THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF MECHANCIAL AND MANUFACTURING ENGINEERING

MECH4880 REFRIGERATION AND AIR CONDITIONING

ASSIGNMENT 1 (2017) – Part A and Part B Overview

1. Problem Statement

Your company has been commissioned by a client to design the HVAC system for a 2 storey retail complex with an adjacent carpark as portrayed in the attached specification using the given design conditions. Your manager has tasked you with calculating the heat loads and performing preliminary duct design and unit selection for the building.

This assignment is divided into two parts, part A accounts for the 40 % of the assignment, while part B is responsible for the remaining 60%. To submit part B, students must have already submitted part A. A professional report should be submitted, that is, the report satisfies all items listed in the important notes (listed later in this document). Note that the order of the sections can be restructured and the list is not limiting (other sections can be added or combined or structured differently) but they must all in some form be present in your submission.

The following documents should be used in conjunction with this overview:

- Assignment 1 – Building Layout and Tenancy Layout
- Assignment 1 – Project Specifications
- Assignment 1 – Assignment Helper

Part A – Due by Week 8 Friday

This section requires students to implement the heat load calculation methodology outlined in AIRAH-DA09. A detailed manual heat load calculations for shops T.0.6 and MM.0.3 must be performed and reported for summer and winter. Additionally a CAMEL heat load simulation must be performed for these two shops. Reporting must include (**but not limited to**) following items:

(1) Design Day Selection and Specification Comprehension
(2) External Loads – Wall Specifications
(3) External Loads – Solar Transmission
(4) External Loads – Partitions
(5) External Loads – Winter
(6) Internal Loads – Summer
(7) Internal Loads – Winter
(8) Cooling and Heating Load Summary
(9) Psychrometrics (Summer only)
(10) CAMEL heat load simulation and validation for T.0.6 and MM.0.3

Part B – Due by Week 13 Friday

This part requires students to perform the cooling and heating load calculations for the entire building using the CAMEL heat load simulation software. The submission should include (**but not limited to**) following elements:

(1) Produce conditioned/ventilated space maps and thermal zone plans
(2) Ventilated space calculations
(3) CAMEL heat load simulation
(4) Air schematics
(5) Duct Design
(6) Pressure loss calculations and fan selection (Ventilated spaces only)
(7) AHU selection
(8) Building improvements and sustainable design

Ensure that you follow the assignment helper as it details the minimum that is expected from each submission.

2. Design Constraints

Outside design conditions:

- Latitude 30^0 South
- Summer 33.8^0C DB / 22.9 ^{0}C WB
- Winter 2.1 ^{0}C DB/80% RH

- Building north is defined as the same as true north
- Minimum supply air temperature 12^0C
- Cooling coil effectiveness, η_C 0.85
- Outside air requirements: 10 litres per second per person

3. Building Details

Location: Temperate Town. Climate zone 6.

Building Type: Class 6 Structure

Building Description: The project is a two storey shopping centre with a carpark adjacent. The building contains 30 different stores providing a variety of choice to shoppers. It features a courtyard centred around restaurants on the first floor and has a feature façade with shade sails on the perimeter of the food court.

4. References

- *ASHRAE Guide and Data Books* (Fundamentals), American Society of Heating, Refrigeration and Air Conditioning Engineers. (Available Online)
- AIRAH Design Manual DA09.
- Australian Standard 1668, Part 2-2012 + A1 (Search SAI GLOBAL in UNSW Library).
- Australian Standard 1668, Part 4-2012 (Search SAI GLOBAL in UNSW Library).
- NCC 2016, SECTION J- Energy Efficiency (Available Online)
- CAMEL User Guide
- Assignment 1 - Building specifications
- Assignment 1 - Assignment helper

