

SUBJECT

Building Technology II

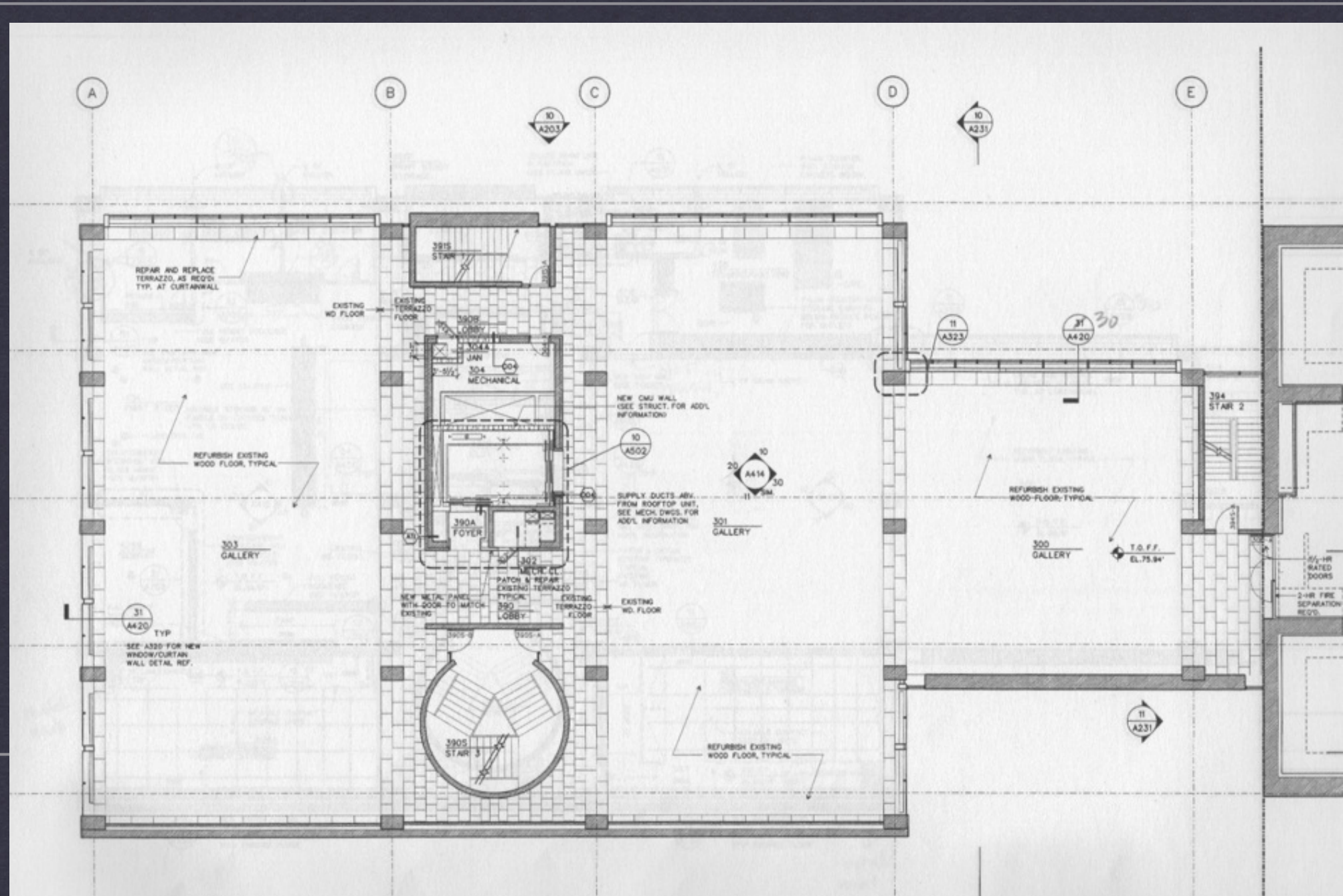
Assignment D- Stair Design

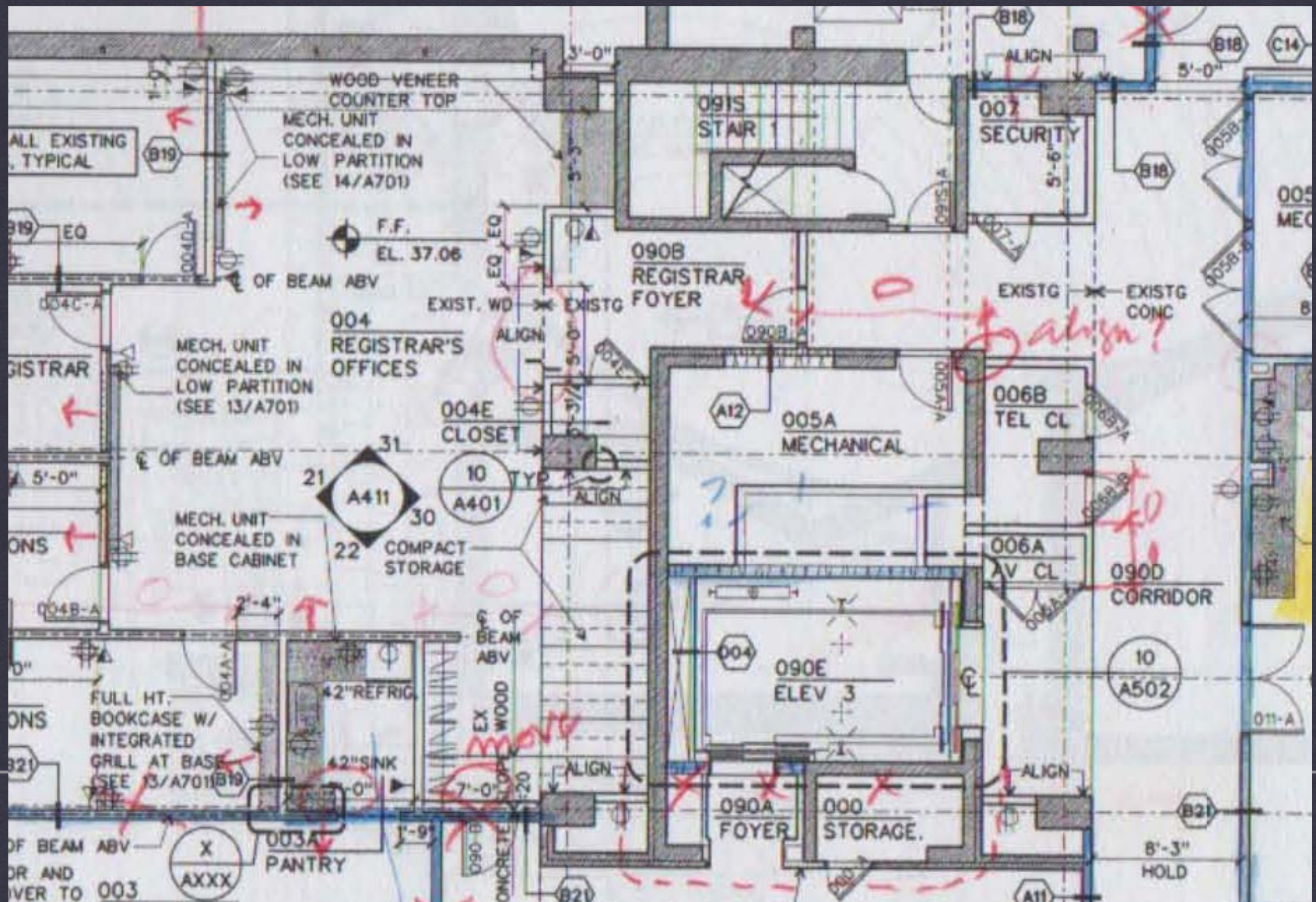
DATE

FALL 2012

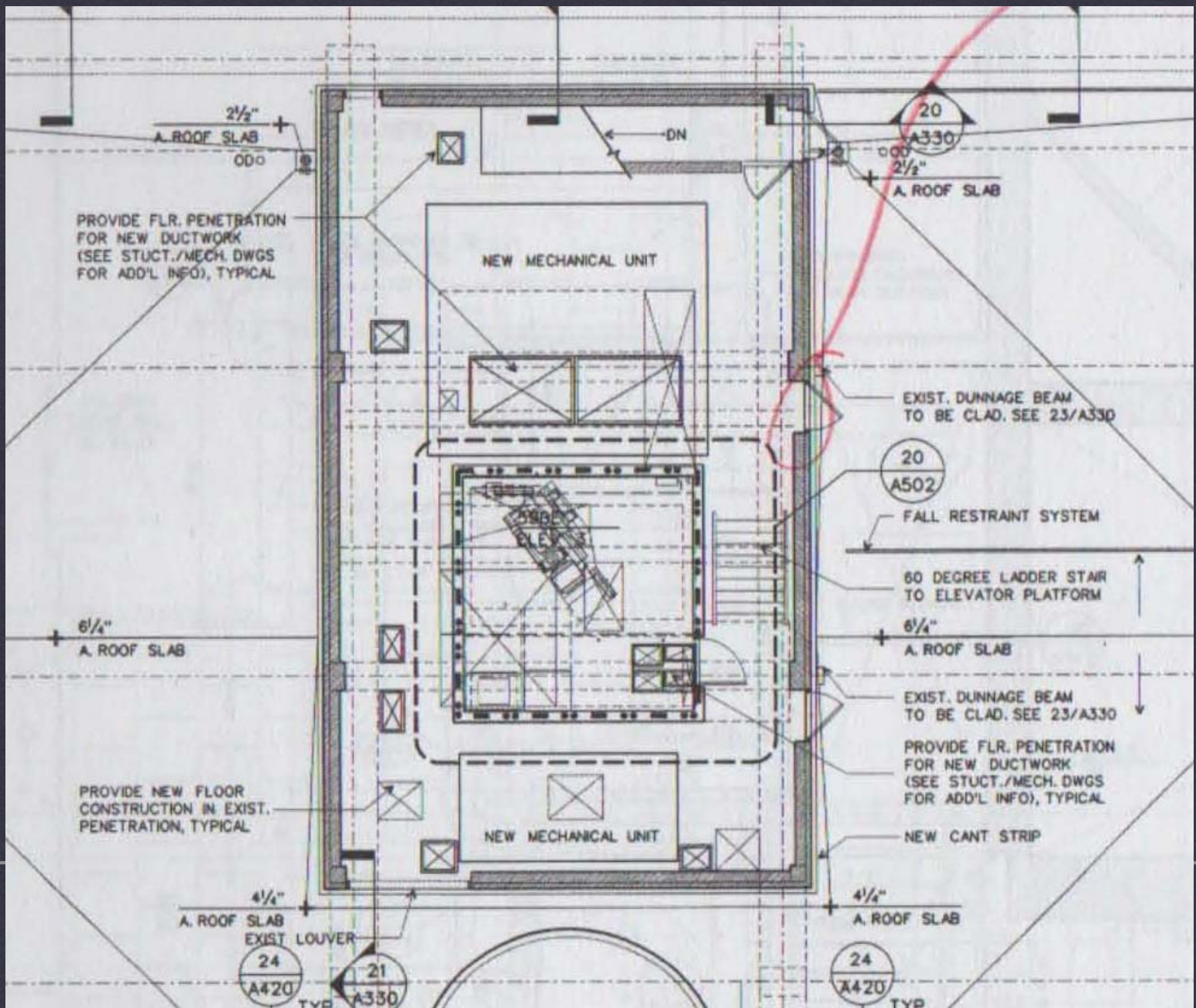
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Yale Art Gallery- Basement Level Plan



