## CONTENTS


**ATRIUMS**

- OVERVIEW
- PRECEDENTS
- SCHEMATIC DESIGN
- GREEN ROOFS


- **ATRIUMS**


**TEAM 6**

**NWARAMBILLI UGBODE**

EKATERINA SIGAL

SERGIO ZAPATA

# CONTENTS

# ATRIUMS

- OVERVIEW
- PRECEDENTS
- SCHEMATIC DESIGN
- GREEN ROOFS

*Atrium of the basilica of Sant'Ambrogio, Milan, 1088–1128.—Alinari/Art Resource, New York*

IN AN ANCIENT ROMAN HOUSE, AN OPEN CENTRAL COURT THAT CONTAINED THE IMPLUVIUM, A BASIN WHERE RAINWATER COLLECTED. IT ORIGINALLY CONTAINED THE HEARTH AND FUNCTIONED AS THE CENTER OF FAMILY LIFE. THE TERM LATER CAME TO BE USED FOR THE OPEN FRONT COURTYARD OF A CHRISTIAN BASILICA,, WHERE CONGREGANTS COLLECTED BEFORE SERVICES. THE ATRIUM WAS REVIVED IN THE 20TH CENTURY IN THE FORM OF GLASS-COVERED, GREENERY-FILLED MULTISTORY SPACES SOMETIMES FOUND IN SHOPPING CENTERS, OFFICE BUILDINGS, AND LARGE HOTELS.

- http://www.merriam-webster.com/dictionary/atrium

IN ARCHITECTURE, AN **ATRIUM** (PLURAL: **ATRIA** OR **ATRIUMS**) IS A LARGE OPEN SPACE LOCATED WITHIN A BUILDING. ATRIA WERE A COMMON FEATURED IN ANCIENT ROMAN DWELLINGS, PROVIDING LIGHT AND VENTILATION TO THE INTERIOR. MODERN ATRIA, AS DEVELOPED IN THE LATE 19TH AND 20TH CENTURIES, ARE OFTEN SEVERAL STORIES HIGH AND HAVING A GLAZED ROOF AND/OR LARGE WINDOWS, AND OFTEN LOCATED IMMEDIATELY BEYOND THE MAIN ENTRANCE DOORS.

ATRIA ARE A POPULAR DESIGN FEATURE BECAUSE THEY GIVE THEIR BUILDINGS A "FEELING OF SPACE AND LIGHT". FIRE CONTROL IS AN IMPORTANT ASPECT OF CONTEMPORARY ATRIUM DESIGN DUE TO CRITICISM THAT POORLY DESIGNED ATRIA COULD ALLOW FIRE TO SPREAD TO A BUILDING'S UPPER STORIES MORE QUICKLY.

THE 19TH CENTURY BROUGHT THE INDUSTRIAL REVOLUTION WITH GREAT ADVANCES IN IRON AND GLASS MANUFACTURING TECHNIQUES. COURTYARDS COULD THEN HAVE HORIZONTAL GLAZING OVERHEAD, ELIMINATING SOME OF THE WEATHER ELEMENTS FROM THE SPACE AND GIVING BIRTH TO THE MODERN ATRIUM.

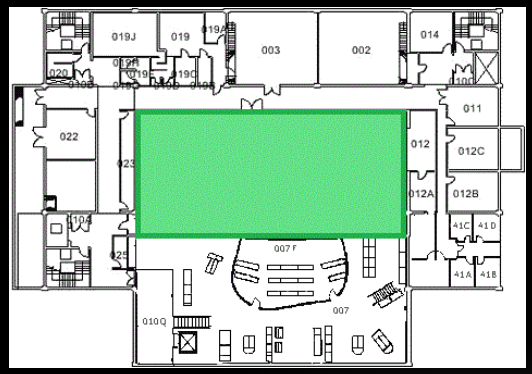
- http://en.wikipedia.org/wiki/Atrium_%28architecture%29

## CONTENTS

## ATRIUMS

- OVERVIEW
- **PRECEDENTS**
- SCHEMATIC DESIGN
- GREEN ROOFS

THE FOUR FLOOR ATRIUM OF GOULD HALL
3949 15th Avenue NE
Seattle, WA USA
COLLEGE OF ARCHITECTURE AND URBAN PLANNING, AT THE UNIVERSITY OF WASHINGTON




FIRST FLOOR PLAN

- https://digital.lib.washington.edu/architect/structures/6068/

## CONTENTS

## ATRIUMS

- OVERVIEW
- **PRECEDENTS**
- SCHEMATIC DESIGN
- GREEN ROOFS

ATRIUM OF MEYERS PEDIATRIC HOSPITAL
Florence, Italy

THE MEYERS PEDIATRIC HOSPIAL IN FLORENCE, ITALY IS AN EXCEPTIONAL SUSTAINABLE DESIGN THAT HARNESSES ARCHITECTURE TO HELP THE HEALING PROCESS. THE COMPLEX IS LOCATED IN A PARK-LIKE SETTING AND CONSISTS OF AN EARLY 20TH CENTURY BUILDING UPDATED WITH A NEW SUSTAINABLE WING. WITH AN EXTENSIVE GREEN ROOF, ROBUST DAYLIGHTING, AND COPIOUS ART AND OPEN SPACE THE HOSPITAL PROVIDES AN IDEAL ENVIRONMENT FOR HEALING.