5. Important Notes

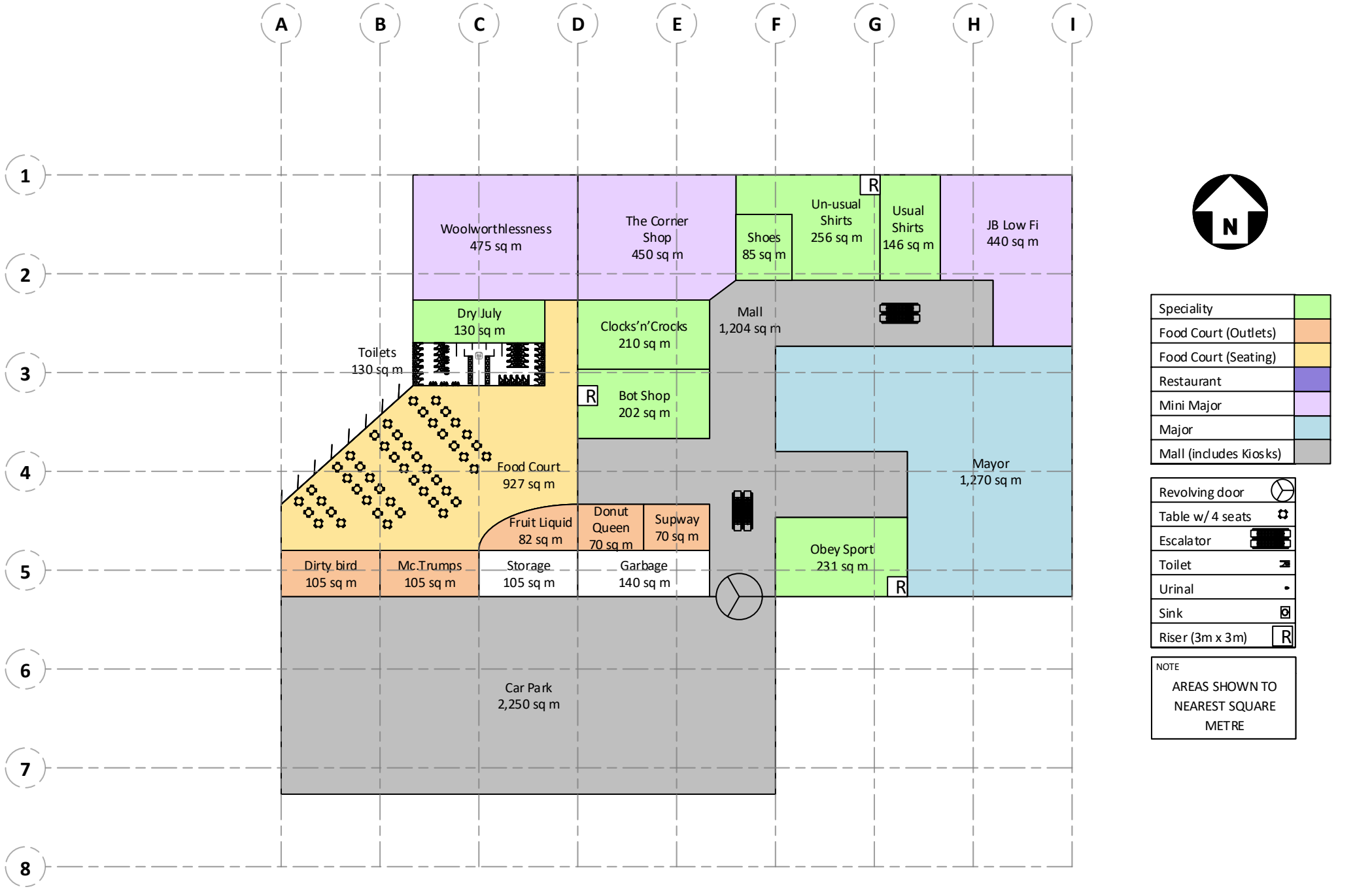
- All calculations ***must*** be in SI units.
- All source of data etc., ***must*** be properly referenced.
- All assumptions ***must*** be listed and justified.
- The professional report ***must*** contain at the front a tabulated summary of the results (Executive Summary).
- In both submissions, only if the calculations are repetitive, full working for a calculation can be forgone for an excel spreadsheet after one sample calculation is provided. The full spreadsheet can be pasted appropriately in report with informative captions. Otherwise detail calculations are always expected to be shown clearly step by step. Take care in ensuring that all steps of a procedure are provided and formulas used are listed throughout the calculation.
- The professional report ***must*** also contain Abstract, Introduction, Conclusion, drawings, a discussion of the results and comparison of the methods, and appropriate tables/figures.
- **Part A is due at 5pm Friday 15th September Week 8**
- **Part B is due at 5pm Friday 27th October Week 13**
- Both Parts ***must*** be submitted via the submission tool in MOODLE

6. Assignment Guidance

- Part A (DA09) – Nicholas Gilmore, Mitchell Kazmierczak
- Part B (CAMEL) – Melanie Finch, Mitchell Kazmierczak
- CAMEL Guidance – ACADS BSG (Workshop conducted in Week 6)

