



Conventional and Worship Buildings Safety Design from IBC Point of View

Prepared & Presented by:

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Learning Objectives:

At the end of this presentation, participants will be able to:

1. Be familiar with ICC (International Code Council), specially IBC (International Building Code).
2. Be aware of the safety issues related to Worship Buildings (Mosques) & how to address it depending on IBC.
3. Be aware of the safety issues related to Conventional Buildings & how to address it depending on IBC.



Summery of Presentation:

The presentation shall concentrate on the introduction of ICC & IBC to the safety design consideration.

The presentation shall also illustrate 2 examples of applying IBC, one in Worship buildings & the other in Conventional buildings to show how codes affected the safety design of both types of buildings.



Speaker Biography:



Architect: Ayman Ahmed Hassan, B.Sc.A, A.I.A, R.I.B.A, I.S.O, PE SEC, is the Projects Manager / Head of Architecture & BIM Consultant at Abdul Rahman Al Naim Consultant Engineers (ACE) with responsibility of Design Management.

Notable is his 10 years as Projects Manager / Head of Architecture for ACE.

Ayman Ahmed Hassan is Member of The American Institute of Architects, **AIA** (International Associate), Member of The Royal Institute of British Architects, **RIBA** (RIBA Affiliate), Member of The Saudi Council of Engineers, **PE SCE**, Member of The Egyptian syndicate of Engineers, Egypt, 2001, **ISO** Internal Auditor certificate of achievement, Bureau VERITAS, Saudi Arabia, 2008, International arbitration advisor in Engineering, 2013 and **Autodesk Certified** in **BIM**, 2012.



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Introduction:

- Safety in Buildings became an important issue since the end of the last century, nearly at the beginning of the 1980. Most of design codes & guidelines developed to include sections that concentrate on how the designers shall ensure safety of Buildings' users.
- One of the leading organizations concerned about that is International Code Council (ICC), where one of its products is International Building Code (IBC) widely used in USA & North America. IBC is the base of most of the developed codes in Middle East & Gulf region.
- In this presentation we shall concentrate on the role of IBC to ensure safety in Conventional & Worship Buildings as the mostly used common Buildings' in the Gulf region.



About ICC (International Code Council) & IBC (International Building Code):

□ The International Code Council is a member-focused association dedicated to helping the building safety community and construction industry to provide **safe, sustainable and affordable** construction through the development of codes and standards used in the design, build and compliance process.

□ The International Codes, or I-Codes, published by ICC, provide minimum safeguards for people at home, at school and in the workplace. The I-Codes are a complete set of comprehensive, coordinated building safety and fire prevention codes. Building codes benefit public safety and support the industry's need for **one set of codes without regional limitations**.



About ICC (International Code Council) & IBC (International Building Code):

- **Vision:** Protect the health, safety and welfare of people by creating safe buildings and communities.
- **Mission:** To provide the highest quality codes, standards, products and services for all concerned with the safety and performance of the built environment.
- **History of ICC:** The International Code Council (ICC) was established in 1994 as a non-profit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes.



About ICC (International Code Council) & IBC (International Building Code):

□ The founders of the ICC are:

1. Building Officials and Code Administrators International, Inc. (BOCA).
2. International Conference of Building Officials (ICBO).
3. Southern Building Code Congress International, Inc. (SBCCI).

□ Publications of ICC: ICC made 2003, 2006, 2009 & 2012 Publications and they are working on 2015 (under publish).



About ICC (International Code Council) & IBC (International Building Code):





IBC Chapters Related to Safety Design:

Use and Occupancy Classifications (IBC Chapters 3 & 4)

- Identify Primary and Secondary Occupancy Classifications.
- Provide distribution of Occupancy Types by Building, Floor or Area.
- Identify High-Hazard Occupancy requirements, if applicable.
- Identify Special Occupancy requirements, if applicable (i.e. high-rise, atriums, underground bldg.s, etc.). [Hyperlink\Chapter 3,4.pdf](#)

Construction Type(s) / General Building Height and Allowable Areas (IBC Chapter 5 & 6)

- Identify construction type(s) to be used in project(s)
- List Allowable and Proposed Building Heights and Stories
- Indicate Allowable Increases based on use of an automatic sprinkler system
- Identify mix of uses and required separation of occupancies (IBC Table 508.4). [Hyperlink\Chapter 5,6.pdf](#)



IBC Chapters Related to Safety Design:

Fire Resistance Rating Requirements (per IBC table 601)

- ❑ Summary of minimum requirements based on type of construction and special project conditions.
- ❑ Table of Building Elements and Fire Resistance Rating requirements.
- ❑ Identify proposed Combustible Materials and Non-Combustible Buildings (IBC Section 603). [Hyperlink\Table 601.pdf](#)

Fire Protection Systems (IBC Chapters 7 & 9)

- ❑ Identify Building Fire Compartments / Building Separation.
- ❑ Identify Smoke Control Systems / Shaft Pressurization or Lobby Requirements.
- ❑ Service Penetration Requirements.
- ❑ Fire Door Requirements. [Hyperlink\IBC 7,9.pdf](#)



IBC Chapters Related to Safety Design:

Occupant Load Calculations (IBC Chapter 3 & Table 1004.1.2)

- ❑ Provide Table by Floor and separate Occupant Classifications.
- ❑ Provide Summary Table of Occupant Loads per floor. [Hyperlink\Table 1004.1.2.pdf](#)

Means of Egress Analysis (IBC Chapter 10)

- ❑ Table by Floor, Occupant Load and Use to determine number of exits and required width of exits per floor.
- ❑ Table identifying Number of Stairs & Stair Width Requirement. [Hyperlink\Chapter 10.pdf](#)

Egress Distance Summary (IBC Chapter 10)

- ❑ Table of Allowable Egress Distances by Type of Occupancy and Fire Protection.



IBC Chapters Related to Safety Design:

Area of Refuge Calculation (IBC Section 1007)

- Provide Table by Floor and Occupant Load

Assembly Occupancy Egress Requirements (IBC Section 1028)

- Identify Assembly Occupancies, if applicable, and list life safety and egress requirements



Application of IBC Chapters on Worship Buildings:

IBC design consideration for Worship Buildings:

- ❑ **Building Classification:** Chapter 3, 303.1: All mosques are considered as worship places, so they are to be classified as **group A3**.
- ❑ **Sprinkler System:** The fire suppression system shall be included a automatic sprinkler (wet type), fire hose cabinet and portable fire extinguisher.
- ❑ **Fire Alarm System:** Fire alarm system shall comprise of the following:
 - An addressable microprocessor-based fire alarm control panel.
 - Intelligent and addressable detectors, manual stations, bells, horns.
- ❑ **Maximum Travel Distance** for fire exits shall not exceed 76.20 m (With sprinkler system)
- ❑ **Services Rooms** like electrical room ,mechanical room and communication rooms shall be 2 hr fire rated as per IBC 2009Table 508.3.



Application of IBC Chapters on Worship Buildings:

- ❑ **Ramped Access** to 50% of building exits shall be provided at least, the ramps shall be sloped of ratio 1:12.
- ❑ **Door Hardware** for exit doors shall support the egress in the direction of escape route (swing to outside).
- ❑ **Exit & Fire Rated Doors** shall be UL tested & labelled shall be provided with door closers with smoke in tumescent seals to the head and both sides.
- ❑ **Egress** 50 % of the egress load shall be dedicated to one exit.