- http://inhabitat.com/stunning-green-roofed-hospital-heals-through-green-design/atrium-at-night/

## CONTENTS

## ATRIUMS

- OVERVIEW
- **PRECEDENTS**
- SCHEMATIC DESIGN
- GREEN ROOFS

ATRIUM OF KURAYOSHI PARK SQUARE
Kurayoshi, Japan

* ALSO FOUR FLOORS

http://www.cecobois.com/repertoire/index.php?option=com_rea&view=fiches&id=217&Itemid=112

# CONTENTS

## ATRIUMS

- OVERVIEW
- PRECEDENTS
- SCHEMATIC DESIGN
- GREEN ROOFS

## CONTENTS

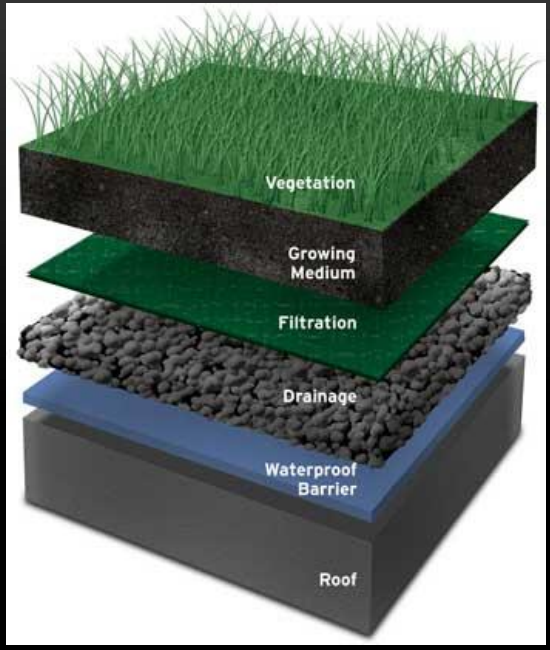
## ATRIUMS

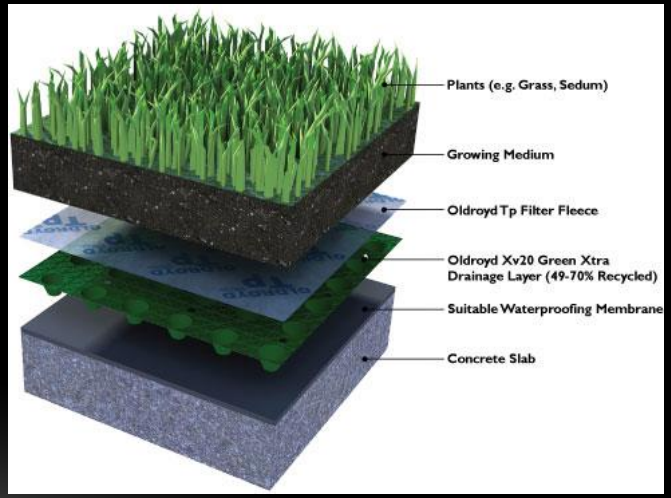
- OVERVIEW
- PRECEDENTS
- SCHEMATIC DESIGN
- GREEN ROOFS

BUILDING A GREEN ROOFTOP INVOLVES INSTALLING A WATERPROOF BARRIER OVER THE ROOF, THEN OVERLAYING ONE TO SIX INCHES OF SOIL. THERE ARE TWO SYSTEMS OF GREEN ROOF DESIGN: **EXTENSIVE** AND **INTENSIVE**. BOTH SYSTEMS INCLUDE RAINWATER CATCHMENTS THAT SEND THE FILTERED RUNOFF INTO BARRELS FOR LANDSCAPE IRRIGATION, EITHER FEEDING BACK TO THE ROOF GARDEN DURING DROUGHTS OR TO SURROUNDING YARDS AND PREVENTING RUNOFF THAT TYPICALLY POLLUTES WATERWAYS AND GROUNDWATER.

*EXTENSIVE* ROOF DESIGN IS THE MOST LIGHTWEIGHT WITH THE LEAST AMOUNT OF SOIL. IT SUPPORTS WATER-RETENTIVE PLANTS SUCH AS SUCCULENTS, WHICH NEED LITTLE MAINTENANCE ONCE ESTABLISHED.

*INTENSIVE* DESIGN USES A DEEPER SOIL LEVEL TO SUPPORT VEGETABLES AND EVEN TREES FOR A PRODUCTIVE GARDEN.