Issued: 8th August 2017

Dr C.Menictas



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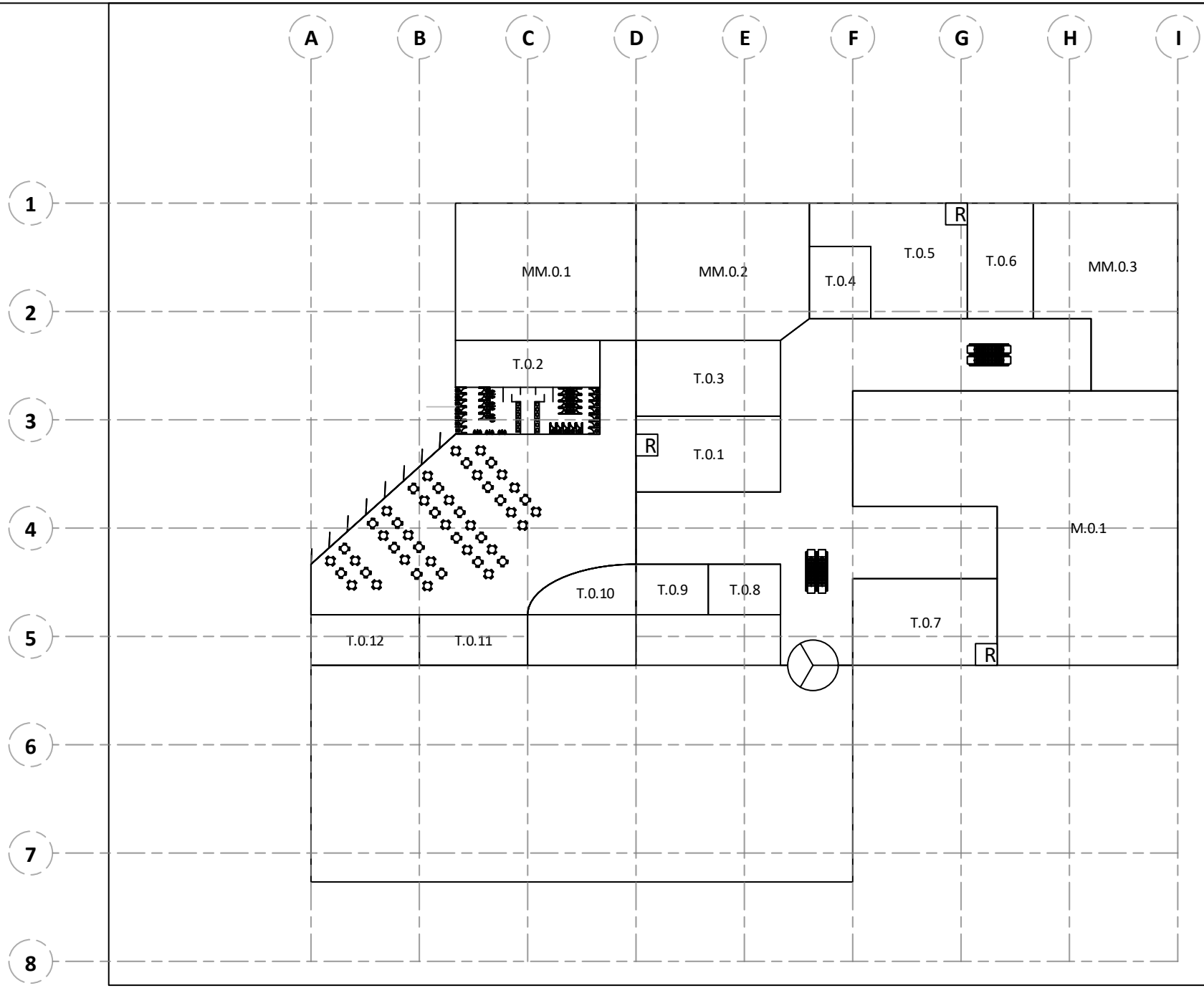
DESCRIPTION	PAGE	SCALE
TOP VIEW	1 OF 7	1: 750