Some Mosques Design Problems:





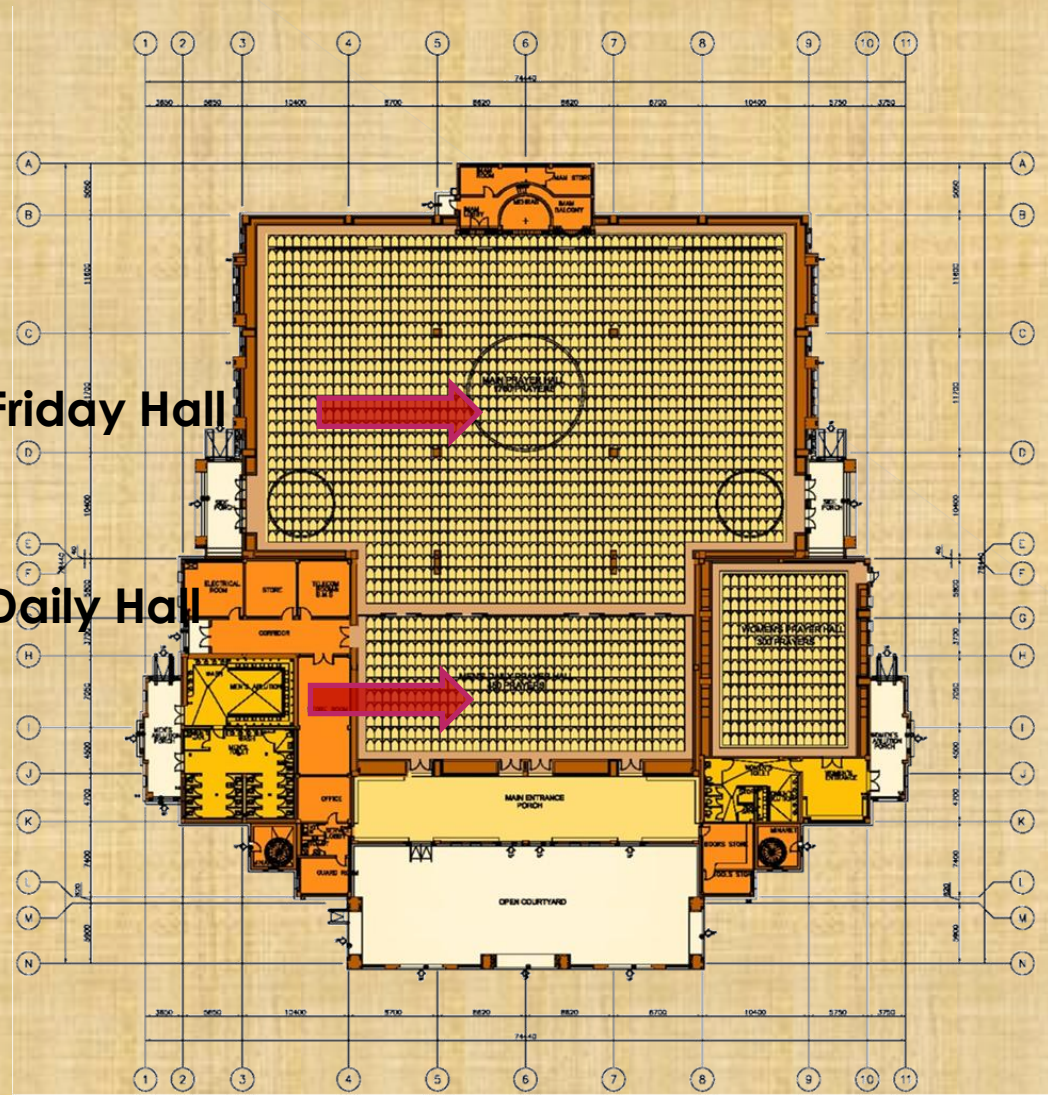
Case Study Dareen Friday Mosque – Jubail Industrial City:





Friday Hall

Daily Hall



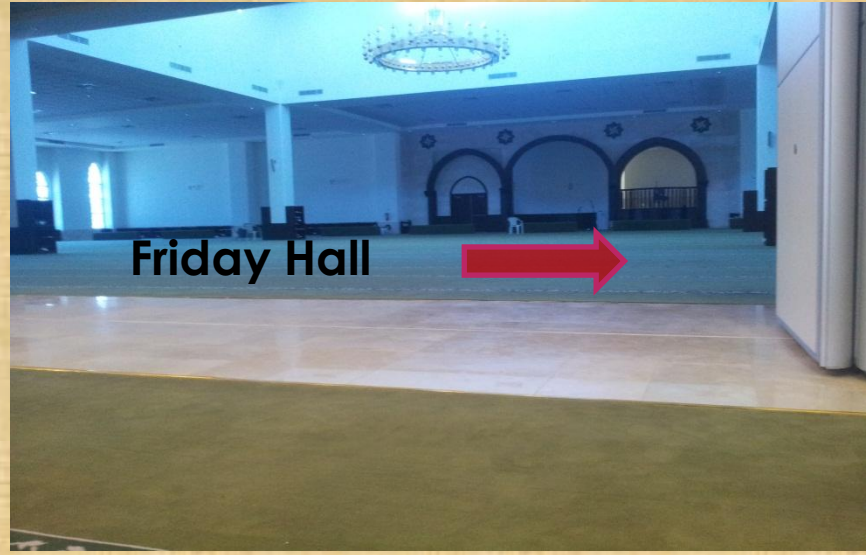
Ground Plan



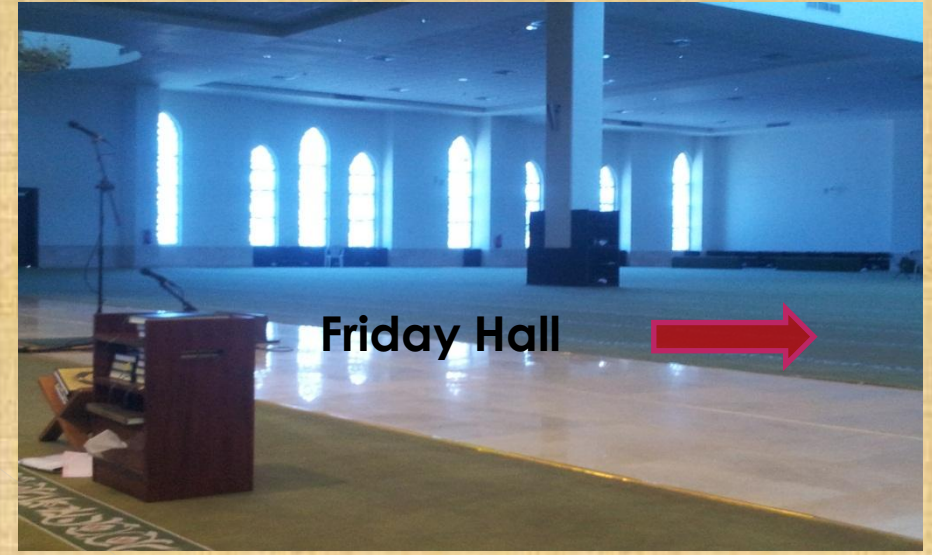
Entrance Facade



Sea View Facade

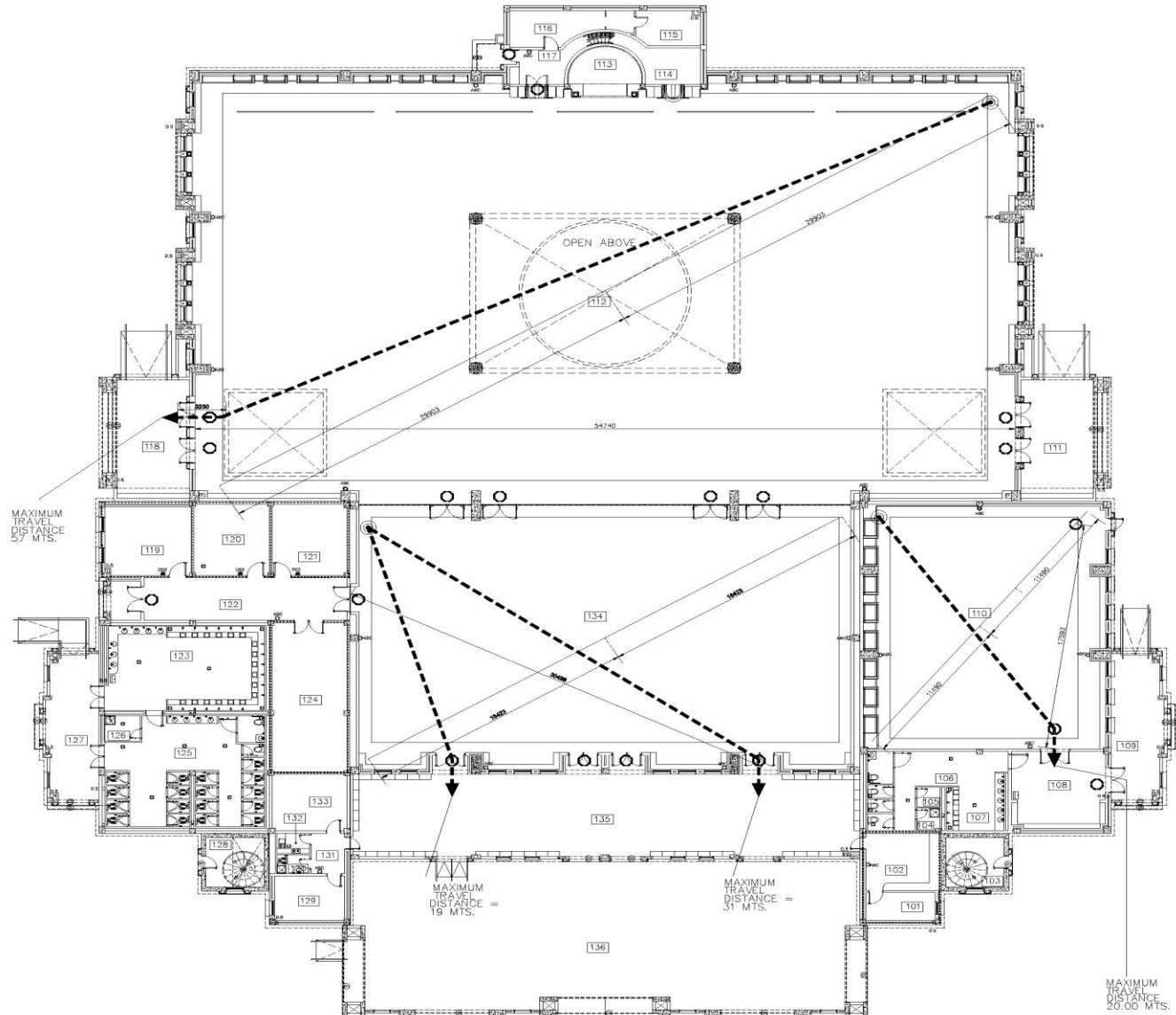


Friday Hall



Friday Hall





Fire Strategy Plan



CODE REQUIREMENT

NOTES	REFERENCE
USE CLASSIFICATION	
OCCUPANCY GROUP / CLASSIFICATION ASSEMBLY / GROUP A3	IBC 303.1
GENERAL BUILDING HEIGHTS , AREAS AND TYPE OF CONSTRUCTION	
THE AREA OF A ONE-STORY, GROUP A-3 BUILDING USED AS A PLACE OF RELIGIOUS WORSHIP, COMMUNITY HALL, DANCE HALL, EXHIBITION HALL, GYMNASIUM, LECTURE HALL, INDOOR SWIMMING POOL OR TENNIS COURT OF CONSTRUCTION TYPE II SHALL NOT BE LIMITED WHEN ALL OF THE FOLLOWING CRITERIA ARE MET: 1. THE BUILDING SHALL NOT HAVE A STAGE OTHER THAN A PLATFORM. 2. THE BUILDING SHALL BE EQUIPPED THROUGHOUT WITH AN AUTOMATIC SPRINKLER SYSTEM IN ACCORDANCE WITH SECTION 903.3.1.1. 3. THE ASSEMBLY FLOOR SHALL BE LOCATED AT OR WITHIN 21 INCHES (533 MM) OF STREET OR GRADE LEVEL AND ALL EXITS ARE PROVIDED WITH RAMPS COMPLYING WITH SECTION 1010.1 TO THE STREET OR GRADE LEVEL. 4. THE BUILDING SHALL BE SURROUNDED AND ADJOINED BY PUBLIC WAYS OR YARDS NOT LESS THAN 60 FEET (18 288 MM) IN WIDTH.	507.6 GROUP A-3 BUILDINGS THE DESIGN IS COMPLETING WITH IBC THE DESIGN IS COMPLETING WITH IBC THE DESIGN IS COMPLETING WITH IBC THE DESIGN IS COMPLETING WITH IBC
AN AUTOMATIC SPRINKLER SYSTEM SHALL BE PROVIDED FOR GROUP A-3 OCCUPANCIES WHERE ONE OF THE FOLLOWING CONDITIONS EXISTS: 1. THE FIRE AREA EXCEEDS (1115 SQ.M.), (1620 SQ.M. > 1115 SQ.M.). 2. THE FIRE AREA HAS AN OCCUPANT LOAD OF 300 PERSONS OR MORE. (650 PERSONS > 360 PERSONS) 3. THE FIRE AREA IS LOCATED ON A FLOOR OTHER THAN THE LEVEL OF EXIT DISCHARGE.	903.2.1.3 GROUP A-3.
TYPE OF CONSTRUCTION TYPE II	
STRUCTURAL FRAME O H BEARING WALLS EXTERIOR AND INTERIOR O H NONBEARING WALLS AND PARTITIONS EXTERIOR O H NONBEARING WALLS AND PARTITIONS INTERIOR O H FLOOR CONSTRUCTION INCLUDING SUPPORTING BEAMS AND JOISTS O H ROOF CONSTRUCTION INCLUDING SUPPORTING BEAMS AND JOISTS O H	TABLE 601 FIRE-RESISTANT RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)
WHEREAS IN DESIGN , BUILDING HEIGHTS ONE-STORY AREA UNLIMITED TYPE OF CONSTRUCTION TYPE II AN AUTOMATIC SPRINKLER SYSTEM IS THERE AE DESIGN COMPILES WITH IBC	FOR MORE INFORMATION SEE DESIGN BASIS REPORT
OCCUPANCY CLASSIFICATION	
OCCUPANT LOAD CALCULATIONS : OCCUPANT LOAD : 1500 PERSONS (MAIN FRIDAY HALL) + 650 PERSONS (DAILY HALL) 300 PERSONS (WOMEN'S HALL) =2450 PERSONS OCCUPANT FACTOR : 1M / 1 PERSON	R.C.D.G.L