Yale Art Gallery- Penthouse Level Plan

Assignment D

CASE STUDY #1: Stair Design

DUE: OCT 26, 2012

*1 board required (min):

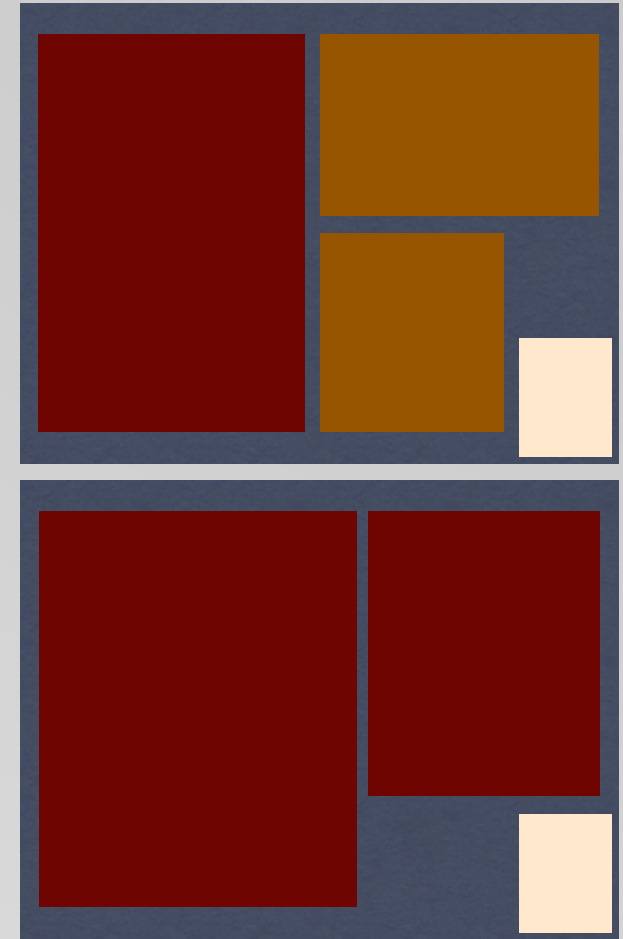
- i. 3D Axon of isolated Stairs
- ii. 2D Section through stairs (cutting through path of travel) @ $1/2"=1'-0"$
- iii. 2D Stair Plan @ $1/2"=1'-0"$
- iv. 2D/3D detail of stair/ landing connection
- v. Stair Calculations

*All views must have a north arrow

*One graphic scale must be included for each unique scale

*All sheets must use the titleblock from Assignment A (change the label to Assignment D and the Dwg number to A-400 and A-401)

*The superstructure should already be built (columns, floors, walls, and roof) in 3D... so now we are going to add the Stairs and elevators



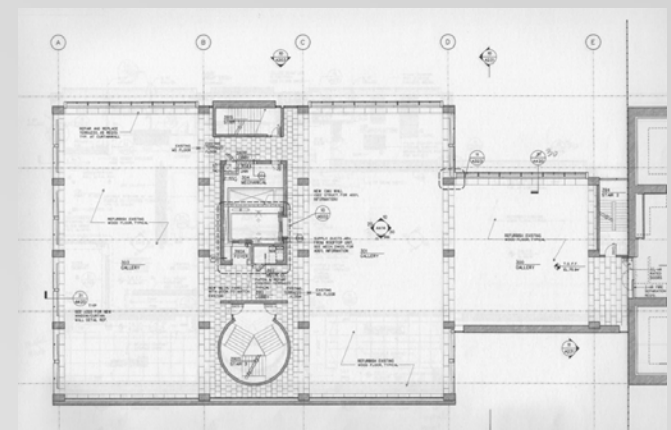
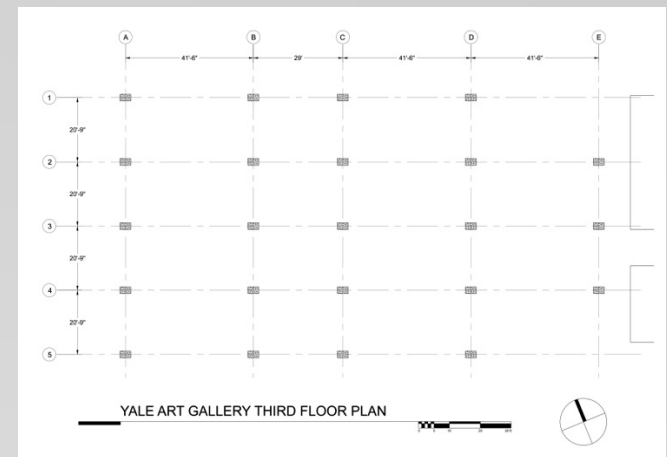
assignment D

CASE STUDY #1: Stair Design

DUE: OCT 26, 2012

- ✱ 24" x 36" title block that follows studio standards
- ✱ emphasis on quality of draftsmanship including:
 - ✱ layer management
 - ✱ line weights
 - ✱ grid dimensions
 - ✱ standard notations (doors, elevators, stairs_refer to Arch Graphic Standards)
- ✱ column size: 26" x 42"
- ✱ submit PDFs and Zip files with all x-refs and rasters included.

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Assignment D (Extra Credit)

CASE STUDY #1: Elevator Design

DUE: OCT 26, 2012

• 1 board required:

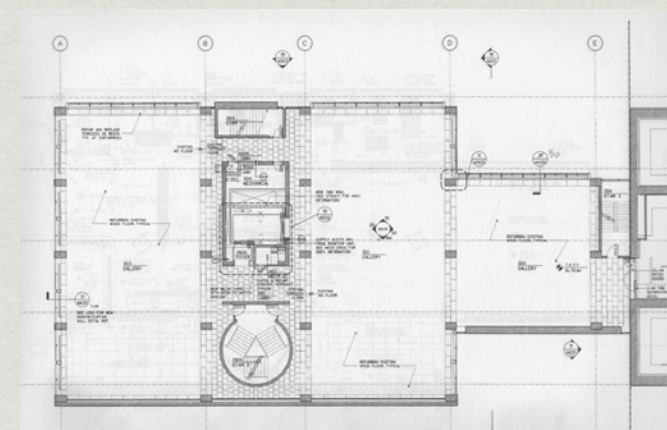
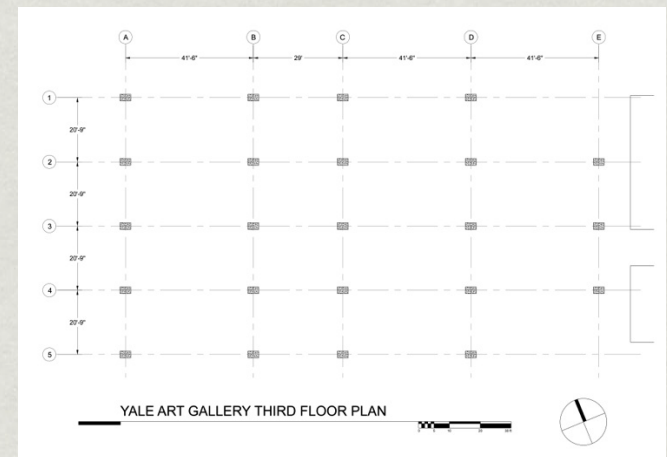
- i. 3D Axon of Elevator System (showing all relevant components)
- ii. 2D Section through Elevator Shaft (with elevator cab) @ $\frac{1}{2}'' = 1'-0''$
- iii. 2D Elevator Cab Plan @ $\frac{1}{2}'' = 1'-0''$

• All plan views must have a north arrow

• One graphic scale must be included for each unique scale

• All sheets must use the titleblock from Assignment A (change the label to Assignment D and the Dwg number to A-400 and A-401)

• The superstructure should already be built (columns, floors, walls, and roof) in 3D... so now we are going to add the Stairs and elevators



-Building Height = 5 floors

-Total weight /load of the building (dead + live loads) = 7,500,000 lbs.