- http://drive2.subaru.com/Win11/greenRoofTops.htm

## CONTENTS

## ATRIUMS

- OVERVIEW
- PRECEDENTS
- SCHEMATIC DESIGN
- GREEN ROOFS

DESPITE THE UP-FRONT COST – FROM $5 TO $35 PER SQUARE FOOT – GREEN ROOFS PROVIDE MULTIPLE BENEFITS THAT OFFSET THEIR EXPENSE WITHIN A FEW YEARS. THE U.S. ENVIRONMENTAL PROTECTION AGENCY ESTIMATES A FIVE-YEAR AVERAGE TO RECOUP COSTS.

COVERING BUILDING TOPS WITH SOIL, SOD, AND GARDENS PROVIDES A PLEASANT PLACE TO SPEND TIME, PARTICULARLY IN URBAN ENVIRONMENTS; PROCESSES $CO_2$ IN THE ATMOSPHERE; AND PRODUCES OXYGEN, PROVIDES FOOD, AND HELPS INSULATE BUILDINGS SO THEY DON'T USE AS MUCH ENERGY TO HEAT OR COOL. THE PLANTS ALSO HELP FILTER THE AIR AS THE BREEZE MOVES THROUGH THEM, PULLING OUT PARTICULATES THAT CAN CAUSE RESPIRATORY ILLNESS.

"GREEN ROOFS INTERCEPT THE SOLAR RADIATION THAT WOULD STRIKE DARK ROOF SURFACES AND BE CONVERTED INTO HEAT, THEREBY IMPROVING ENERGY CONSERVATION," SAID HITESH MEHTA, A LANDSCAPE ARCHITECT WHO HAS DESIGNED MANY SUSTAINABLE RESORTS AROUND THE WORLD. "BECAUSE GREEN ROOFS REDUCE THE SURFACE TEMPERATURE OF A ROOF BY MINIMIZING HEAT-ABSORBING SURFACES, A GREEN ROOF HELPS TO REDUCE ENERGY COSTS INSIDE THE BUILDING AS WELL. LIKE URBAN FORESTS AND REFLECTIVE ROOFING SURFACES, THEY ABSORB AND/OR DEFLECT SOLAR RADIATION SO THAT IT DOES NOT PRODUCE HEAT. THE URBAN HEAT ISLAND EFFECT INCREASES THE USE OF MORE ELECTRICITY FOR AIR CONDITIONERS, AND IT INCREASES THE RATE AT WHICH CHEMICAL PROCESSES GENERATE POLLUTANTS SUCH AS GROUND-LEVEL OZONE. IT ALSO EXACERBATES HEAT-RELATED ILLNESSES."

- http://drive2.subaru.com/Win11/greenRoofTops.htm

# CONTENTS

## ATRIUMS (CONTINUED)

- HISTORY
  - FUNDAMENTALS/
  - GEOMETRY
  - FIRE/SMOKE CONTROL
  - MAINTAINANCE
  - EXTERIOR ENVELOPE
  - SPACE ATRIBUTES
  - NATURAL LIGHTING
  - ACCESIBLE
  - AESTHETICS
  - FUNCTIONAL
  - PRODUCTIVE
  - SECURE
  - SUSTAINABLE

- SOURCES

- **ATRIUMS (CONTINUED)**

**TEAM 6**

NWARAMBILLI UGBODE

**EKATERINA SIGAL**

SERGIO ZAPATA

## CONTENTS

## ATRIUMS (CONTINUED)

- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES

# ATRIUM

A central hall or court in a modern building, with rooms or galleries opening off it, often glass-covered

## CONTENTS

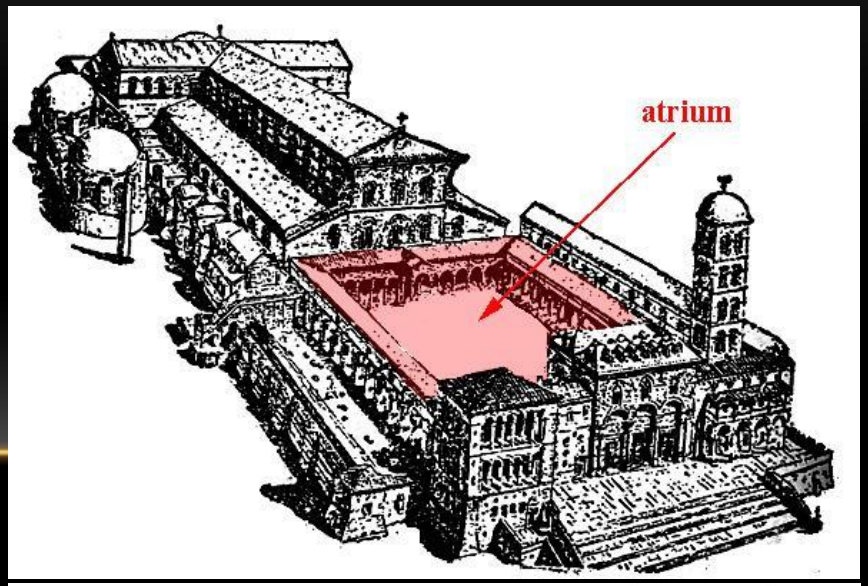
## ATRIUMS (CONTINUED)