MEANS OF EGRESS

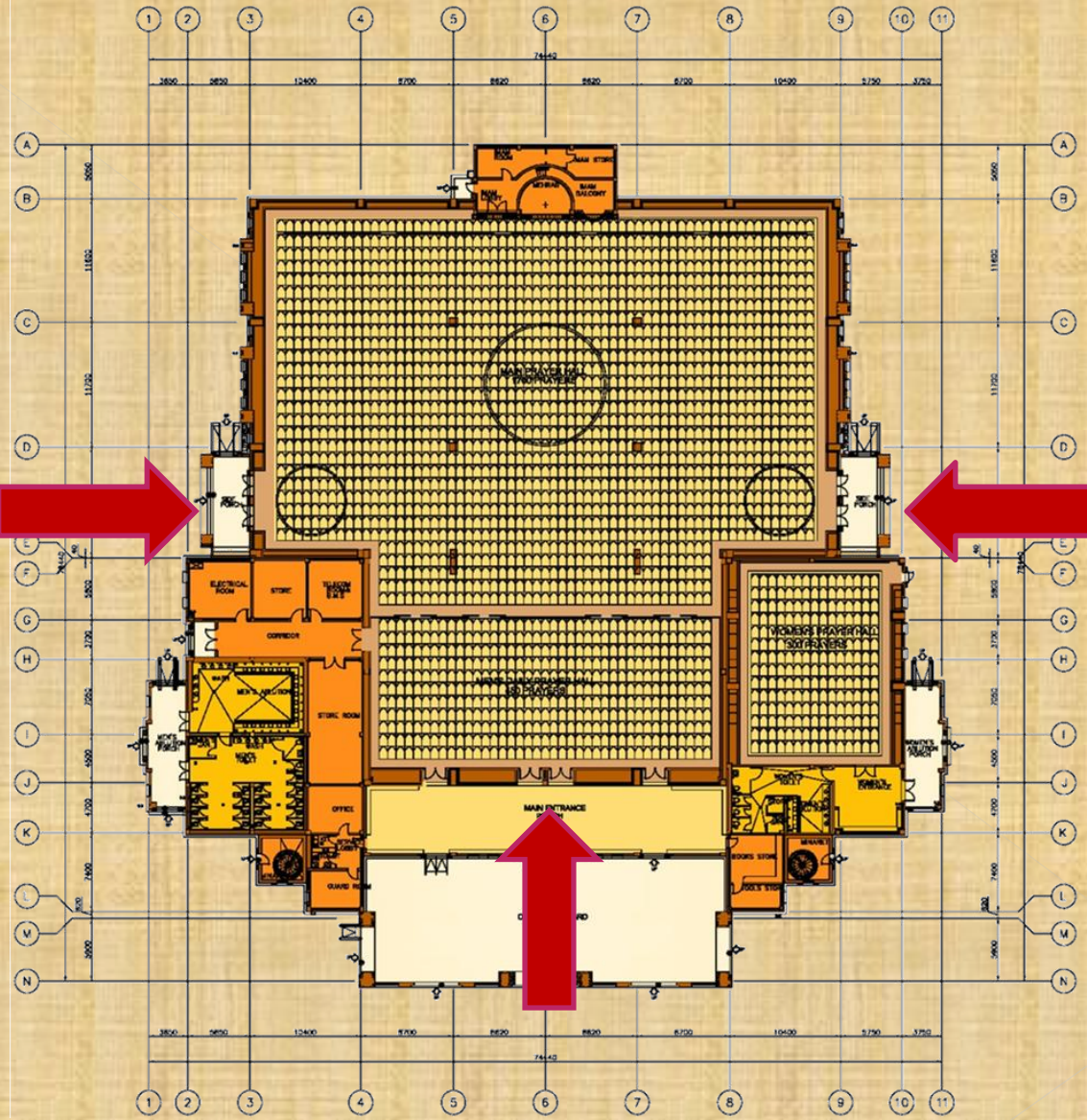
MEANS OF EGRESS : EGRESS CAPACITY FACTOR FOR EGRESS COMPONENTS = 0.15 *25,4=3.81MM ASSEMBLY MAIN EXIT. GROUP A OCCUPANCIES THAT HAVE AN OCCUPANT LOAD OF GREATER THAN 300 SHALL BE PROVIDED WITH A MAIN EXIT. THE MAIN EXIT SHALL BE OF SUFFICIENT WIDTH TO ACCOMMODATE NOT LESS THAN ONE-HALF OF THE OCCUPANT LOAD FRIDAY PRAYER HALL : EGRESS DOOR WIDTH : 1500 X 0.5 X 5.08 = 3810 MM DAILY PRAYER HALL : EGRESS DOOR WIDTH : 650 X 0.5 X 5.08 = 1651 MM WOMEN PRAYER HALL : EGRESS DOOR WIDTH : 300 X 0.5 X 5.08 = 762 MM MINIMUM REQUIRED AS PER IBC 2006 FOR ONE LEAVE = 813 MM	IBC TABLE 1005.1 1025.2 ASSEMBLY MAIN EXIT WITH SPRINKLER SYSTEM IBC1008.1.1
IN DESIGN, EGRESS DOOR WIDTH = 2000 MM	R.C.D.G.L
001-500 PERSONS AT MINIMUM 2 EXITS SHALL BE PROVIDED 501-1000 PERSONS AT MINIMUM 3 EXITS SHALL BE PROVIDED MORE THAN 1000 PERSONS AT MINIMUM 4 EXITS SHALL BE PROVIDED	IBC TABLE 1019.1
IN DESIGN, 4 EXITS IN THE FRIDAY HALL AND IN DESIGN, 4 EXITS IN THE DAILY HALL AND 2 EXITS IN WOMEN'S HALL	
THREE OR MORE EXITS OR EXIT ACCESS DOORWAYS WHERE ACCESS TO THREE OR MORE EXITS IS REQUIRED, AT LEAST TWO EXIT DOORS OR EXIT ACCESS DOORWAYS SHALL BE ARRANGED IN ACCORDANCE WITH THE PROVISIONS OF SECTION 1015.2.1. WHERE A BUILDING IS EQUIPPED THROUGHOUT WITH AN AUTOMATIC SPRINKLER SYSTEM THE SEPARATION DISTANCE OF THE EXIT DOORS OR EXIT ACCESS DOORWAYS SHALL NOT BE LESS THAN ONE-THIRD OF THE LENGTH OF THE MAXIMUM OVERALL DIAGONAL DIMENSION OF THE AREA SERVED.	IBC 1015.2.2 1015.2.1 EXCEPTION
AE COMPILES WITH IBC SEE GROUND FLOOR PLAN	GROUND FLOOR PLAN
EXIT ACCESS TRAVEL DISTANCE SHALL BE NOT MORE THAN 76.20M	IBC TABLE 1016.1
WHEREAS IN DESIGN (FRIDAY PRAYER HALL), TRAVEL DISTANCE SHALL BE NOT MORE THAN 57 M WHEREAS IN DESIGN (DAILY PRAYER HALL), TRAVEL DISTANCE SHALL BE NOT MORE THAN 31 M WHEREAS IN DESIGN, (WOMEN PRAYER HALL) TRAVEL DISTANCE SHALL BE NOT MORE THAN 20 M	
THE FIRE HOSE CABINET SYSTEM ARE DESIGNED IN ACCORDANCE WITH NFPA 14 STANDARD. HOSE VALVE SIZE IS 1-1/2" WITH 30 METERS LONG HOSE. MULTIPURPOSE DRY CHEMICAL POWDER PORTABLE FIRE EXTINGUISHER CLASS ABC 6 KG WEIGHT SHALL BE PROVIDED INSIDE FHC. CARBON DIOXIDE PORTABLE FIRE EXTINGUISHER CLASS BC 6KG WEIGHT SHALL BE PROVIDED IN ELECTRICAL ROOM. MULTIPURPOSE DRY CHEMICAL TYPE, UL RATED ABC, 6 KG SHALL BE PROVIDED IN ALL COMMON AREAS.	



Exit Doors / Open to outside



Exit Doors / Open to outside



Ground Floor Plan



Application of IBC chapters on Conventional Buildings:

IBC design consideration for Conventional Buildings:

- ❑ **Building Classification:** Assembly **Group A-1** Occupancy, usually with fixed seating, intended for the production and viewing of the performing arts and motion pictures as per IBC Section 303.
- ❑ **Sprinkler System:** The fire suppression system shall be included a automatic sprinkler (wet type), fire hose cabinet and portable fire extinguisher.
- ❑ **Fire Alarm System:** Fire alarm system shall comprise of the following:
 - An addressable microprocessor-based fire alarm control panel.
 - Intelligent and addressable detectors, manual stations, bells, horns.
- ❑ **Maximum Travel Distance** for fire exits shall not exceed 76.20 m (With sprinkler system)
- ❑ **Services Rooms** like electrical room ,mechanical room and communication rooms shall be 2 hr fire rated as per IBC 2009Table 508.3.



Application of IBC chapters on Conventional Buildings:

- Ramped Access** to 50% of building exits shall be provided at least, the ramps shall be sloped of ratio 1:12.
- Door Hardware** for exit doors shall support the egress in the direction of escape route (swing to outside).
- Exit & Fire Rated Doors** shall be UL tested & labelled shall be provided with door closers with smoke in tumescent seals to the head and both sides.
- Egress** 50 % of the egress load shall be dedicated to one exit.