-Column size = 3'-6" x 2'-2"

-Floor to Floor height: 12'-6"

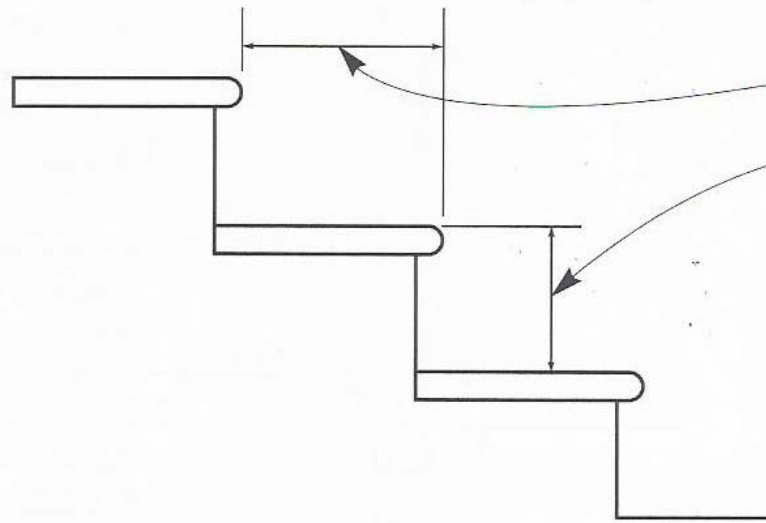
BASIC BLDG CALCULATIONS

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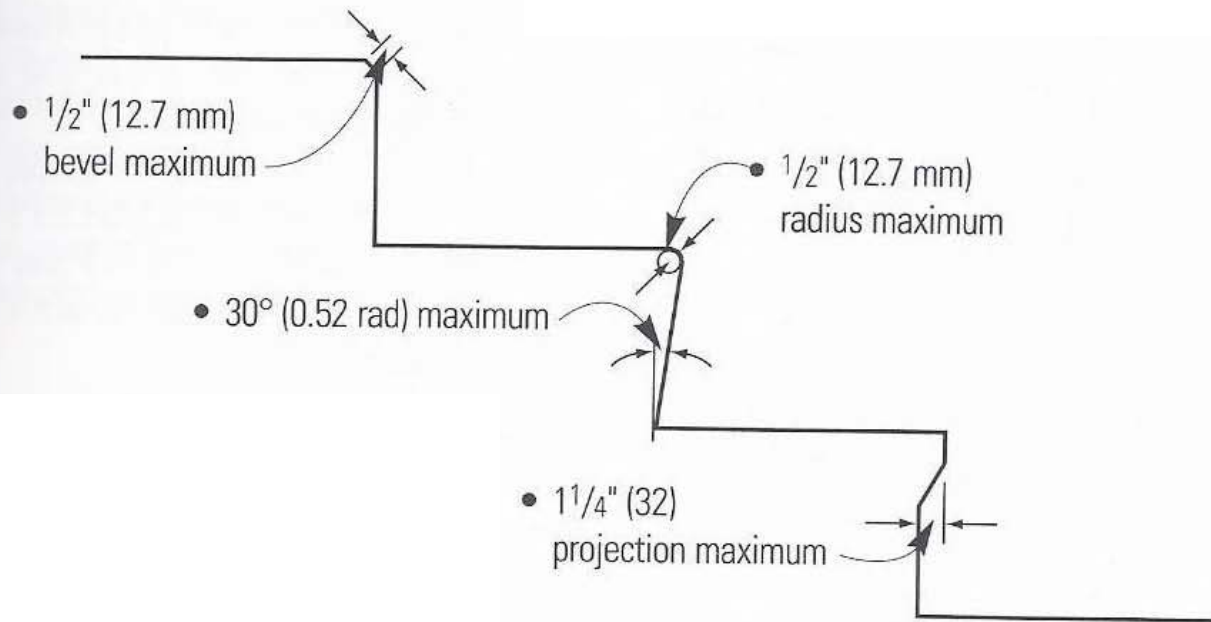
Building Background Info

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1. Find the **Total** stair rise. (**TS**)
2. Divide that by the **“Estimated” number of stairs** needed. (**ENS**)
3. That gives you the **number of risers needed** (although it is a decimal and you can't have a fraction of a stair). (**NRN**)
4. So, we need to recalculate. Take the **$TS / NRN = \text{Total Riser Height}$** .
5. Calculate the number and size of Treads using the chart.



- § 1003.3.3.3. Stair treads shall have a minimum depth of 11" (279).
- Stair risers shall have a minimum height of 4" (102) and a maximum height of 7" (178).
- The primary exception to rise and run requirements occurs in residential and utility uses where risers may have a maximum height of 7 3/4" (197) and treads may have a minimum length of 10" (254).
- § 1003.3.3.3.1. Treads and risers are to be essentially uniform in dimension with a tolerance of 3/8" (9.5 mm) plus or minus between the smallest and largest within any flight.



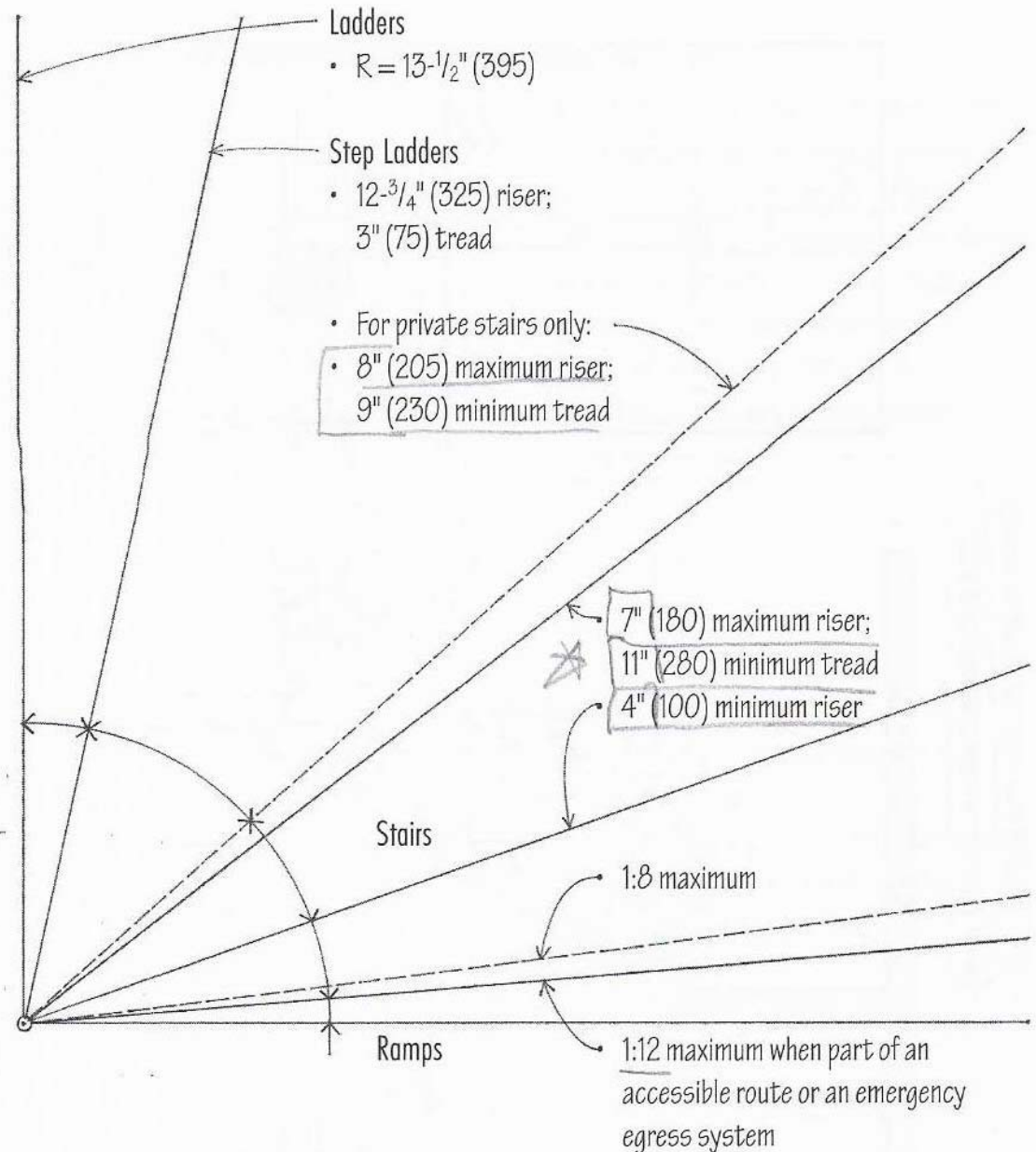
- Stair risers on accessible egress paths must be closed.
- Nosing dimensions, the slope of risers and the projection of treads past risers are prescribed in § 1003.3.3.2.

- Tread (inches) + 2x riser (inches) = 24 to 25
- Riser (inches) x tread (inches) = 72 to 75

Riser and Tread Dimensions

Riser inches (mm)	Tread inches (mm)
5 (125)	15 (380)
5- ¹ / ₄ (135)	14- ¹ / ₂ (370)
5- ¹ / ₂ (140)	14 (355)
5- ³ / ₄ (145)	13- ¹ / ₂ (340)
6 (150)	13 (330)
6- ¹ / ₄ (160)	12- ¹ / ₂ (320)
6- ¹ / ₂ (165)	12 (305)
6- ³ / ₄ (170)	11- ¹ / ₂ (290)
7 (180)	11 (280)
7- ¹ / ₄ (185)	10- ¹ / ₂ (265)
7- ¹ / ₂ (190)	10 (255)
7- ³ / ₄ (195)	9- ¹ / ₂ (240)
8 (205)	9 (230)

These riser and tread dimension are permitted only for private stairways serving an occupancy of less than 10 and stairways leading to an unoccupied roof.



With all stairs, there is always 1 less tread than riser...