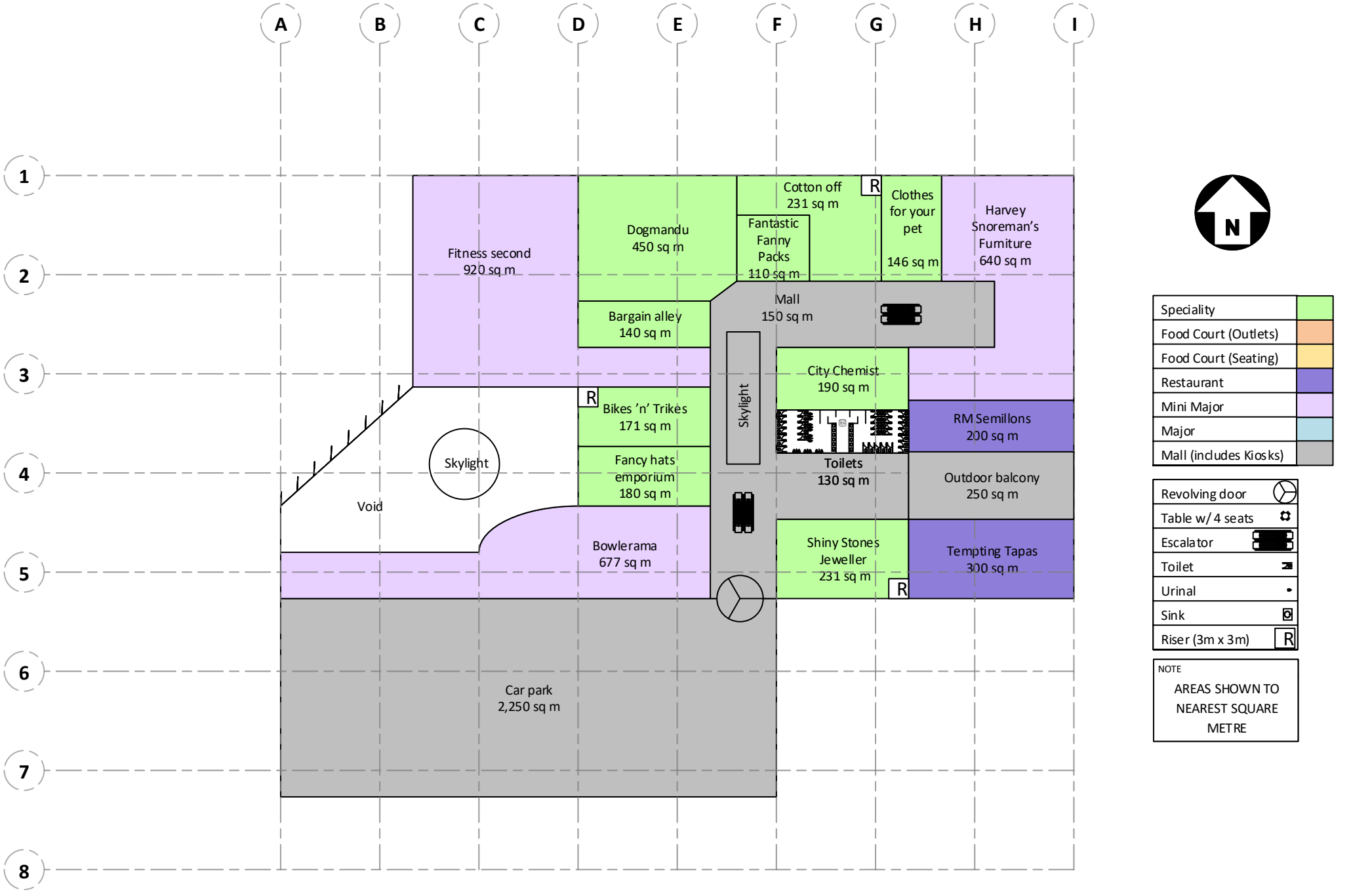


ROOM CODE
Category.Floor.Number
T – Tenancy
MM – Mini Major
M – Major
.
0 – Ground floor
1 – First floor

Revolving door	
Table w/ 4 seats	
Escalator	
Toilet	
Urinal	
Sink	
Riser (3m x 3m)	R

0.0 m 30.0 m 50.0 m 100.0 m

SIZE	TITLE	DATE
A4	GROUND FLOOR PLAN (BW)	08/08/17
DESCRIPTION	PAGE	SCALE
TOP VIEW	2 OF 7	1: 750



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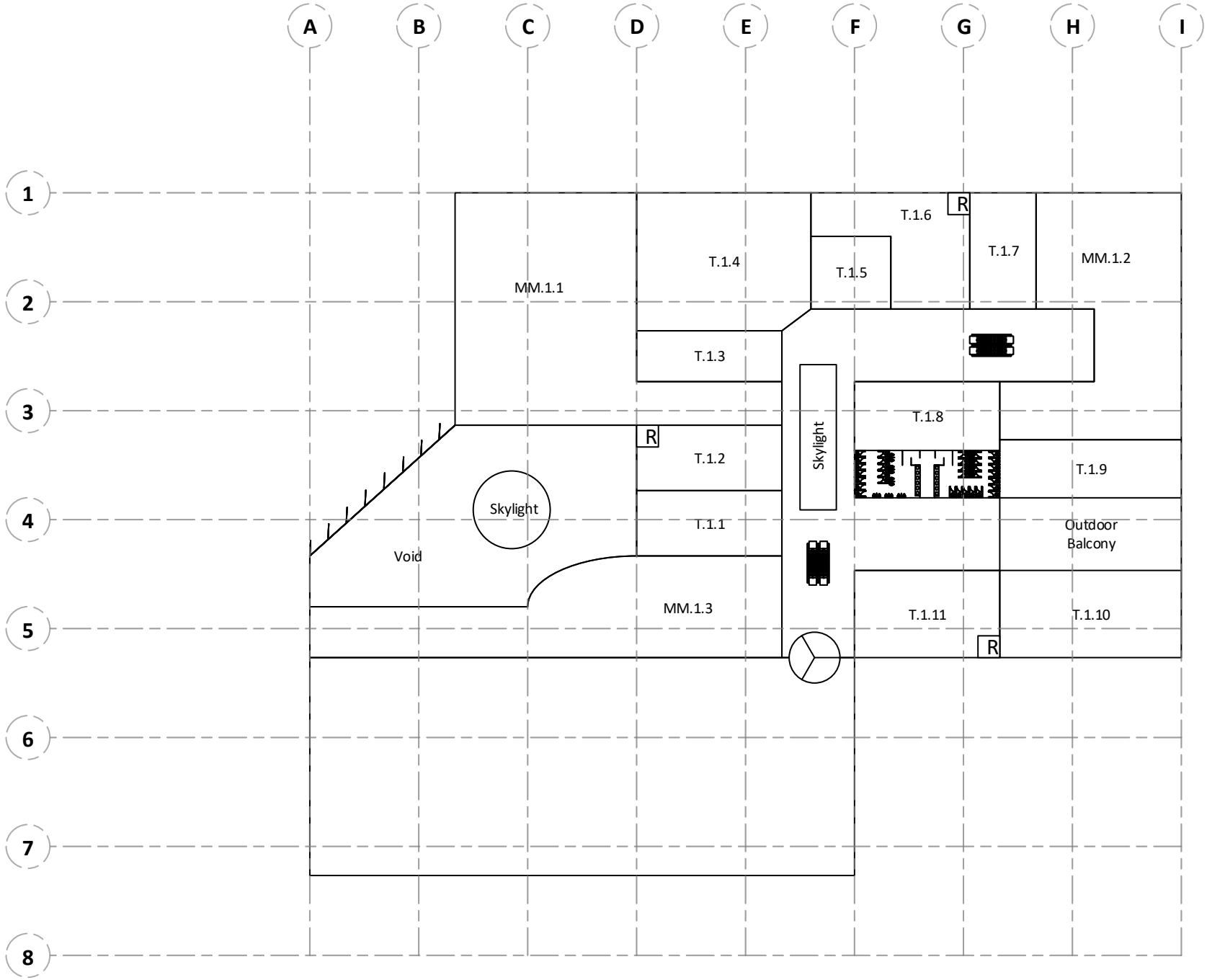
DESCRIPTION	PAGE	SCALE
TOP VIEW	3 OF 7	1: 750