Some Conventional Centers Problems:



Evacuation of People at once



Escape Route Crowded

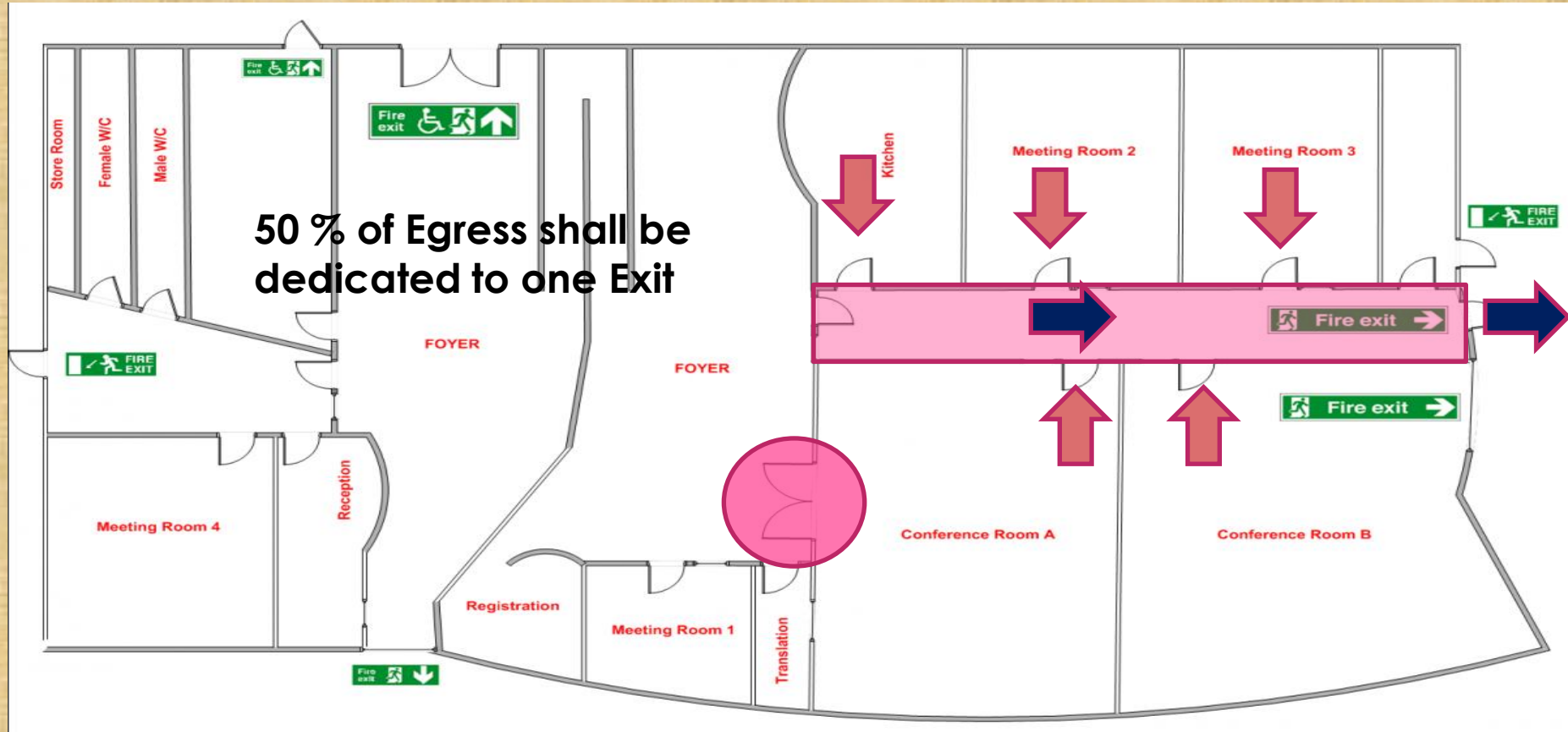


Presence of Adequate Fire fighting System



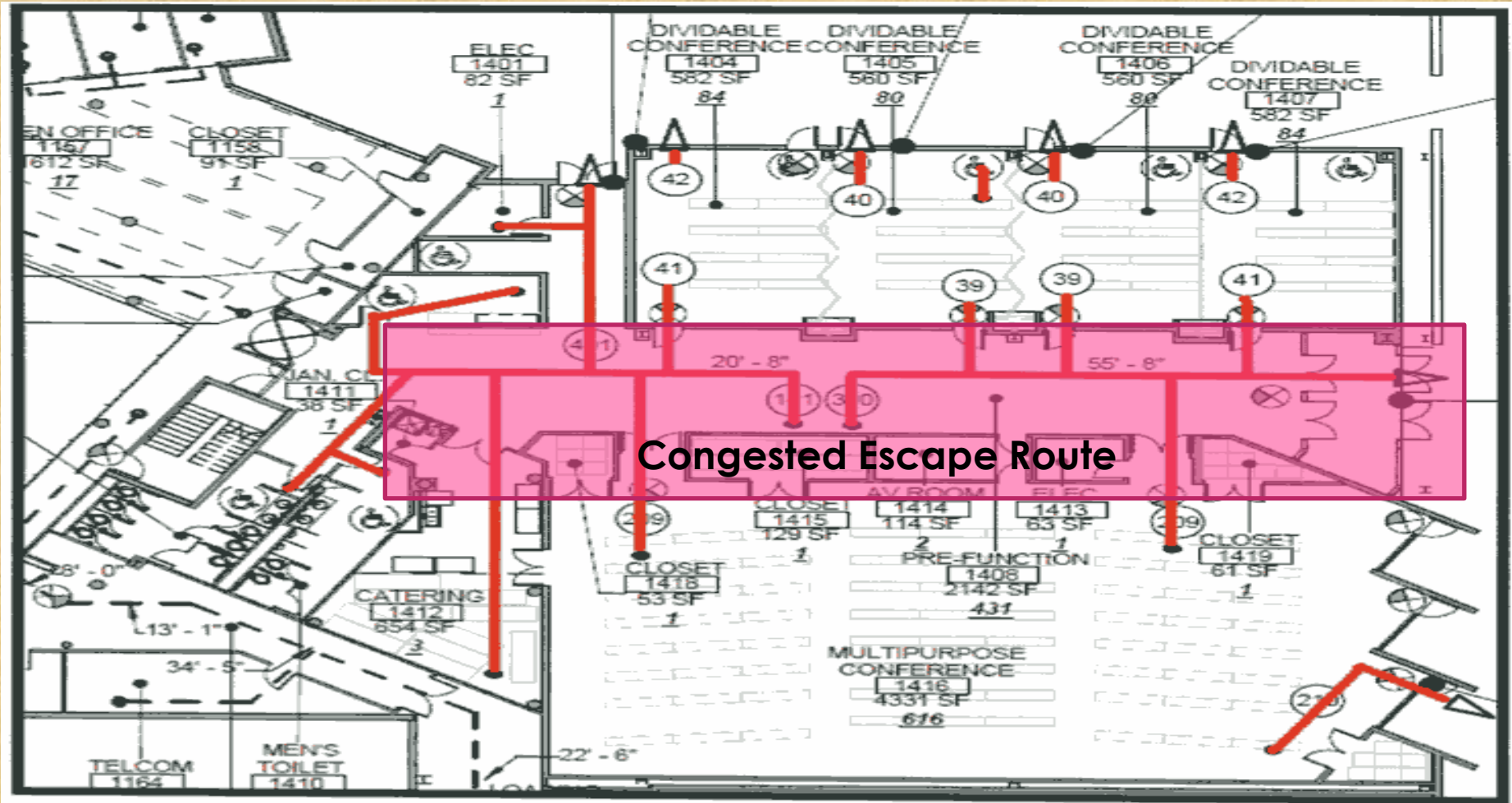
Presence of Mezzanine Level

Some Conventional Centers Problems:



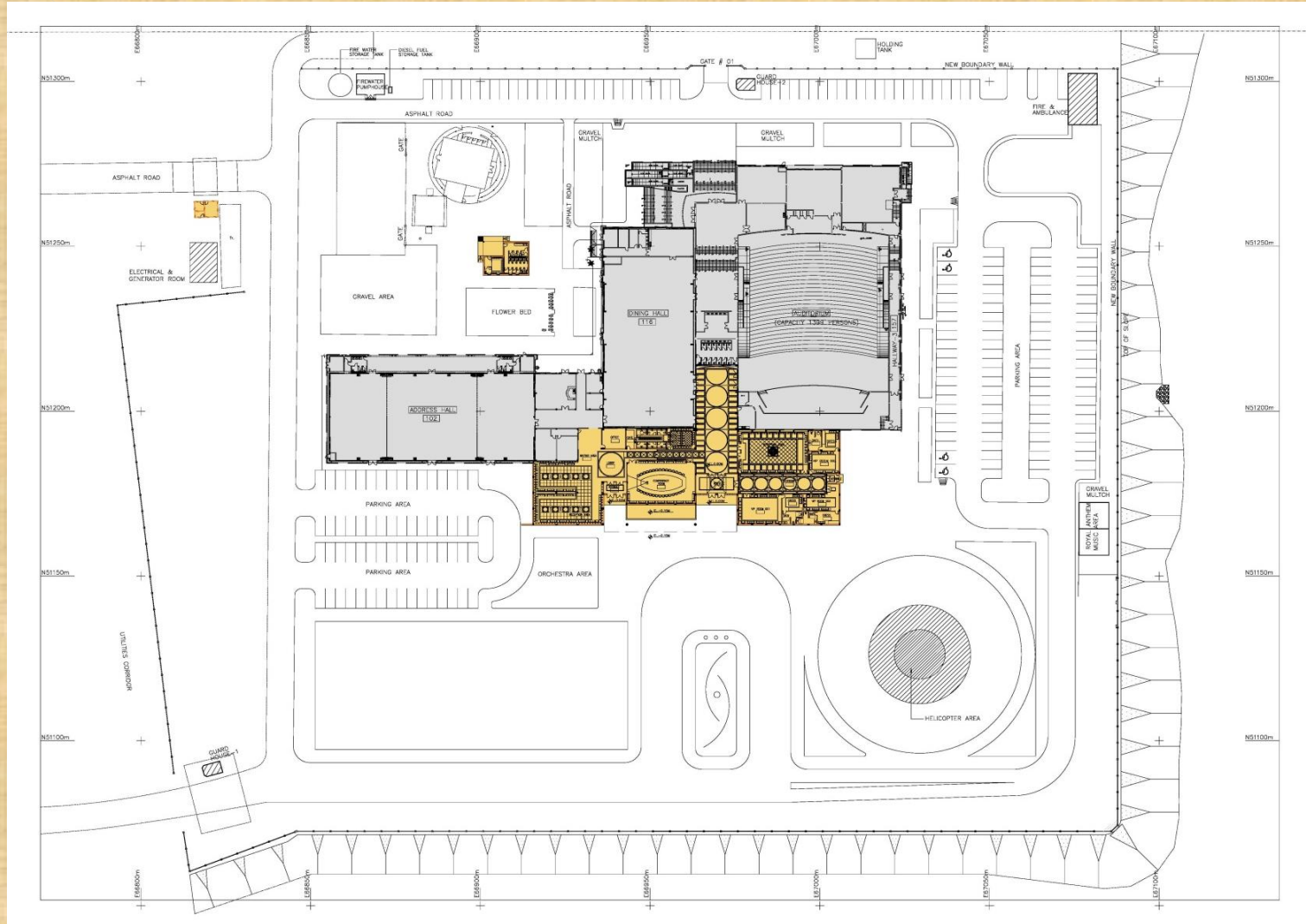
NICVA Building Exit Points & Fire Exits

Some Conventional Centers Problems:





Case Study Jubail Industrial City Multi Event Center:



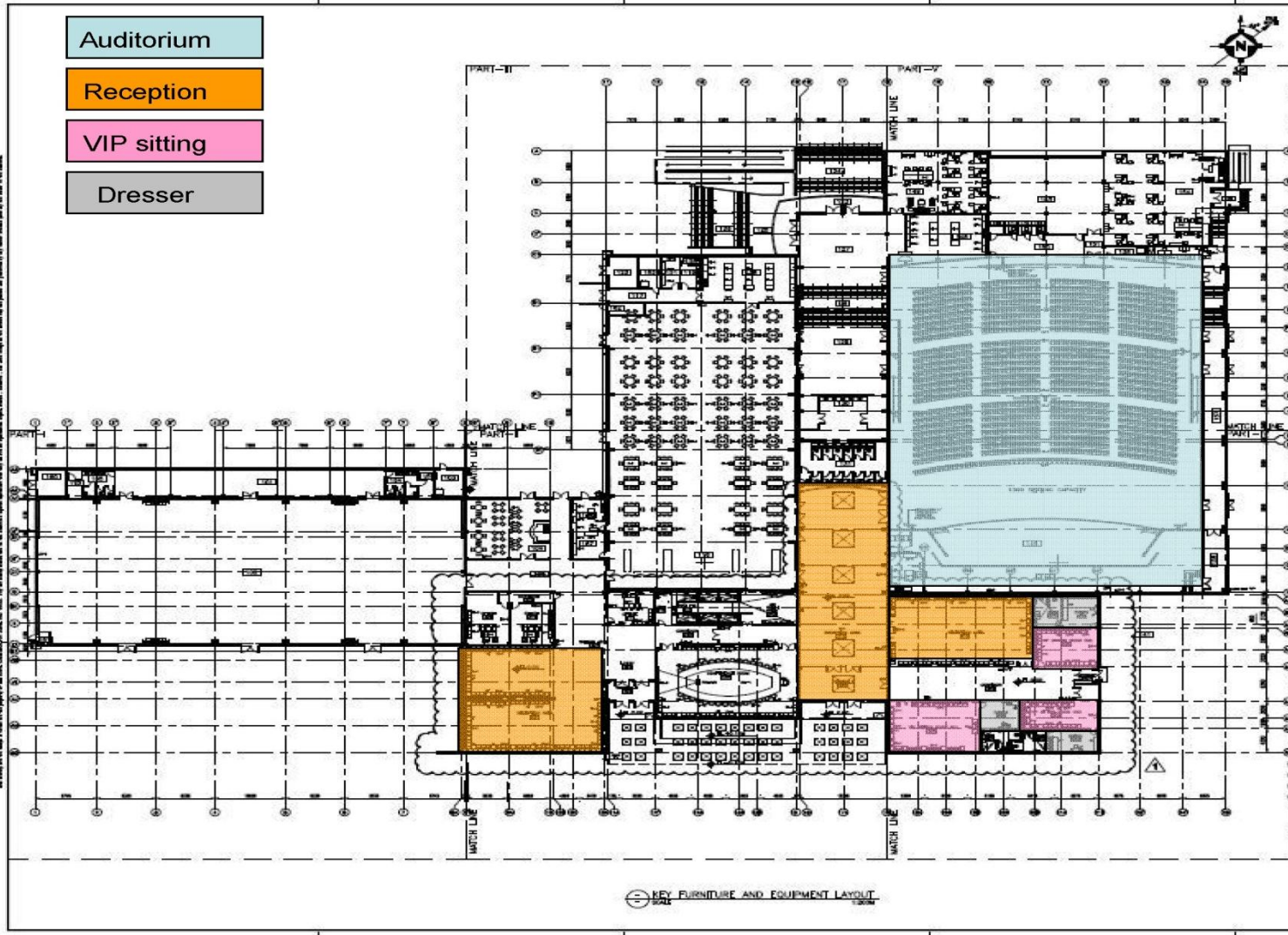
Site layout Plan

Safety Design in Buildings



- Auditorium
- Reception
- VIP sitting
- Dresser

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KEY FURNITURE AND EQUIPMENT LAYOUT

NOTES

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

LEGEND

ROOM NUMBER DESIGNATION
 1. ROOM NO. PARTS AND WALLS

① DRAIN LINE
 ② FLOOR FINISH
 ③ FLOOR FINISH

④ PORTABLE FIRE EXTINGUISHER
 FIRE EXTINGUISHER
 ISSUE FOR SIZE A 1

REFERENCE DRAWINGS

ISSUED NO.	ISSUED DATE
IC-000	12-2008
IC-001	12-2008
IC-002	12-2008
IC-003	12-2008
IC-004	12-2008
IC-005	12-2008
IC-006	12-2008
IC-007	12-2008
IC-008	12-2008
IC-009	12-2008
IC-010	12-2008