STAIRS

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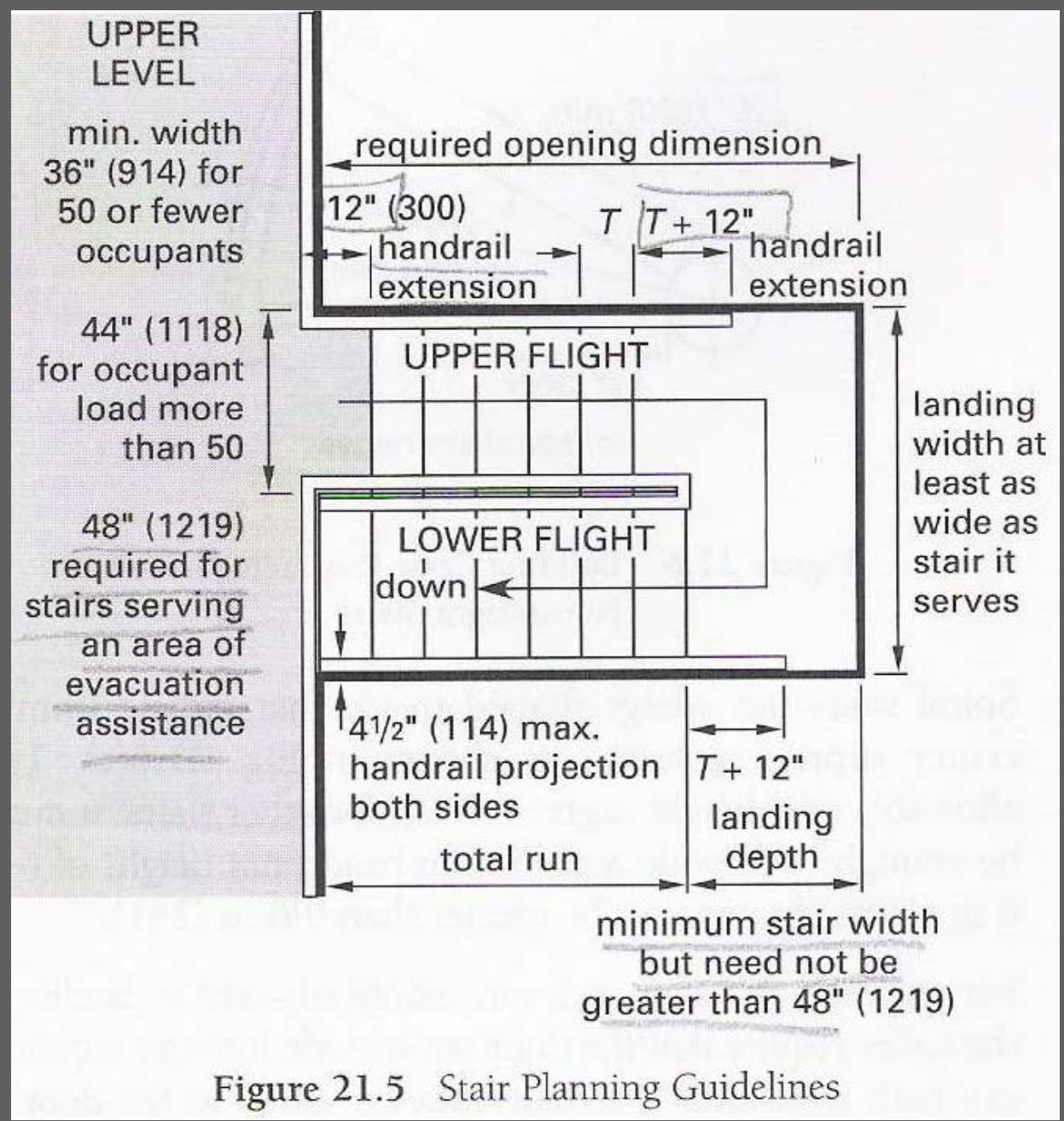
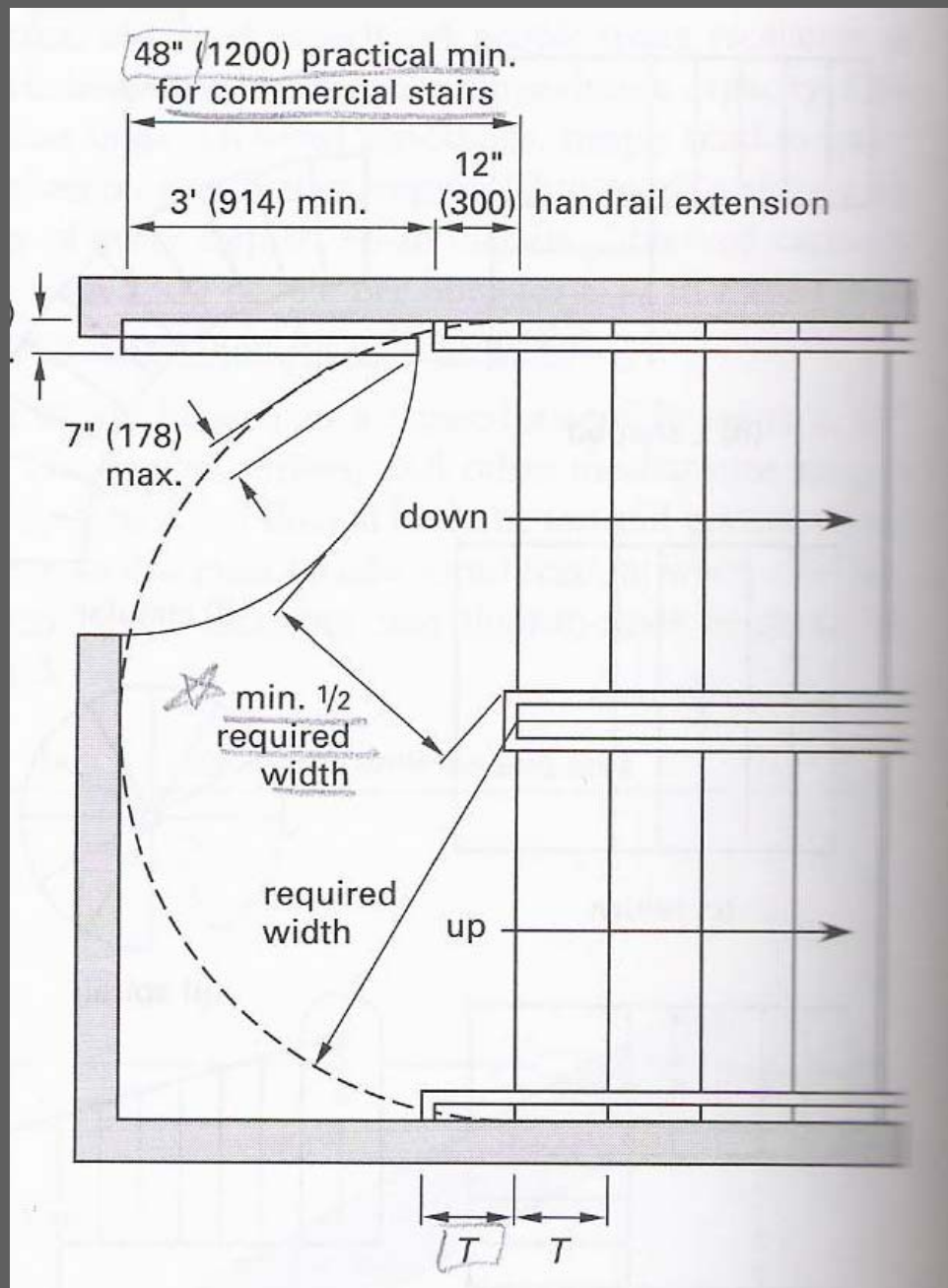
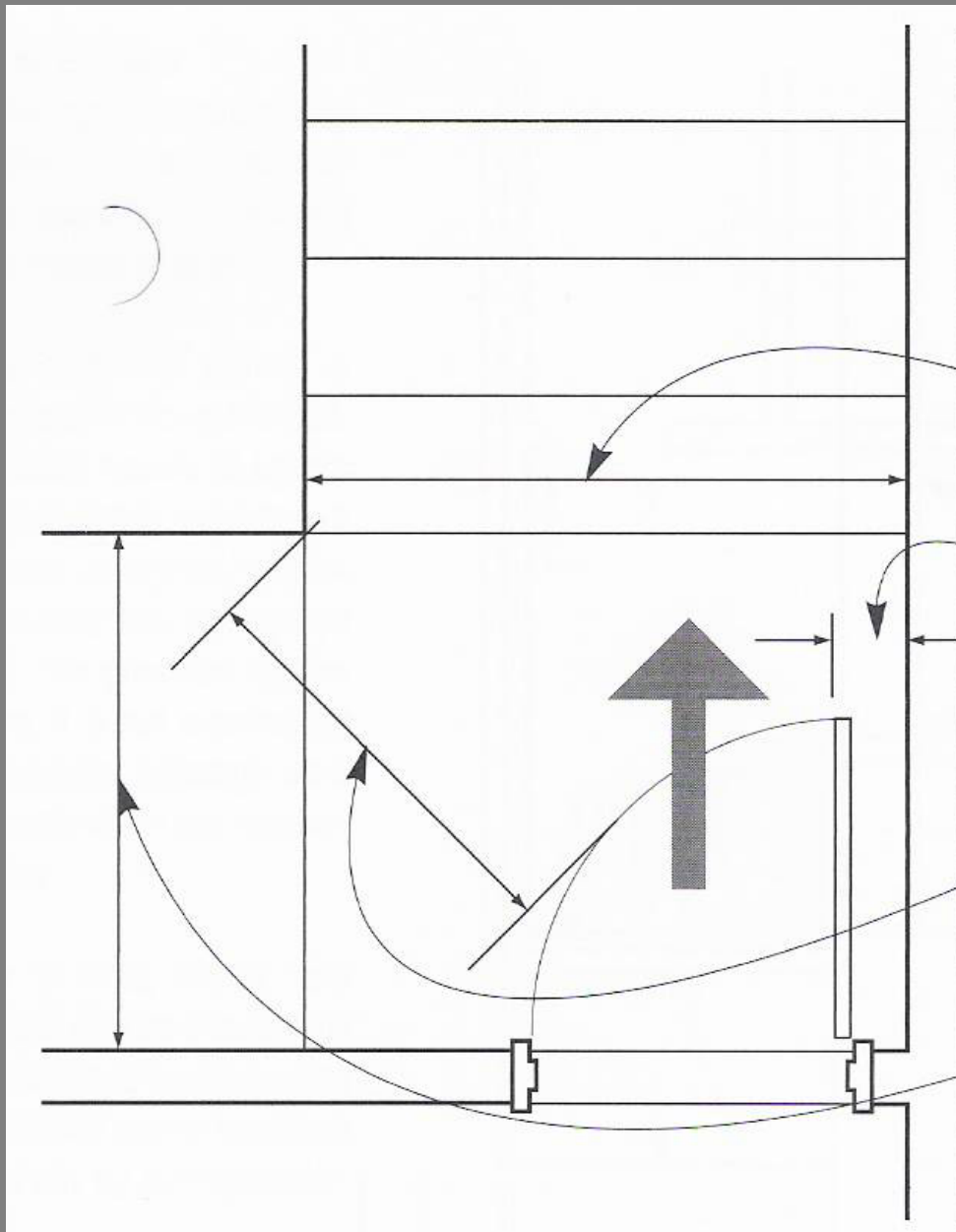


Figure 21.5 Stair Planning Guidelines

Means of Egress



Means of Egress



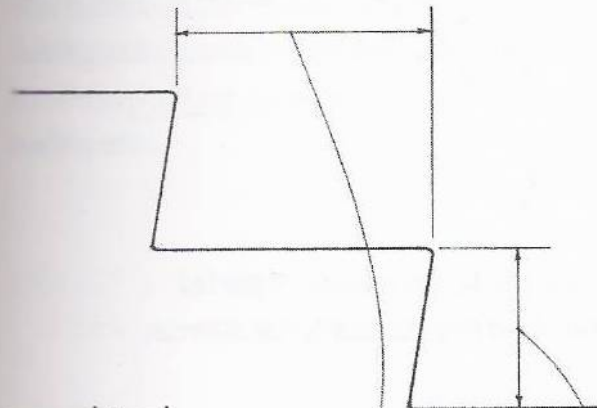
- § 1003.3.1.4. There should be a landing or floor on each side of a door, and the elevation of the floor or landing should be the same. There are exceptions in residential occupancies for screen doors and at interior stairways to allow doors to swing over landings.
- § 1003.3.1.5. Landings are to have a width not less than that of the stairway or the door, whichever is greater.
- Doors in the open position should not reduce the required width or depth of a landing by more than 7" (178).
- For occupant loads of 50 or more, the door in any position may not reduce the width of the landing to less than half of its required width.
- Landings are to be a minimum of 44" (1118) in length in the direction of travel, except they may be 36" (914) long in residential occupancies.