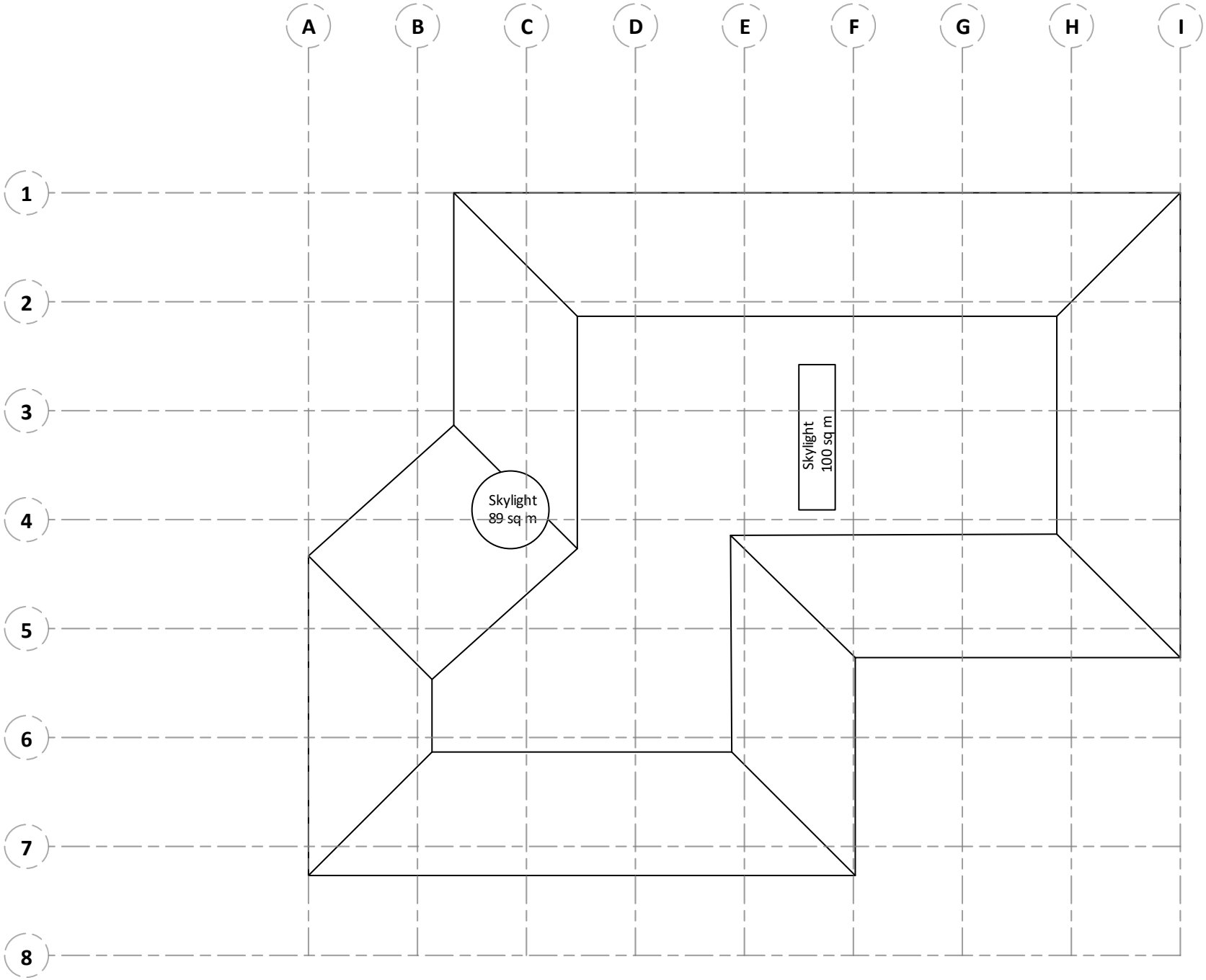


ROOM CODE
Category.Floor.Number
T – Tenancy
MM – Mini Major
M – Major
.
0 – Ground floor
1 – First floor

Revolving door	
Table w/ 4 seats	
Escalator	
Toilet	
Urinal	
Sink	
Riser (3m x 3m)	R

