to work on small pieces and as a preparation area for larger pieces painted in the scene shop or on stage. The typical paint shop has spaces with special ventilation for mixing and spraying, a shop office, tool storage, and material storage.

Costume Shop

Costume shop size is determined by the number and the elaborateness of the costumes that must be produced, but also by the processes and equipment used. The result is that even a shop that produces relatively few costumes needs a minimum footprint to accommodate the required craft work and equipment.

The main shop floor is where draping, layout, cutting, sewing, and pressing occur. At least one 4’ by 6’ or 4’ by 8’ cutting table is required, plus space for one or more sewing machines, sergers, steam ironing tables, and fitting forms. Materials and frequently used stock must be readily at hand, either stored in the main shop or an adjacent space.

In addition to the main area, a typical shop will have an office; a laundry room with a washer, dryer, and utility sink; a dye room with special ventilation and a commercial dye vat; and a crafts room for jewelry, millinery, and other work with paints and adhesives, also with special ventilation. The shop may have one or more rooms for fitting costumes to performers, with full-length mirrors and good lighting, but if they are nearby, dressing rooms can be used as fitting rooms.

Electrics, Sound, and Projection

The electrics, sound, and projection shops are three separate spaces, but with similar needs. Each must provide office space, tool storage, a work area, and storage space for equipment. A drill press is an essential tool, probably shared. In addition to equipment repair and maintenance, these shops can be used to fabricate a wide range of production elements and equipment, for example, property lighting fixtures, LED backdrops, or distribution systems for smoke or haze effects.
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