Means of Egress

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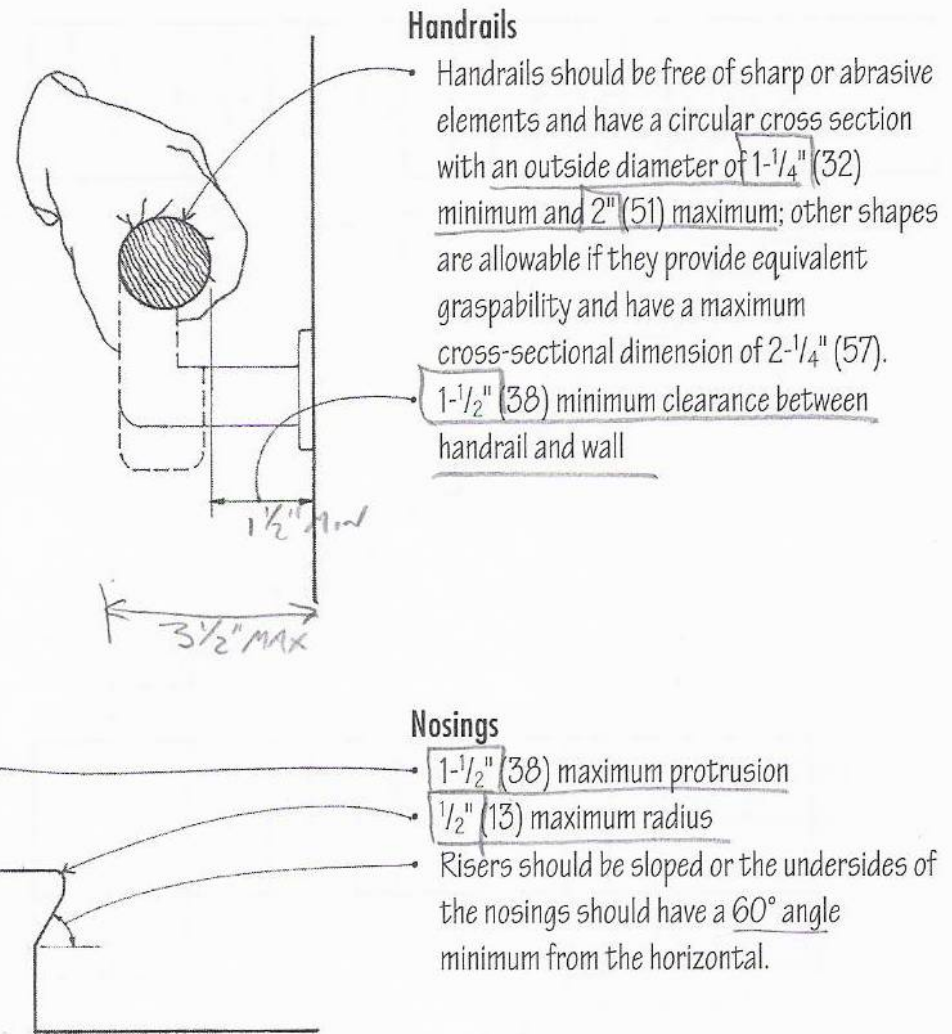
ADA Accessibility Guidelines

Accessible stairs should also serve as a means of egress during an emergency, or lead to an accessible area of refuge where people who are unable to use stairs may remain temporarily in safety to await assistance during an emergency evacuation.



Risers and Treads

- Tread depth: 11" (280) minimum
- Riser height: 4" (100) minimum; 7" (180) maximum
- Uniform riser and tread dimensions are required.
- Open risers are not permitted.



Handrails

- Handrails should be free of sharp or abrasive elements and have a circular cross section with an outside diameter of 1-1/4" (32) minimum and 2" (51) maximum; other shapes are allowable if they provide equivalent graspability and have a maximum cross-sectional dimension of 2-1/4" (57).
- 1-1/2" (38) minimum clearance between handrail and wall

Nosings

- 1-1/2" (38) maximum protrusion
- 1/2" (13) maximum radius
- Risers should be sloped or the undersides of the nosings should have a 60° angle minimum from the horizontal.

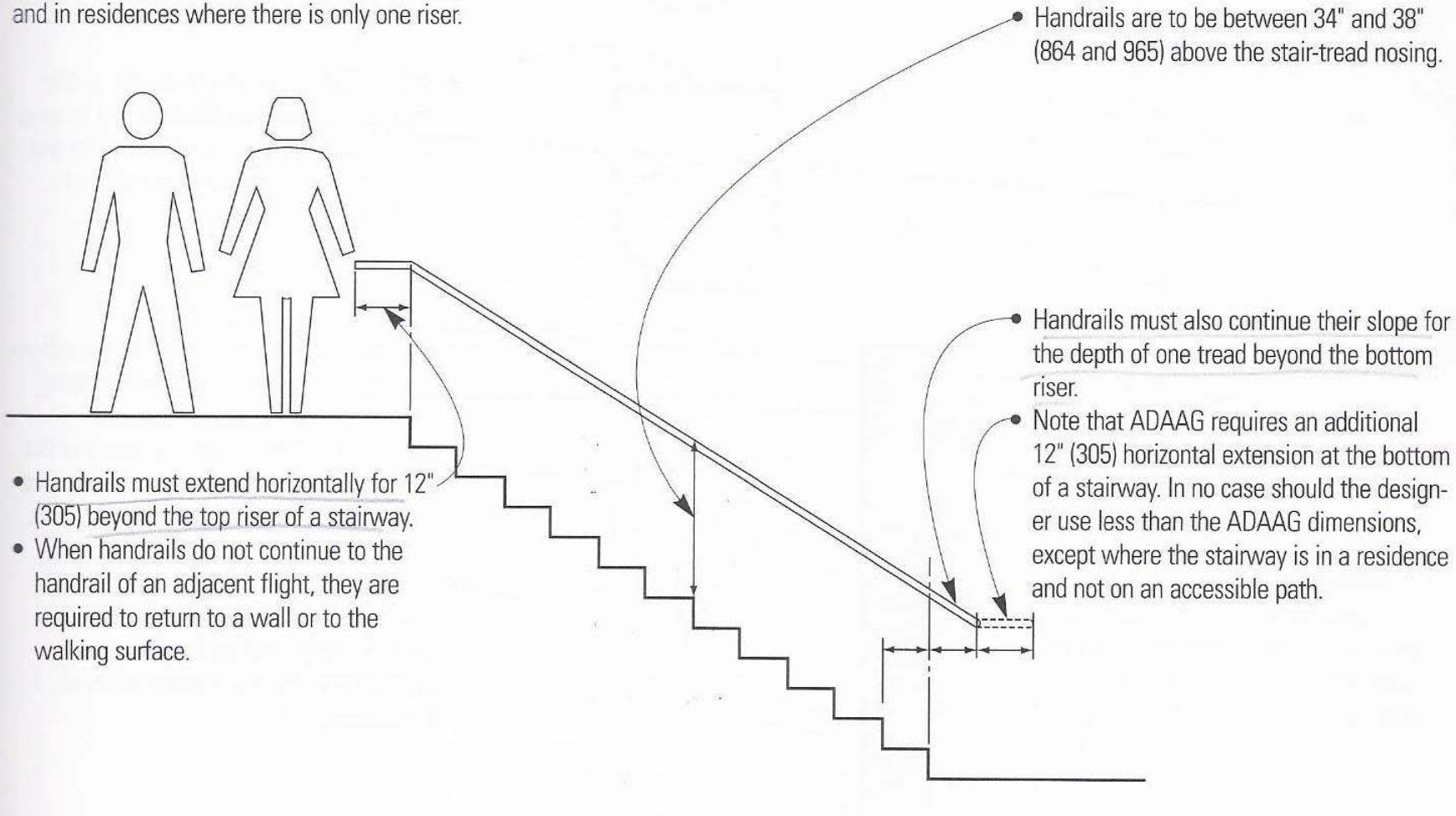
Means of Egress

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Handrails

§ 1003.3.11 specifies that stairways are to have handrails on each side except in aisle stairs, where a center rail is provided, or in dwellings. Handrails are not required on decks having a single level change between two areas that are equal to or greater than a landing dimension, and in residences where there is only one riser.

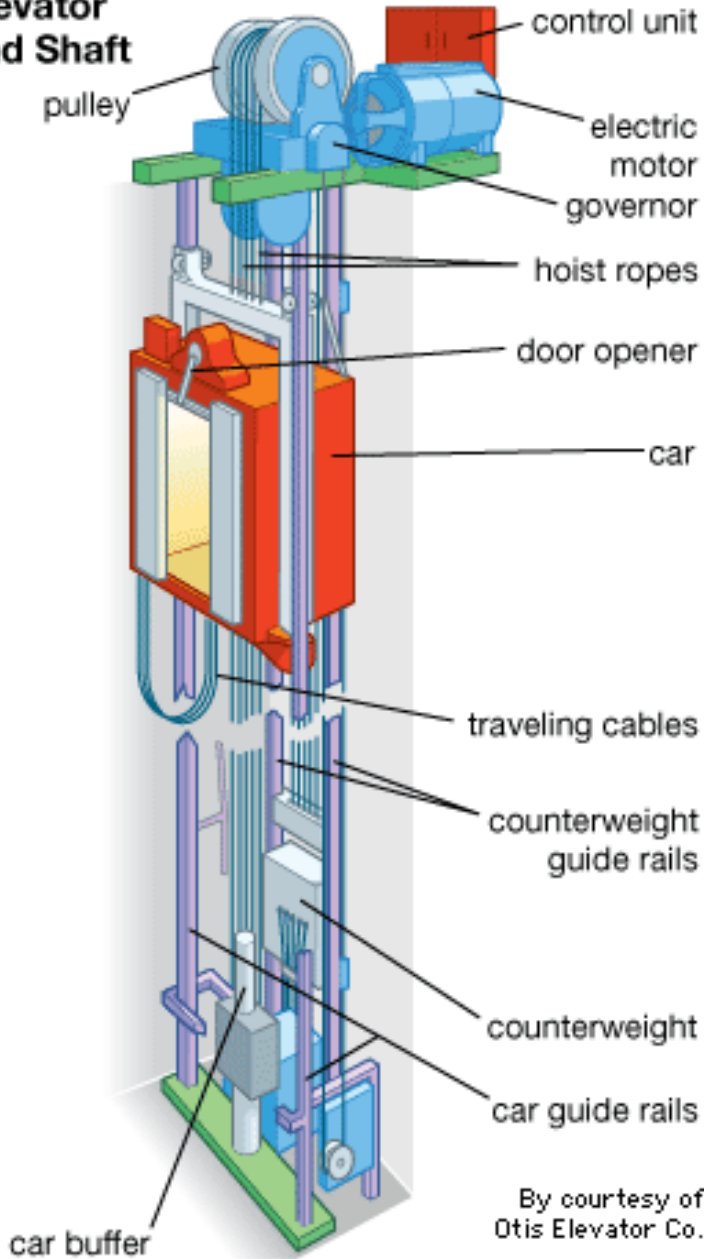


Handrails

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Elevator and Shaft



By courtesy of
Otis Elevator Co.