0.0 m 30.0 m 50.0 m 100.0 m

SIZE	TITLE	DATE
A4	FIRST FLOOR PLAN (BW)	08/08/17
DESCRIPTION	PAGE	SCALE
TOP VIEW	4 OF 7	1: 750



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SIZE	TITLE	DATE
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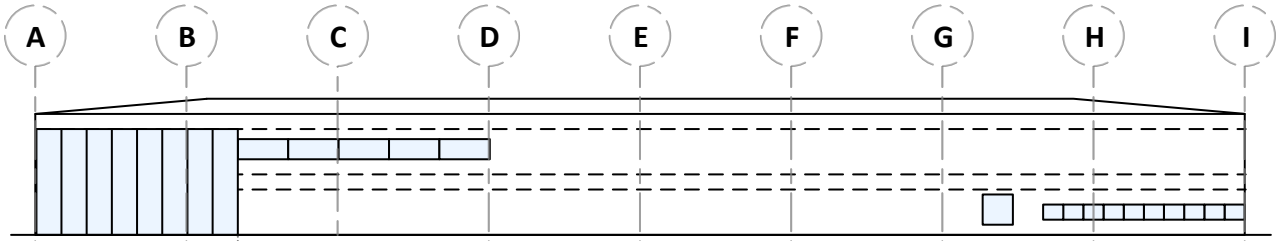
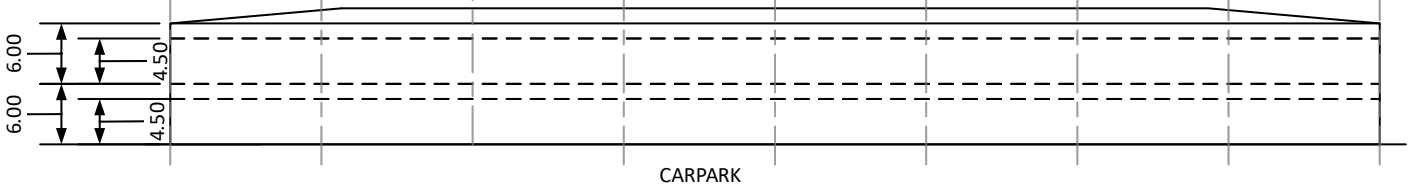
DESCRIPTION	PAGE	SCALE
TOP VIEW	5 OF 7	1: 750

VEW FACING SOUTH



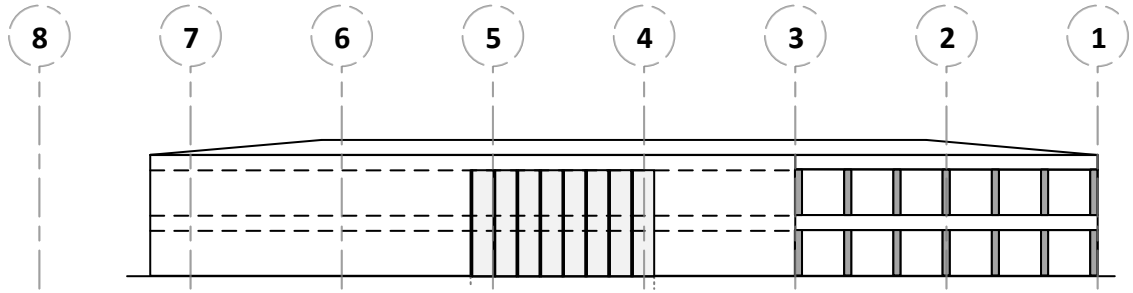
VIEW FACING NORTH



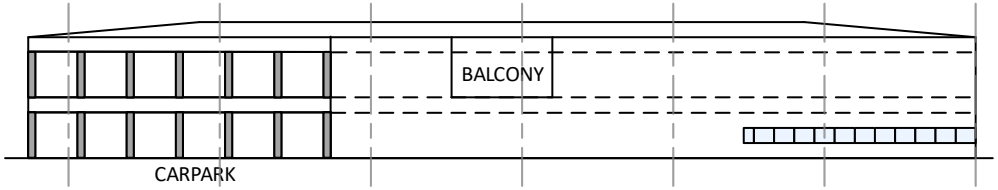
Glass	
Façade Panel	
Carpark Obstruction	

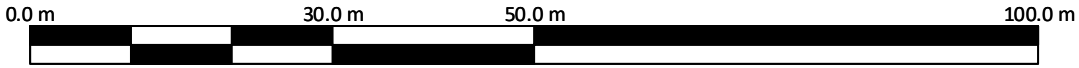
HEIGHTS CONSISTENT ACROSS BUILDING

VIEW FACING EAST



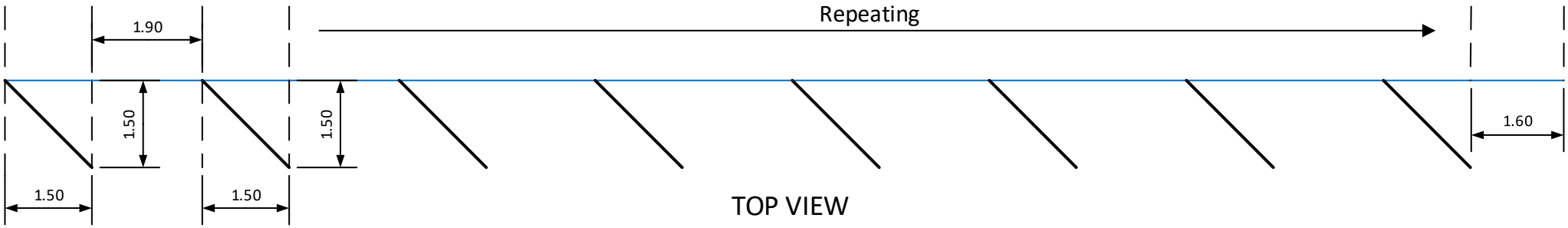
VIEW FACING WEST





SIZE: A4	TITLE: ELEVATION VIEWS	DATE: 08/08/17
DESCRIPTION: NORTH, SOUTH, EAST AND WEST FACING	PAGE: 6 OF 7	SCALE: 1: 750