KEY PLAN

REVISIONS

NO.	DESCRIPTION	DATE
1	ISSUED FOR CONSTRUCTION	12-2008

SAUDIEN AREA CONSULTANTS
 ENGINEERS ARCHITECTS INTERIORS DESIGNERS

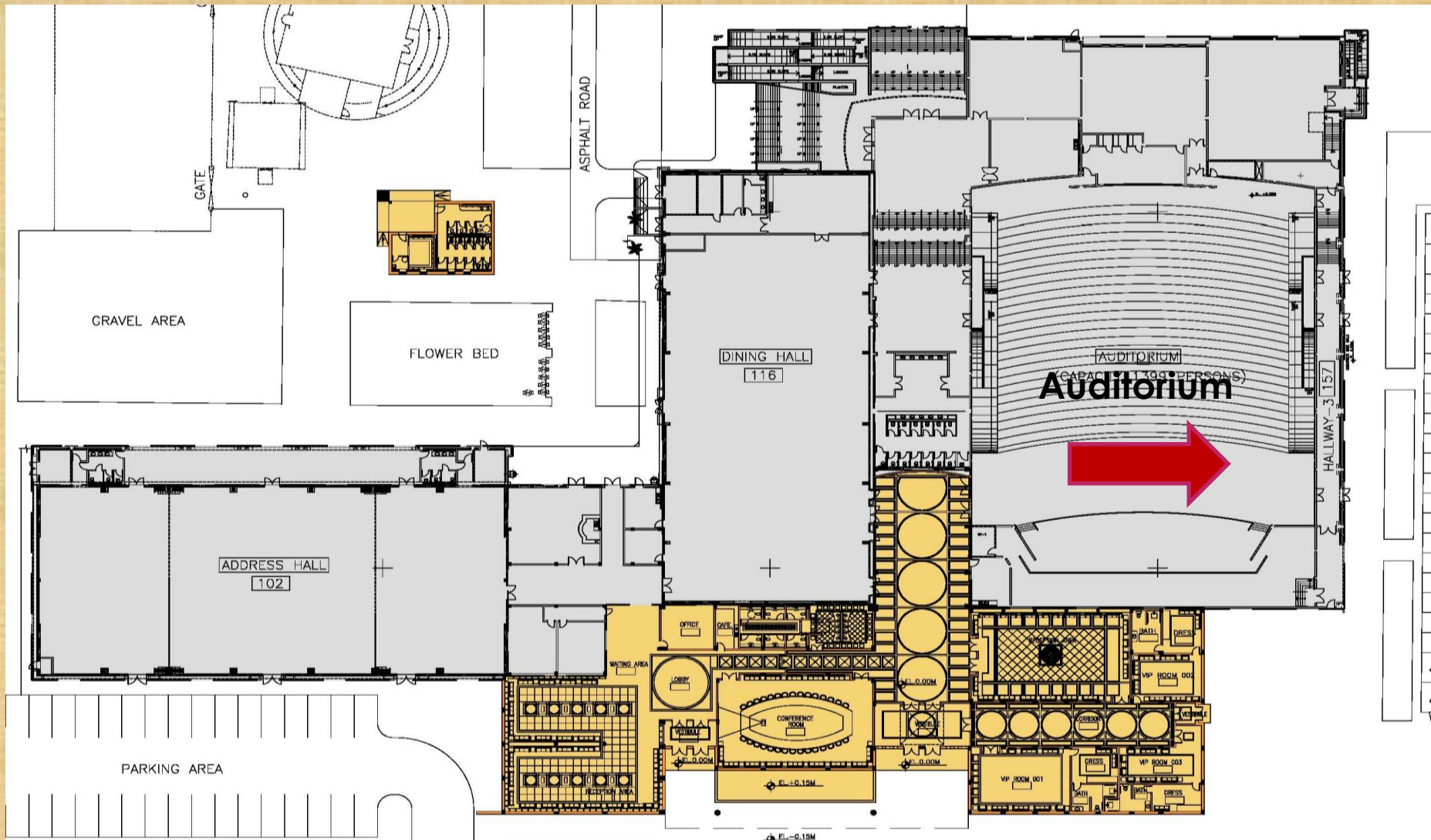
COMPANION
 مخرج كوستة
 مركز المتاحف السعودية

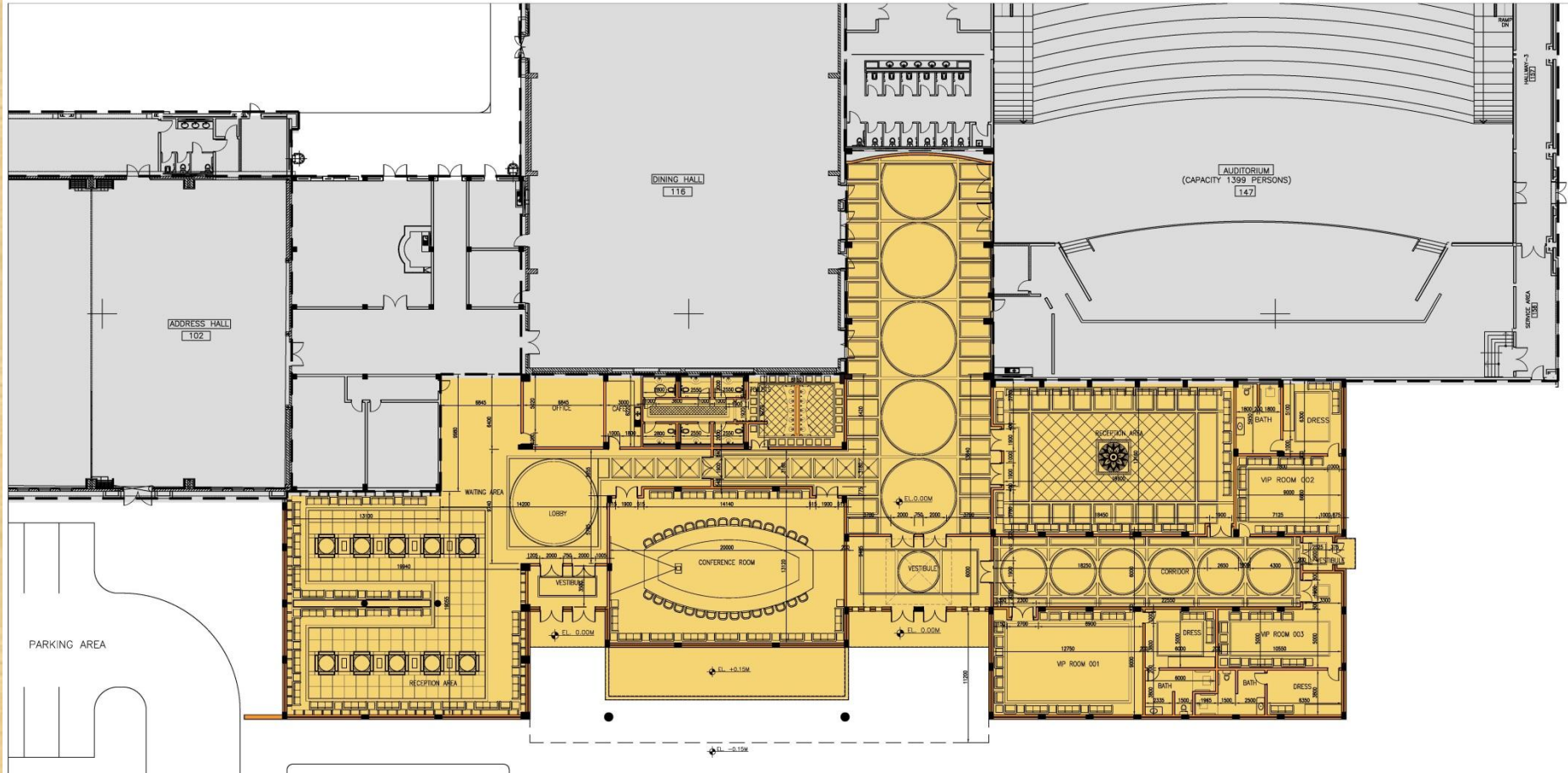
KEY FURNITURE AND EQUIPMENT LAYOUT
 SAUDIEN AREA CONSULTANTS
 ENGINEERS ARCHITECTS INTERIORS DESIGNERS
 NUMBER NO. 1-000000
 DRAWING NO. 000-0000
 SCALE 1:1000
 SHEET NO. 000-0000-0000