- A penthouse houses the hoisting machinery on the roof of a building.
- A control panel contains switches, buttons, and other equipment for regulating the hoisting machinery.
- The hoisting machinery for raising and lowering an elevator car consists of a motor-generator set, traction machine, speed governor, brake, driving sheave, and gears, if used.
- Heavy steel machine beams support the hoisting machinery for an elevator.
- Driving sheave is the hoisting pulley.
- Idle sheave tightens and guides the hoisting cables of the elevator system.

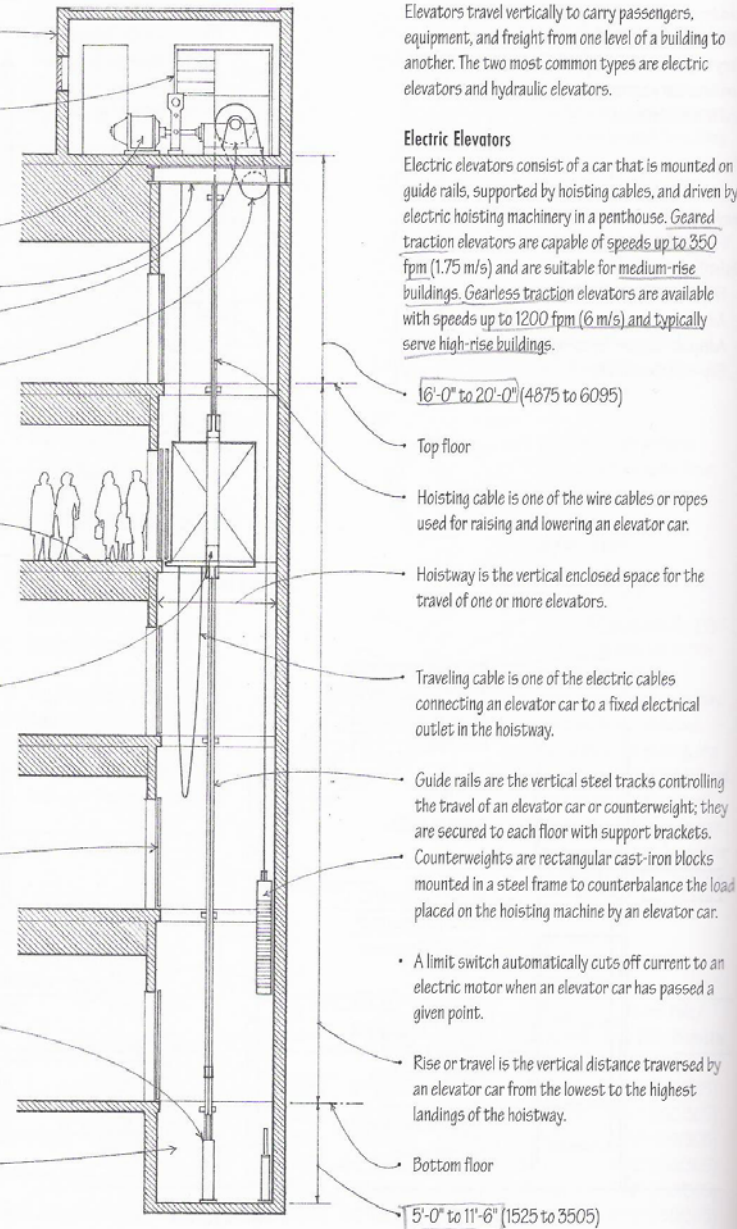
- Landing is the portion of a floor adjacent to an elevator hoistway, used for the receiving and discharge of passengers or freight.

- Elevator car safety is a mechanical device for slowing down and stopping an elevator car in the event of excessive speed or free fall, actuated by a governor and clamping the guide rails by a wedging action.

- Hoistway door between a hoistway and an elevator landing is normally closed except when an elevator car is stopped at the landing (7'-0" and 8'-0" (2135 and 2440) heights typical).

- Buffer is the piston or spring device that absorbs the impact of a descending elevator car or counterweight at the extreme lower limit of travel.

- Elevator pit is the portion of the shaft that extends from the level of the lowest landing to the floor of the hoistway.



Elevators travel vertically to carry passengers, equipment, and freight from one level of a building to another. The two most common types are electric elevators and hydraulic elevators.

Electric Elevators

Electric elevators consist of a car that is mounted on guide rails, supported by hoisting cables, and driven by electric hoisting machinery in a penthouse. Geared traction elevators are capable of speeds up to 350 fpm (1.75 m/s) and are suitable for medium-rise buildings. Gearless traction elevators are available with speeds up to 1200 fpm (6 m/s) and typically serve high-rise buildings.

16'-0" to 20'-0" (4875 to 6095)

Top floor

Hoisting cable is one of the wire cables or ropes used for raising and lowering an elevator car.

Hoistway is the vertical enclosed space for the travel of one or more elevators.

Traveling cable is one of the electric cables connecting an elevator car to a fixed electrical outlet in the hoistway.

Guide rails are the vertical steel tracks controlling the travel of an elevator car or counterweight; they are secured to each floor with support brackets. Counterweights are rectangular cast-iron blocks mounted in a steel frame to counterbalance the load placed on the hoisting machine by an elevator car.

- A limit switch automatically cuts off current to an electric motor when an elevator car has passed a given point.

Rise or travel is the vertical distance traversed by an elevator car from the lowest to the highest landings of the hoistway.

Bottom floor

5'-0" to 11'-6" (1525 to 3505)

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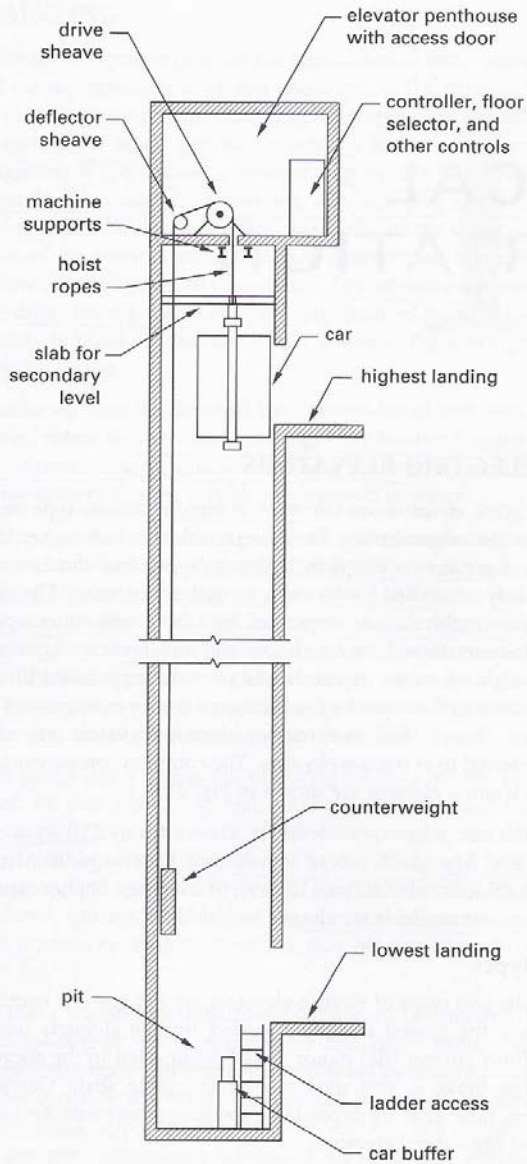


Figure 21.1 Traction Elevator

GENERAL

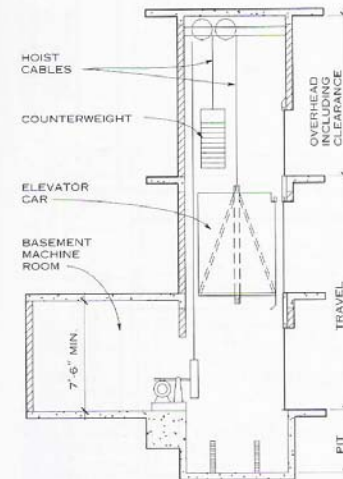
Medium- and high-rise buildings require geared traction and gearless traction elevator systems. The main difference between the two systems lies in travel speed. General design considerations involving hoistway, machine room, and elevator planning are similar.

Both geared and gearless drive units are governed by electronic controls, which coordinate car leveling, passenger calls, collective operation of elevators, door operation, car acceleration and deceleration, and safety applications. A broad range of control systems is available to meet individual building requirements.

Structural requirements call for the total weight of the elevator system to be supported by the machine beams and transmitted to the building (or hoistway) structure. Consult with elevator consultants and structural engineers.