FRONT VIEW



TOP VIEW

NOTE	SIZE	TITLE	DATE
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN METRES	A4	FAÇADE DIMENSIONS	08/08/17
	DESCRIPTION: TOP AND SIDE VIEW	PAGE: 7 OF 7	SCALE: 1: 100

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SCHOOL OF MECHANCIAL AND MANUFACTURING ENGINEERING

MECH4880 REFRIGERATION AND AIR CONDITIONING

ASSIGNMENT 1 (2017) – Project Specifications

The following specifications are to be followed unless contradicted by the building layouts or by any information given in part A of the assignment.

Air Conditioning Design Conditions

General Details:	
Latitude	30^0 South
Location	Temperate Town, Climate Zone 6
Orientation	Building north is defined as the same as true north
Minimum supply air temperature	12^0C
Cooling coil effectiveness	$\eta_c = 0.85$
Infiltration	For any external entrance to the mall allow 500l/s. For any external entrance to a shop allow 200l/s.

External Conditions:	
Summer	33.8^0C DB / 22.9 ^{0}C WB
Winter	2.1 ^{0}C DB/80% RH
External Glazing and Skylights	$Food\ court\ façade: U = 5.48\ SHGC = 0.435$ $Skylights: U = 5.26\ SHGC = 0.574$ $All\ other\ glazing: U = 5.62\ SHGC = 0.611$
External Walls, Floors and Roofing	External walls: R=2.6 Floors: R=1.5 Roofing: R=3.2 Absorbance = 0.7 (medium colour) Values are as above unless the surface does not compliance with NCC2016 Section J then raise to minimum value as specified by Section J
Storage Mass	Can be assumed as $420\ kg/m^2$

Internal Conditions:	
Outside Air Requirement	$10\ l/s.person$
Internal Walls	Internal Walls and Partitions: R=1 Internal Floors and Ceilings: See External Values are as above unless the surface does not compliance with NCC2016 Section J then raise to minimum value as specified by Section J
Internal Glazing	6mm plate glass as defined in DA 09

Design Safety Factor	
Safety factor on all plant and air handling systems	No safety factor is to be applied on this project for the sizing and selection of any plant
Diversity in plant	No diversity is to be applied on this project for the sizing and selection of any plant

Unless otherwise stated use the appropriate tabulated data below with the tenancy layouts for the conditions and loading for each shop.

Speciality Shops	
Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$35\ W/m^2$
Occupancy	$3.5\ m^2/person$
Percentage of gross floor area assumed to be occupied	70%
Sensible/Latent Load Per person	72W / 58W

Food Court (Outlets)	
Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$80\ W/m^2$
Occupancy	Greater of 6 people or 1 person per $15m^2$
Sensible/Latent Load Per person	72W / 58W

Food Court (Seating)	
Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$10\ W/m^2$
Occupancy	$3.5\ m^2/person$
Percentage of gross floor area assumed to be occupied	80% or as per seating shown
Sensible/Latent Load Per person	82W / 78W

Restaurants	
Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$60\ W/m^2$
Occupancy	$1.5\ m^2/person$
Percentage of gross floor area assumed to be occupied	60%
Sensible/Latent Load Per person	82W / 78W

Mini Majors	
Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$30\ W/m^2$
Occupancy	$3.5\ m^2/person$

Percentage of gross floor area assumed to be occupied	70%
Sensible/Latent Load Per person	72W / 58W

Majors	
Summer Set Point	$23.5^{o}C\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^{o}C\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$25\ W/m^2$
Occupancy	$4\ m^2/person$
Percentage of gross floor area assumed to be occupied	80%
Sensible/Latent Load Per person	72W / 58W
Special Note	Must have a dedicated AHU

Mall (include kiosks)	
Summer Set Point	$23.5^{o}C\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^{o}C\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$10\ W/m^2$
Occupancy	$5\ m^2/person$
Percentage of gross floor area assumed to be occupied	100%
Sensible/Latent Load Per person	72W / 58W

System Sizing

Energy efficient measures for this project will be undertaken to reach HVAC system energy reduction targets. The system designer shall not undersize or oversize system components such that it would lead to greater energy consumption. The following table is a guide to system sizing for the project and must not be exceeded without approval.