- HISTORY
- FUNDAMENTALS/ GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

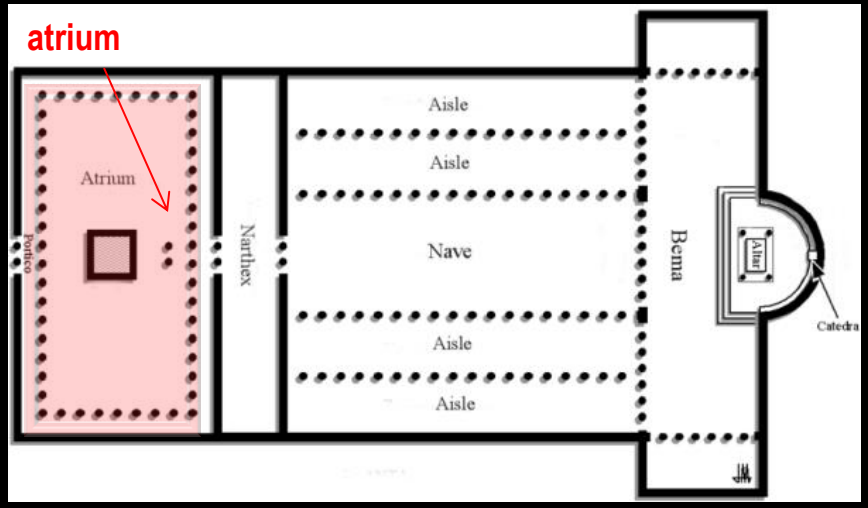
SOURCES


# HISTORY

- An open-roofed entrance hall or central court in an ancient Roman house




•One particular feature of the early Christian Communities Houses - the atrium, or courtyard with a colonnade surrounding it.



## CONTENTS

## ATRIUMS (CONTINUED)


- HISTORY
- FUNDAMENTALS/ GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES


# TODAY

Today the term atrium is associated with commercial or public buildings. The atrium space type includes glazed courtyard spaces and multistoried spaces. Atria are used as key architectural features in main entries, public circulation areas or as special destinations within a building.

Atrium design often involves skylights and generous glazing areas that provide an infusion of natural light which make them a prominent building areas well suited to serve ceremonial and social functions.

## CONTENTS

## ATRIUMS (CONTINUED)

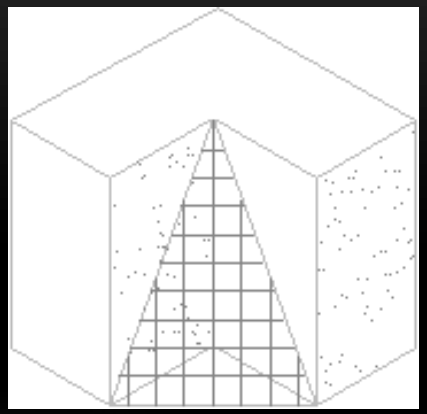

- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES

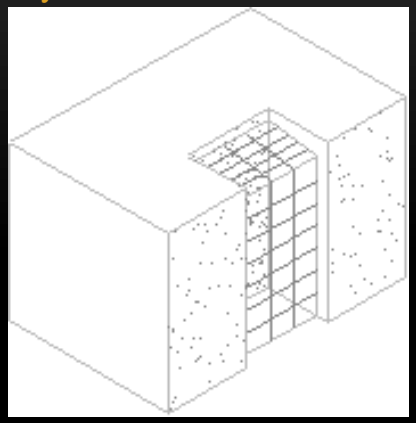

# FUNDAMENTALS

## geometry

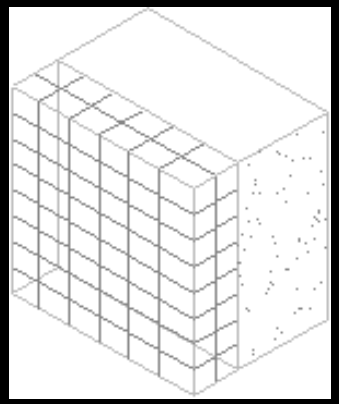
***Simple Types:***



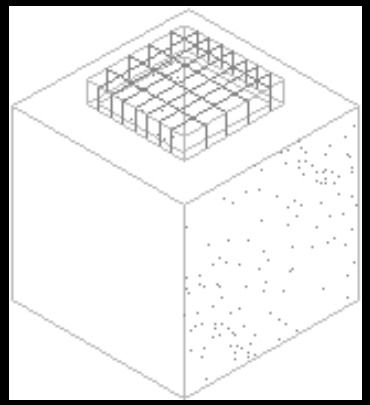
1. Two sided: Atrium abuts two sides of the occupied portion of the structure.