NOTES

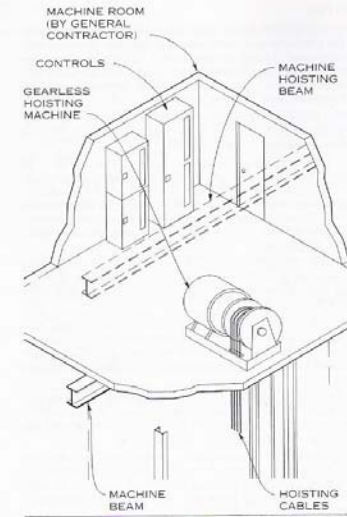
1. Pit depths, overhead clearances, and penthouse sizes should be in accordance with ASME requirements. Local codes may vary from these requirements.
2. All overhead dimensions for passenger elevators are based on standard 8-ft-high cabs.
3. Layout dimensions of the passenger elevator are based on center-opening entrances. Other types are available.
4. The machine room for traction elevators is usually located directly above the hoistway. Space must be provided for the elevator drive, electronic control equipment, and governor; provide sufficient clearance for equipment installation, repair, and removal. Adequate lighting and ventilation (temperature maintained between 65 and 100°F or 18 and 38°C are required by codes, and sound insulation should be provided. Machine room sizes may vary depending on number of cars, type of control, etc. Check with elevator consultant for requirements.
5. Check local codes for required fire enclosures.



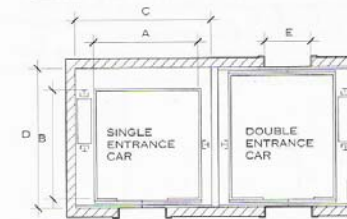
NOTE

This is a very specialized application, and consultation with experts is advised. Traction elevators with basement machine rooms are used in new and existing buildings where overhead clearance is limited.

TRACTION ELEVATOR WITH BASEMENT MACHINE ROOM



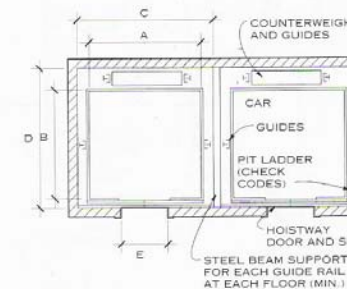
GEARLESS ELEVATOR MACHINE ROOM



NOTE

Side-mounted counterweights allow an optional rear entrance door.

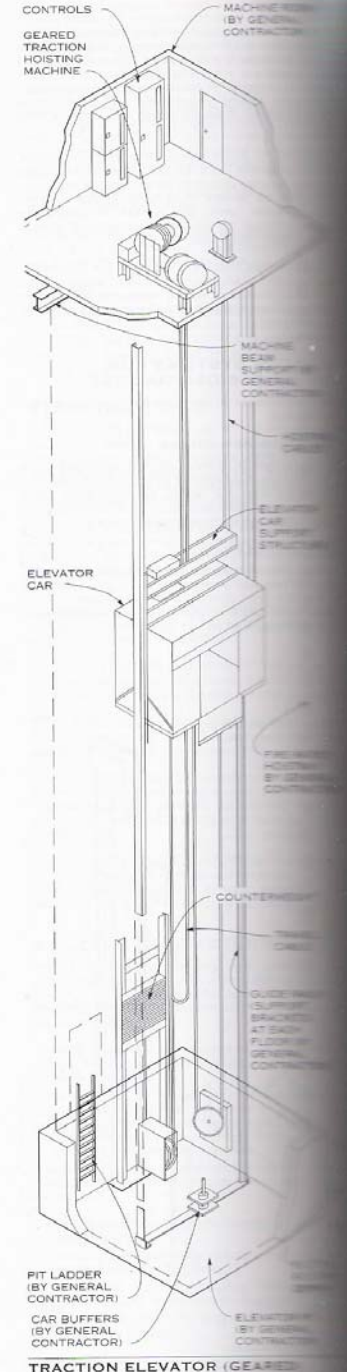
SIDE-MOUNTED COUNTERWEIGHT



REAR-MOUNTED COUNTERWEIGHT ELEVATOR HOISTWAY TYPES

TRACTION ELEVATOR DIMENSIONS (FT-IN)

RATED LOAD (LB)	A	B	C	D	E
2000	5-8	4-3	7-4	6-11	3-0
2500	6-8	4-3	8-4	6-11	3-6
3000	6-8	4-7	8-4	7-5	3-6
3500	6-8	5-3	8-4	8-1	3-6
4500	5-8	7-10	8-2	10-5	4-0



TRACTION ELEVATOR (GEARED)

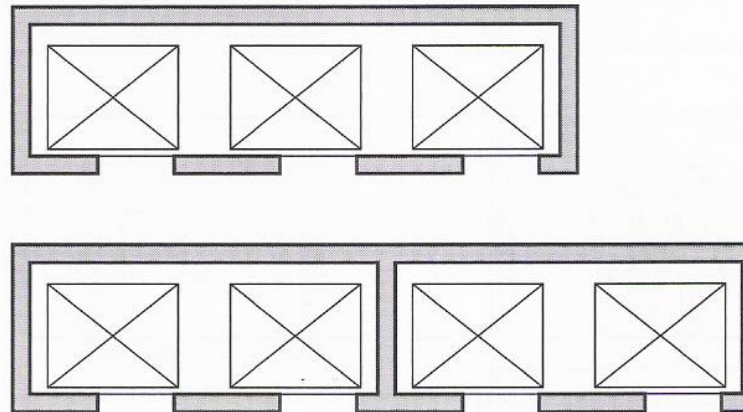
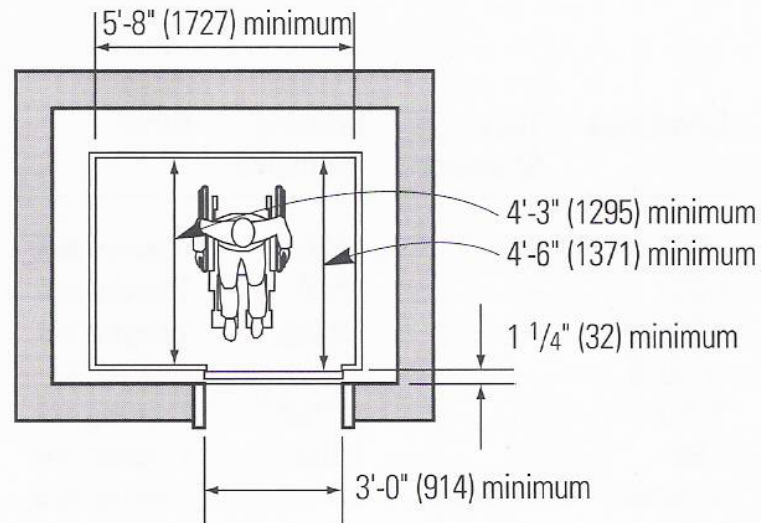
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Chapter 30 governs the design, construction and installation of elevators and other conveying systems, including escalators, moving walks, personnel hoists and materials. We will discuss requirements with significant design impacts.

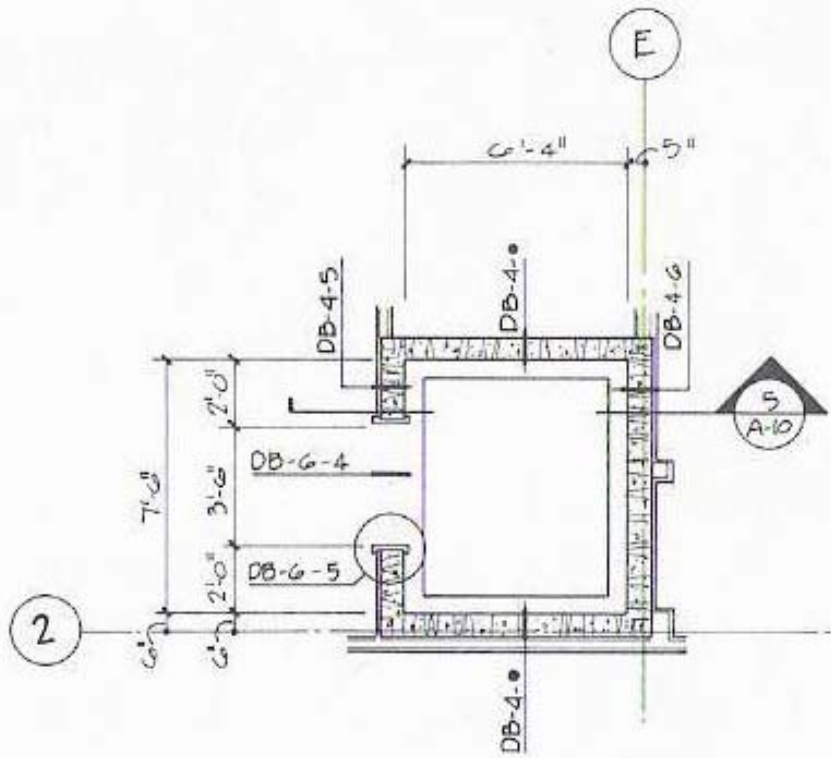
- Where passenger elevators are required to be accessible per Chapter 11, the elevators are to comply with ICC/ANSI A117.1. Typical elevator cab dimensions and controls for accessible elevators are illustrated.
- Hoistways are to have fire-resistance ratings as required by Chapters 6 and 7. Doors in elevator shafts, including the elevator car doors, are to comply with the requirements of Chapter 7.
- When four or more cars serve the same portion of a building, they are to be located in two separate hoistways. The purpose of this requirement is to minimize the chance that a fire or other emergency can disable or contaminate with smoke all of the elevators in a bank. Three elevators can be in a single enclosure, but five elevators would need a division between sets of cars.