Date: 27 OCT. 2014

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Ground Floor Plan full





Ground Floor Plan / King Lounge & meeting room

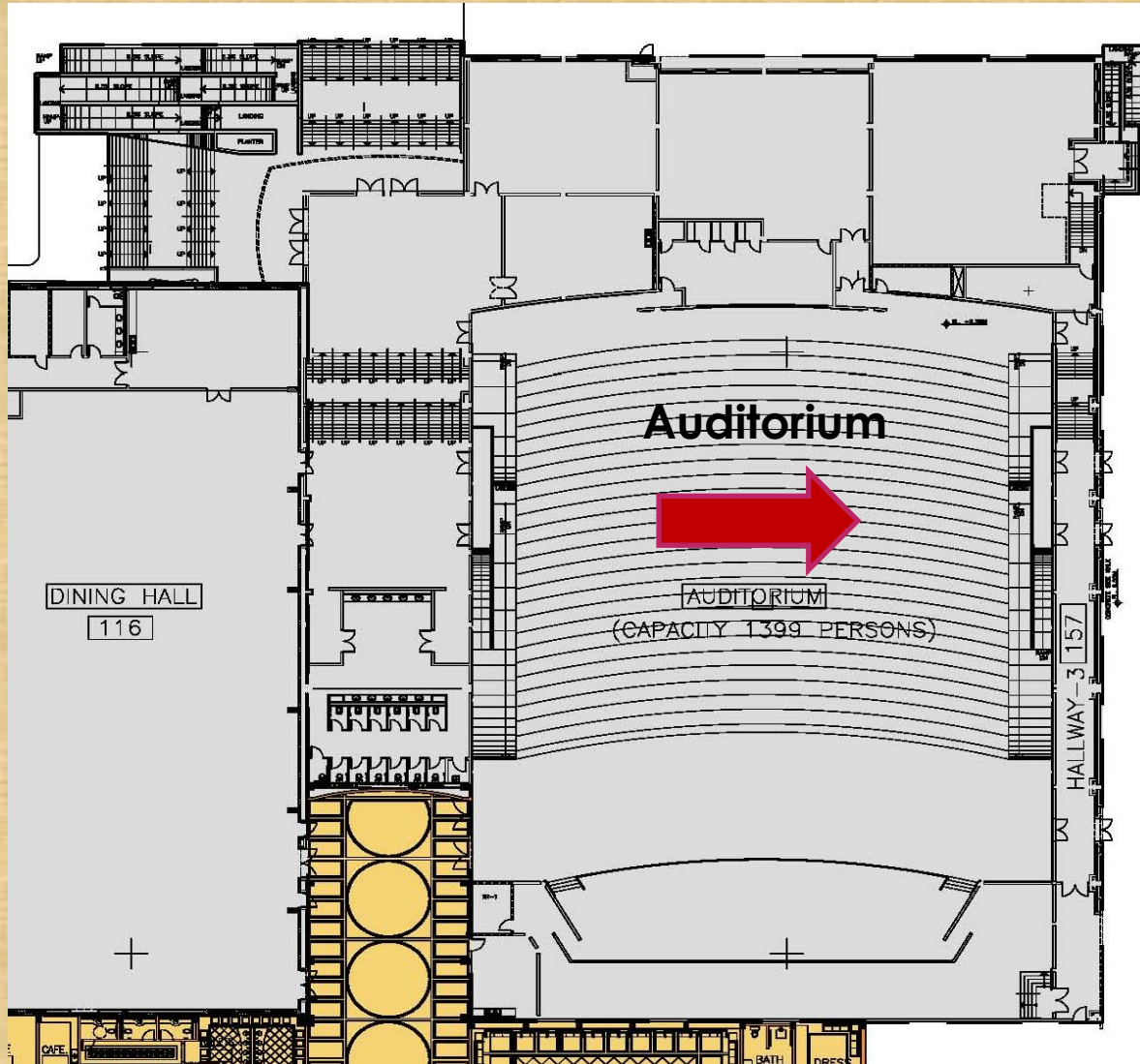


Building Main Facade



Date: 27 OCT. 2014
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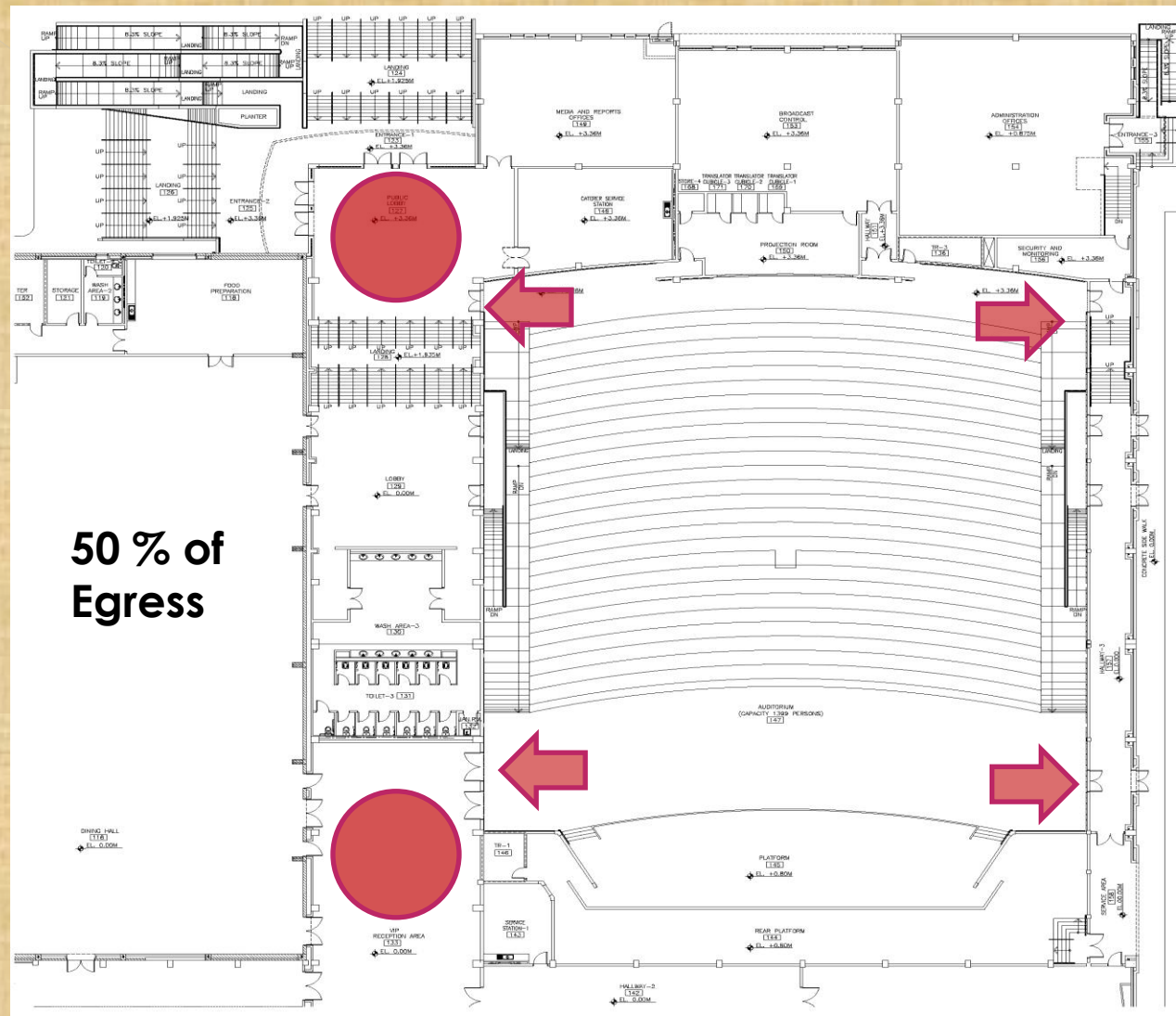
Building Main Facade



Date: 27 OCT. 2014

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Ground Floor Plan / Auditorium





Conclusion:

- ❑ IBC is an important design regulation documents which contribute to Buildings Safety.
- ❑ IBC shall work side by side with another safety codes to achieve maximum security to buildings' users.
- ❑ Worship Design Building Practice is facing a lot of safety issues which IBC address successfully.
- ❑ Conventional Design Building Practice is facing a lot of safety issues which IBC address successfully.



Thank you!

Now the board is open for Questions

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