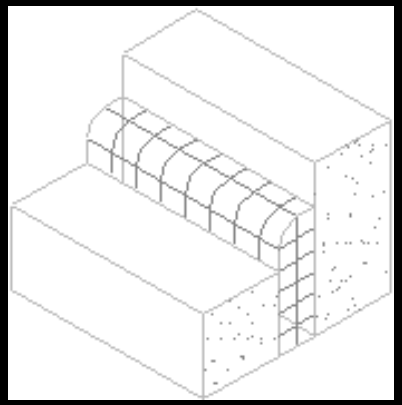
2. Three sided: Atrium abuts three sides of the occupied portion of the structure.



3. Single sided: Atrium abuts one side of the occupied portion of the structure.



4. Four sided: Atrium abuts four sides of the occupied portion of the structure.



5. Linear: Atrium sandwiched between two occupied portions of structure.

CONTENTS

ATRIUMS (CONTINUED)

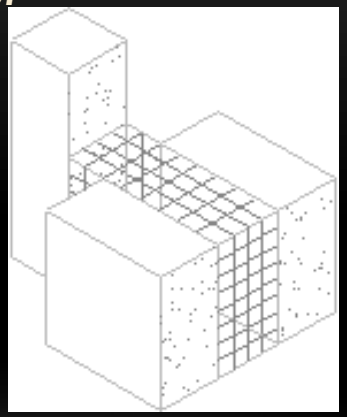
- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES

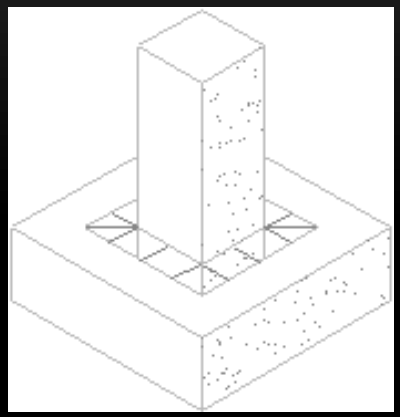
# FUNDAMENTALS

## geometry

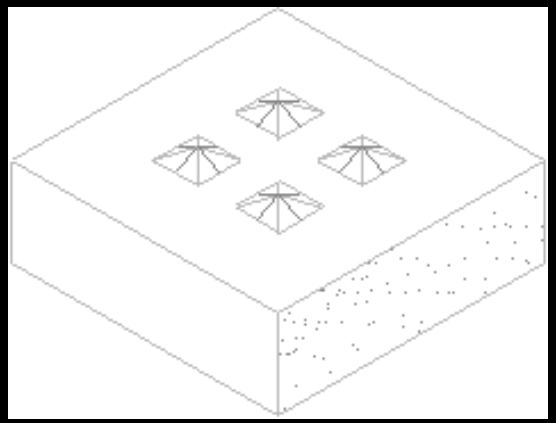
***Complex types:***



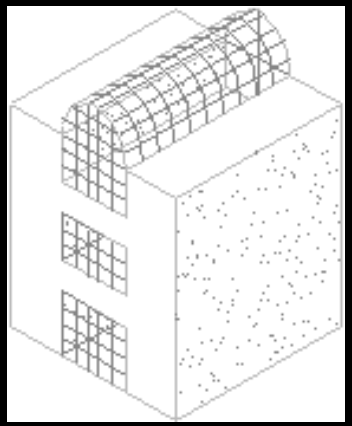
1. Bridging: Atrium connects several occupied portions of structure.