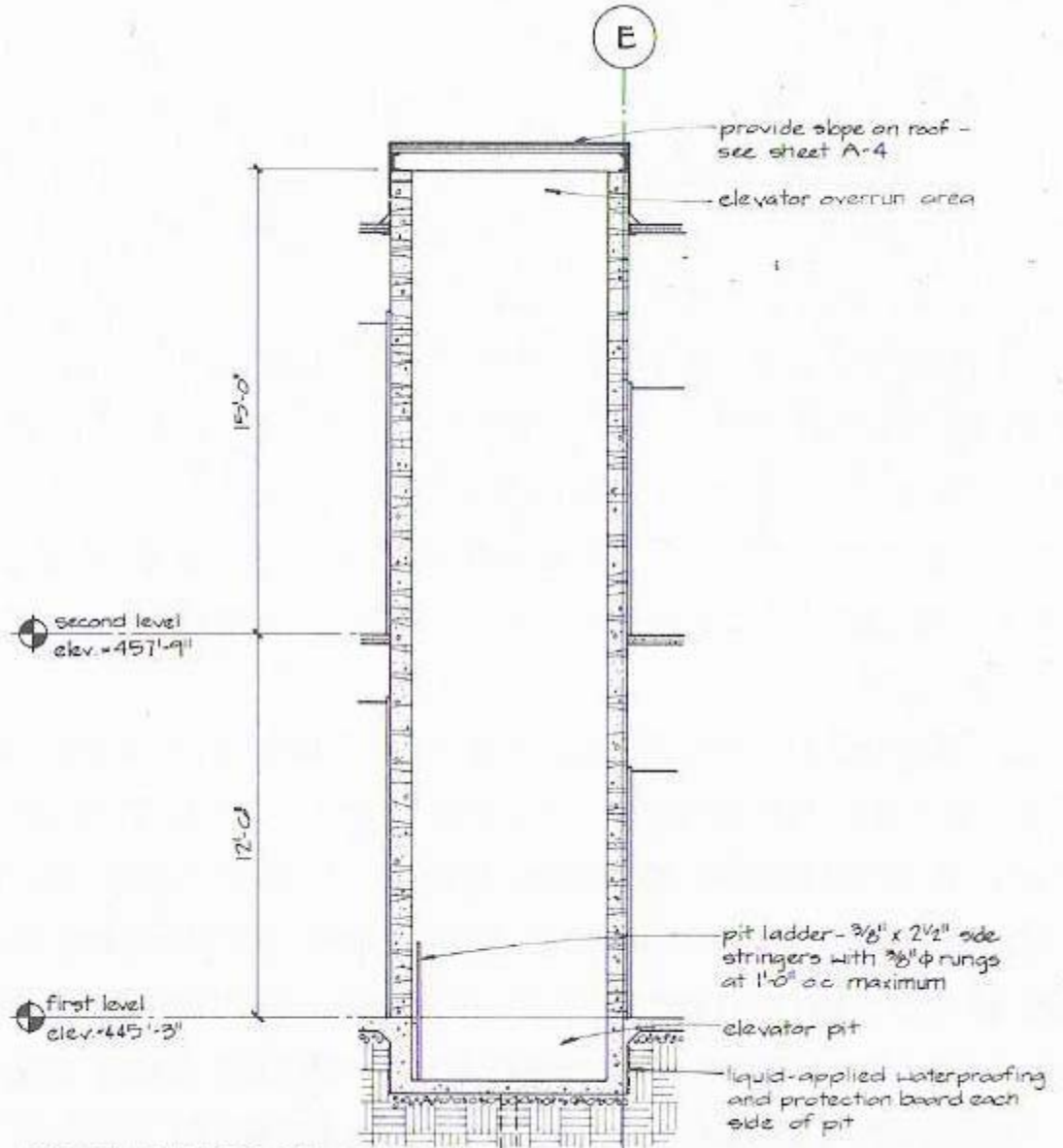
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4  ELEVATOR 01 - TYPICAL LEVEL

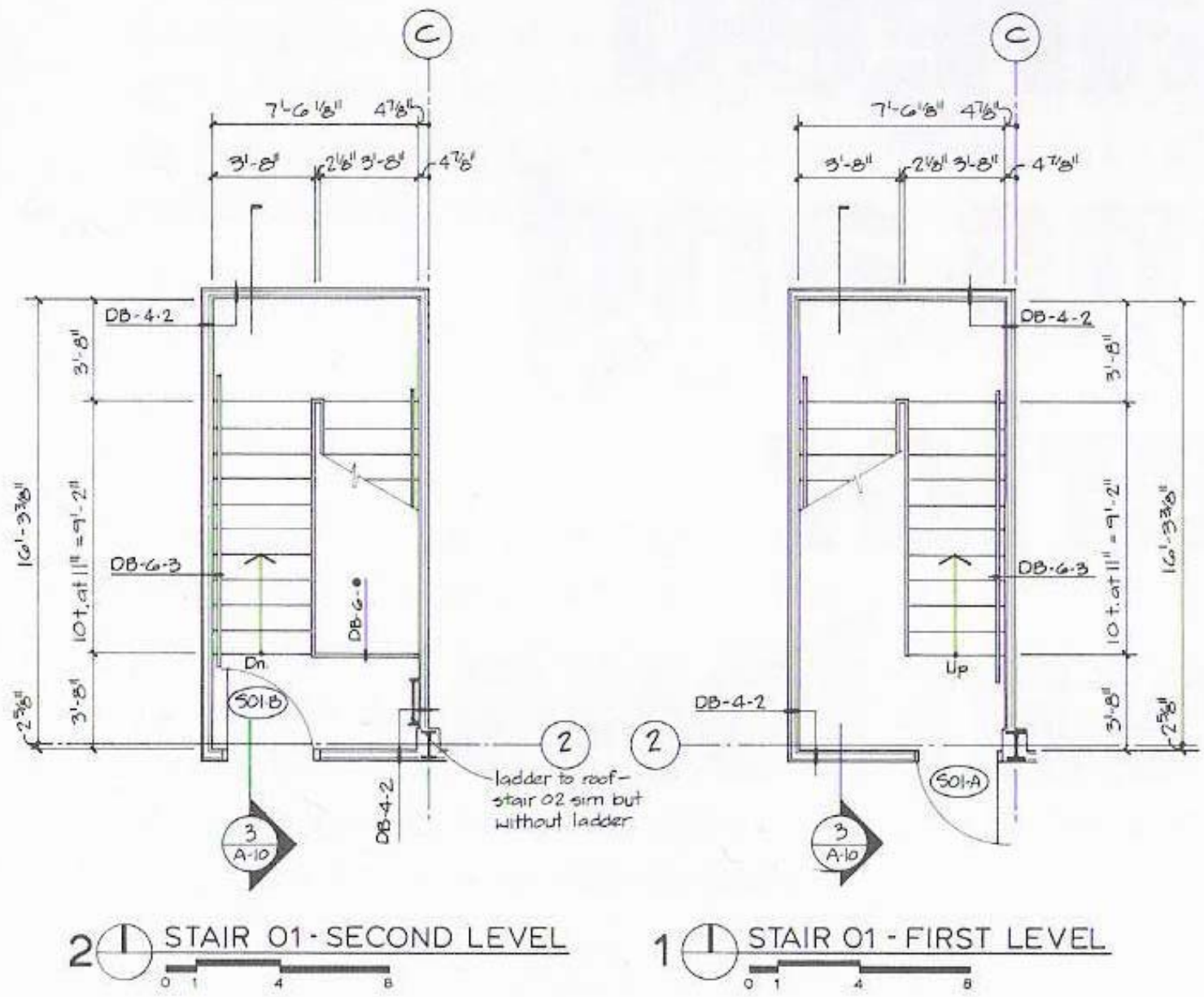



5  ELEVATOR 01 - SECTION



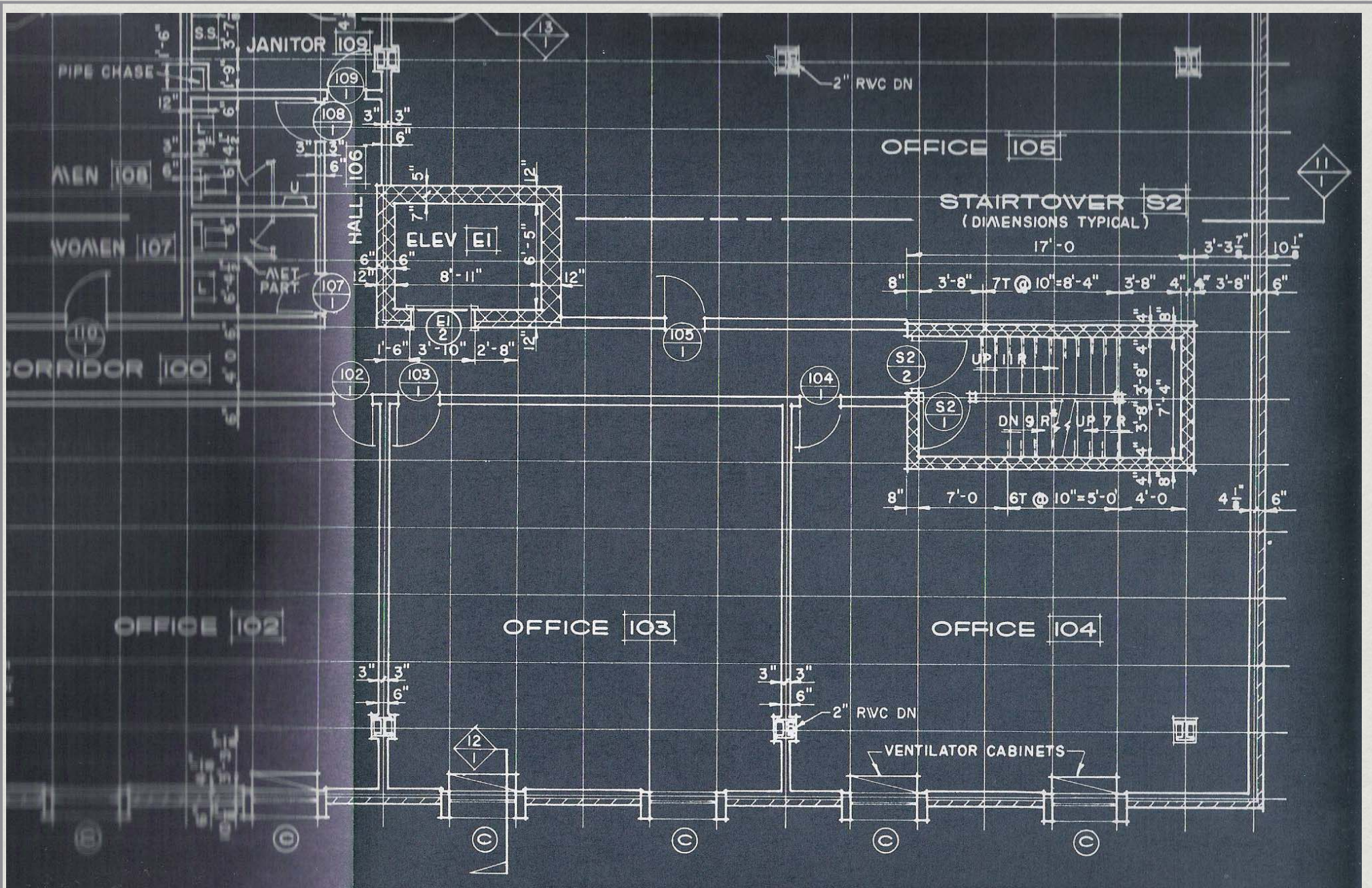
Examples

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Examples

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Examples

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