2. Podium: Atrium sits at the bottom or below an occupied portion of structure.



3. Multiple Lateral: Atrium spaces scattered throughout plan on single or multiple stories.



4. Multiple Vertical: Atrium spaces scattered throughout height of tower structure.

## CONTENTS

## ATRIUMS (CONTINUED)

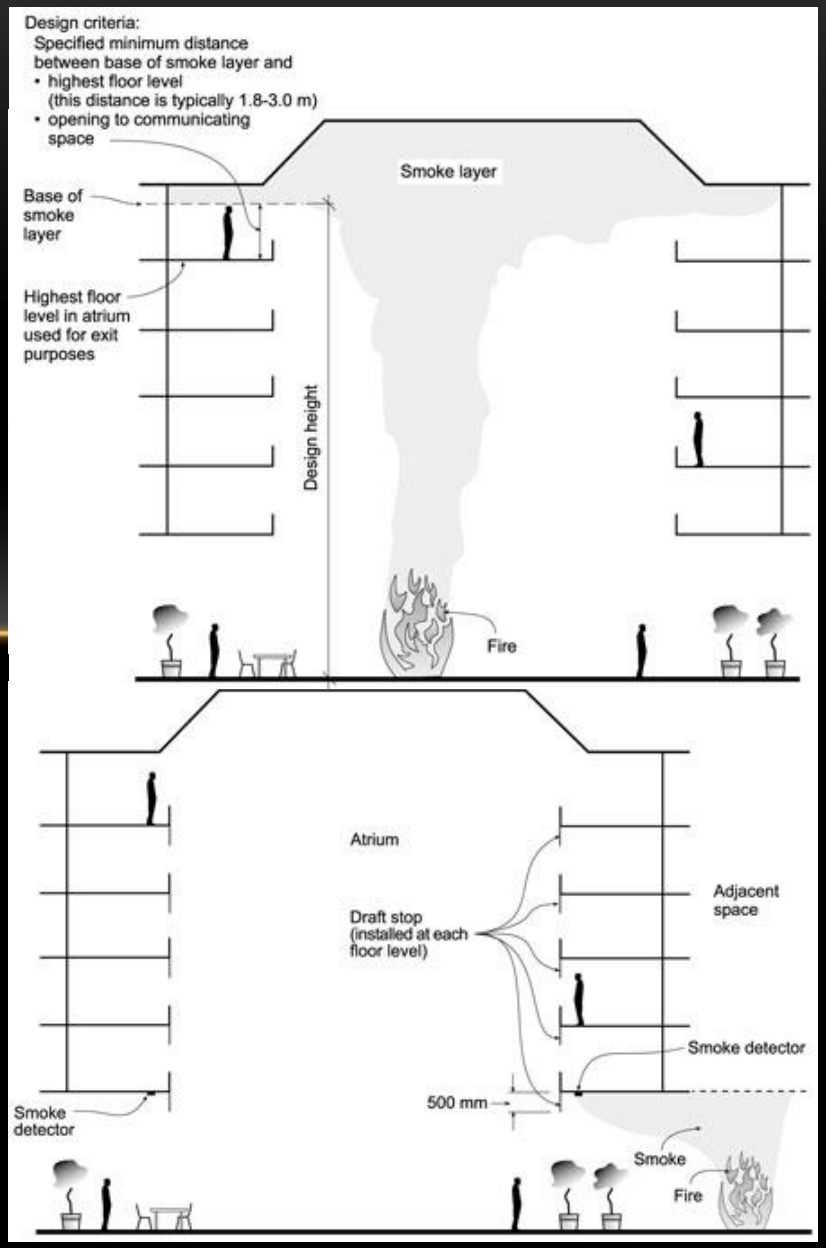
- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- **FIRE/SMOKE CONTROL**
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES

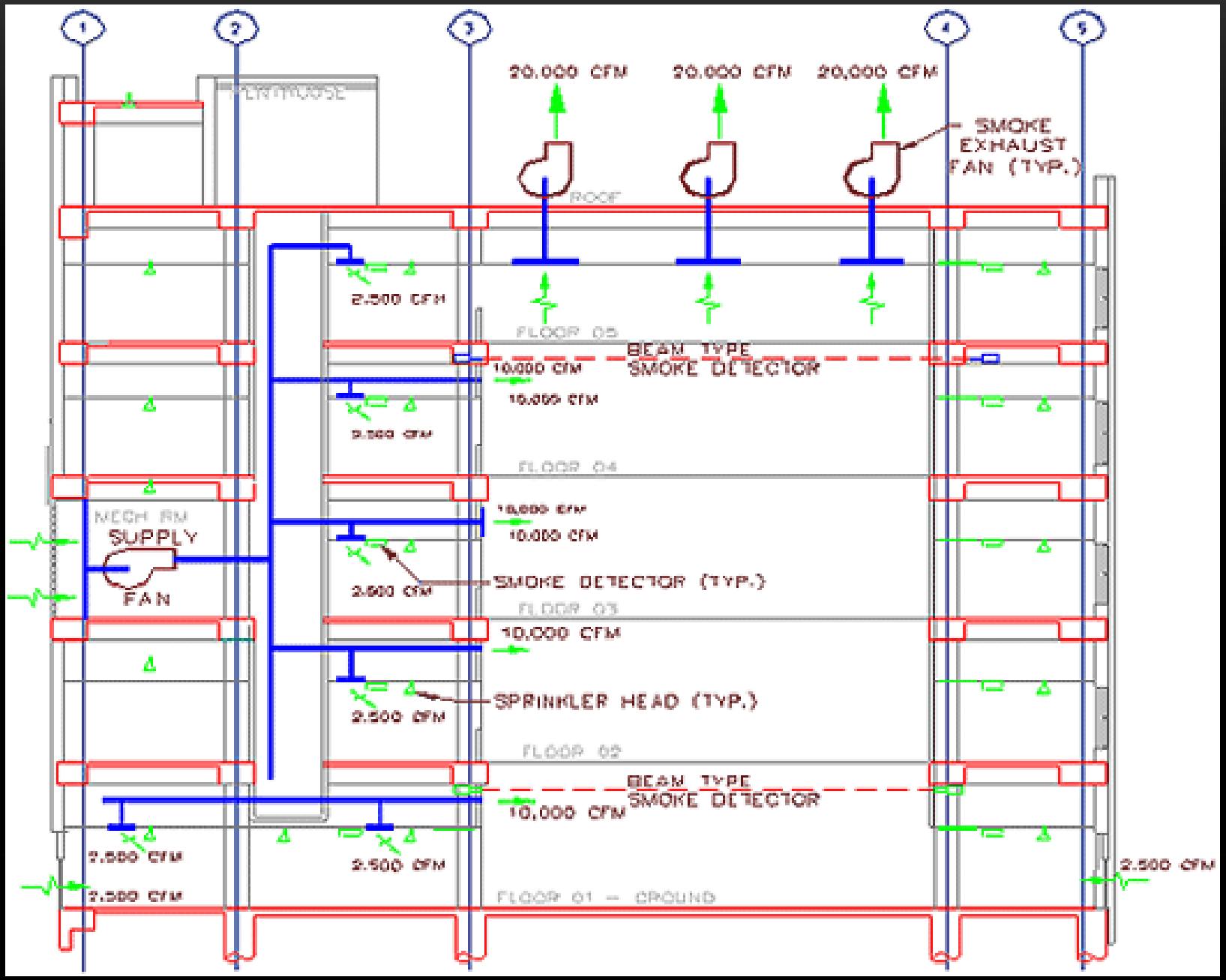
# FIRE PROTECTION AND SMOKE CONTROL

## Requirements :

- An engineered smoke control system should be combined with an automatic fire sprinkler system
- Some form of boundary is required to assist the smoke control system in containing smoke to just the atrium area
- The Life Safety Code and IBC require that the atrium space be separated from adjacent areas by fire barriers having a fire rating of 1 hour or equivalent
- The sprinklers are to be located to wet the entire surface of the glass walls
- Means of escape, emergency egress is a fundamental plan issue and must be integral with the circulation concept of the building
- Emergency egress must be incorporated from day one
- Smoke control strategies must be part of the initial ventilation concepts
- Fire control and fire fighting provisions must be integrated in to the original concepts



# EXAMPLE OF AN ATRIUM AIR FLOW



CONTENTS

ATRIUMS (CONTINUED)

- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES

# MAINTENANCE

The key elements that the design engineer should consider in the atrium comfort system design are space temperature, energy efficiency and air system type

*Space Temperatures-*

If the space is to be a heavily occupied, constant use space, 75˚ F should be considered (summer design).
However, if the space is a transient operation, a higher temperature of 78˚ F should be considered.

*Energy Efficiency-*

- Upper level stratification
- Spot cooling where occupants are located
- Night (or unoccupied) setback points
- Triple pane glass
- Motorized shading advices

*System Type-*

Consider using a constant volume air supply in the vestibule to overcome wind pressure at the entry point.
Design should be focused on detailed level of control for HVAC zone control, temperature reset, lighting functions, etc.

## CONTENTS

## ATRIUMS (CONTINUED)

- HISTORY
- FUNDAMENTALS/ GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES

# EXTERIOR ENVELOPE

SKIN OF THE ATRIUM :

- WALLS
- ROOFS
- SLOPING SURFACES

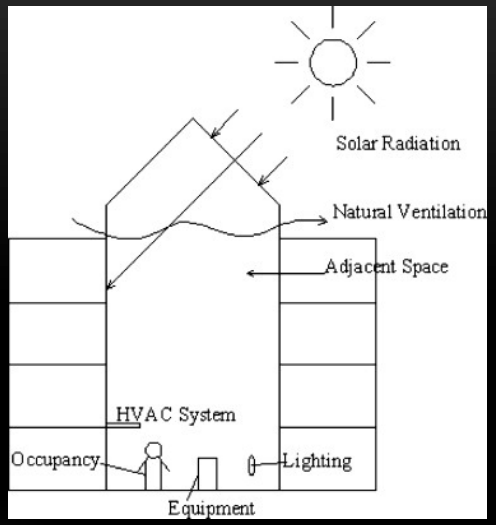
* keep water and wind out of the interior space and control the amount and quality of daylight penetrating the space

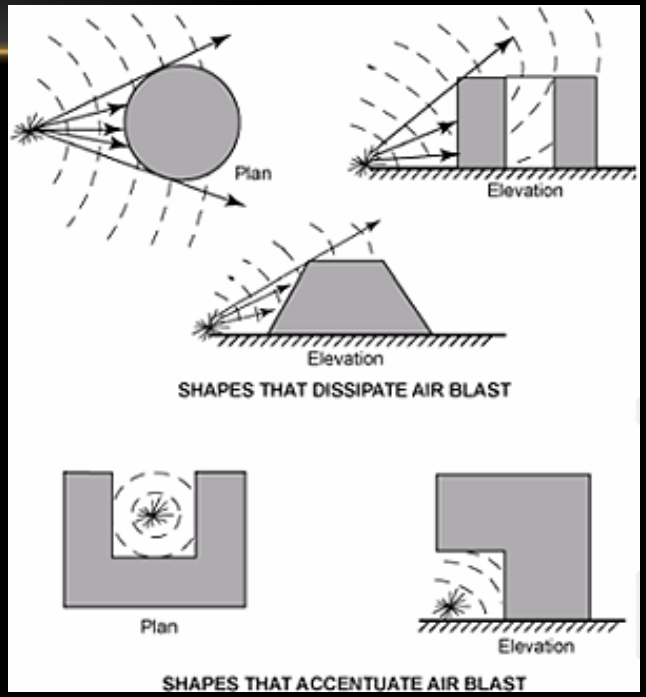
0penings in the atrium skin should be limited to those required for ventilation and smoke evacuation at the top and bottom and pedestrian access or exit at the bottom

Exterior glazing should be of a high performance curtain wall system designed and constructed for the purpose of spanning large distances

Glazing in a horizontal application requires protecting atrium occupants from falling glass either by utilizing wired glazing, laminated glazing or providing safety screening below the glazing

Sloping skin elements maintain a weather tight seal, accommodate movement in multiple directions and tie into adjacent systems at difficult angles



## CONTENTS

## ATRIUMS (CONTINUED)


- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES


# NATURAL LIGHTING

Students with the most day lighting in their classrooms progressed 20% faster on math tests and 26% faster on reading tests in one year than those with the least day lighting

•East or west glazing difficult to control glare because direct sun at low angles will be admitted at some point during the day

•Horizontal glazing at the roof should also be carefully considered because direct light is inevitable from this orientation

•Diffuse natural light generally is the preferred form of natural lighting

•The lighting level should be maintained in the range of 15 foot-candles either thru day-lighting or artificial means

•If indirect schemes are possible, they should be considered

•If the atrium is used as an egress, the lighting must be capable of immediate restart should normal power be lost

•Planting and vegetation needs should be addressed. Point source lighting may be necessary.

•Develop a plan for lamp replacement in high ceilings

**CONTENTS**

**ATRIUMS (CONTINUED)**


- HISTORY
- FUNDAMENTALS/ GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- **ACCESIBLE**
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES


# ACCESSIBLE

Include accessible elevators and ramps in addition to stairways

## CONTENTS

## ATRIUMS (CONTINUED)


- HISTORY
- FUNDAMENTALS/ GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- **AESTHETICS**
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES


# AESTHETICS

- Highlight or soften the verticality of the space by delineating horizontal bands (such as at floor or ceiling levels) with windows, lighting, wall coverings, and signage.
- Specify appropriate finishes for open stairways, pedestrian bridges, and other transitional spaces that match finishes in adjacent spaces.
- Include glazing system materials or detailing that emits natural light, but prevents glare and light reflection.

## CONTENTS

## ATRIUMS (CONTINUED)


- HISTORY
- FUNDAMENTALS/ GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- **FUNCTIONAL**
- PRODUCTIVE
- SECURE
- SUSTAINABLE

SOURCES


# FUNCTIONAL

•Design appropriate spaces for the unique requirements of plant species, including attention to lighting, temperature, and air flow. Specify plants with comfort levels similar to occupant comfort levels.

•Accommodate flexibility and storage of furniture and equipment for ceremonial events and exhibits.

•Design for maintainability of hard to reach areas, such as re-lamping of high light fixtures and periodic cleaning of dust gathering surfaces. Consider use of portable lifts over scaffolding.

•Design as an informal meeting space where intellectual/social exchange can take place.

•Specify durable finishes to accommodate maximum pedestrian traffic.

## CONTENTS

## ATRIUMS (CONTINUED)


- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- **PRODUCTIVE**
- **SECURE**
- **SUSTAINABLE**

SOURCES


# PRODUCTIVE

•Specify HVAC equipment that will ensure a comfortable and reliable temperature. For more information see WBDG High-Performance HVAC.

•If the atrium will be used for performances or ceremonies, study its acoustic properties and include sound absorptive materials as needed.

# SECURE

•Provide for smoke control/Fire protection engineering requirements
•In high-risk buildings, such as government or public assembly areas, incorporate blast-resistive design in atria structural system and glazing
•Design for safety in balconies overlooking atria:

Glass railings can become dangerous as breaking/falling objects in terrorism or seismic event
Design to prevent/discourage falls and suicide attempts

# SUSTAINABLE

•Atria can be used as light courts. Utilize day lighting to reduce energy use through skylights and window walls.

•Create a vertical "chimney" effect with low intakes and high outlets to facilitate natural ventilation.

# CONTENTS

## ATRIUMS (CONTINUED)

- HISTORY
- FUNDAMENTALS/
- GEOMETRY
- FIRE/SMOKE CONTROL
- MAINTAINANCE
- EXTERIOR ENVELOPE
- SPACE ATRIBUTES
- NATURAL LIGHTING
- ACCESIBLE
- AESTHETICS
- FUNCTIONAL
- PRODUCTIVE
- SECURE
- SUSTAINABLE

**SOURCES**


- http://en.wikipedia.org/wiki/Atrium_(architecture)
- http://www.wbdg.org/design/atrium.php
- http://custo.buildingmedia.com/crs.php?L=180&C=815
- http://www.docstoc.com/docs/31455958/ATRIUM-SMOKE-MANAGEMENT-SYSTEM-DESIGN-Reputation-Resources-Results
- ASHRAE 1999 Applications, chapter 4.8