Duct Sizing	
Main Duct (AHU/FCU)	$1\ Pa/m\ or\ 7.5\ m/s\ whichever\ is\ lesser$
Branch Ducts (AHU/FCU)	$1\ Pa/m\ or\ 6\ m/s\ whichever\ is\ lesser$
Flexible Ducts	Not required
Grilles	$Maximum\ of\ 300\ l/s\ per\ grille$
Exhaust Ducts	$1\ Pa/m\ or\ 7.5\ m/s\ whichever\ is\ lesser$

Ventilation

All ventilation requirements are to be in compliance with AS 1668.2 + A1-2015 and AS 1668.4 2012.

Variations

Any details included here for individual tenancies take priority over any of the previously listed general values. These encompass particular tenant requests or space repurposing.

Shop MM.0.1 (Woolworthlessness)

Summer Set Point	$22^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$22^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$25\ W/m^2$
Occupancy	$2.25\ m^2/person$
Percentage of gross floor area assumed to be occupied	75%
Sensible/Latent Load Per person	72W / 58W

Shop T.1.11 (Shiny Stones Jeweller)

Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$55\ W/m^2$
Occupancy	$3\ m^2/person$
Percentage of gross floor area assumed to be occupied	85%
Sensible/Latent Load Per person	72W / 58W

Shop T.0.2 ("Dry July")

Summer Set Point	$22^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$20^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$35\ W/m^2$
Occupancy	$3\ m^2/person$
Percentage of gross floor area assumed to be occupied	75%
Sensible/Latent Load Per person	72W / 58W

Shop MM.1.1 (Fitness Second)

Summer Set Point	$23.5^oC\ dry\ bulb/55\%\ RH$
Winter Set Point	$21^oC\ dry\ bulb/80\%\ RH$
Lighting and Power (applicable to gross floor area)	$55\ W/m^2$
Occupancy	$3\ m^2/person$
Percentage of gross floor area assumed to be occupied	80%
Sensible/Latent Load Per person	115W / 185W

Shop T.0.6 (Usual shirts):

Calculate the U values as per follows. If the calculated values do not comply with NCC 2016- section J, add insulation in increments of R=0.5 until the U value requirement is met.

Floor: 100mm concrete with + 25mm sand/topping + carpet and underlay

Ceiling: 100 mm wood rafters, plaster below, fibreglass insulation between the rafters, topped by 25 mm wooden roof deck and covered by metal decking (clip-lock style)

External: 2×90mm brick with 60mm air gap + 15mm gypsum plaster + thin marble

Internal: 12mm plaster board + 100mm + 12mm plaster board

Windows: As per elevation plans. Windows are assumed to be 6mm plate glass as per DA09.

Internal Loads

Occupancy: 45 customers and 5 staff

Equipment:

Shop	Name	Quantity
T.0.6	Refrigerator 500L	1
T.0.6	Coffee brewer	1
T.0.6	Cash register	4
T.0.6	Microwave oven	1
T.0.6	Water cooler	1

Lighting: 30 W/m^2

MM.0.3 (JB low-fi) construction:

Calculate the U values as per follows. If the calculated values do not comply with NCC 2016- section J, add insulation in increments of R=0.5 until the U value requirement is met.

Floor: 100mm concrete with + 25mm sand/topping + carpet and underlay

Ceiling: Bituminous felt roof with 150mm of concrete and 25 mm of sand and cement topping and plaster tiles

External: 2×90mm brick with 60mm air gap + 15mm gypsum plaster

Internal: 12mm plaster board + 100mm + 12mm plaster board

Windows: As per elevation plans. Windows are assumed to be 6mm plate glass as per DA09.

Internal Loads

Occupancy: Average of 90 customer/staff with 140 customer/staff during peak times

Equipment:

Shop	Name	Quantity
MM.0.3	Coffee machine 5L	1
MM.0.3	Microwave oven	1
MM.0.3	Toaster	1
MM.0.3	Desktop computer	1
MM.0.3	Laptop computer	1
MM.0.3	Flat-panel monitor 15”	5
MM.0.3	Flat-panel monitor 30”	10
MM.0.3	Flat-panel monitor 45”	15
MM.0.3	Flat-panel monitor 60”	10
MM.0.3	Cash register	4

Lighting: $30\ W/m^2$

MECH4880 REFRIGERATION AND AIR CONDITIONING

ASSIGNMENT 1 (2017) – Assignment Helper

Aim

The purpose of this document is to provide a more detailed and partially stepped out explanation for each section and is the minimum expectation for both Part A and Part B reports. This document outlines two main procedures to follow, these are **discuss** and **perform**. Discuss questions are designed such that you are given some direction for what to do next while developing your understanding of the concept. Discuss questions should typically be answered in a maximum of one paragraph, while the depth of your understand and research should be demonstrated in your response, keeping your answer succinct is also a critical part of explaining and reporting engineering findings. Perform questions which usually follow from discuss questions are designed to use the understanding you develop from the discuss question and complete that section of the report.

Preceding the breakdown of both parts to the assignment is a list of assumptions that have already been made for your assignment, take care in reading and understanding them as they can greatly simplify the amount of work you need to complete.

Part A

Section 1 – Design Day Selection and Specification Comprehension

Discuss: What are design days and what is their significance to heat load calculation?
Perform: Select the summer and winter design days for the project.
Discuss: What are the design conditions (Internal and external) for the project?
Discuss: Calculate the size of the buildings ceiling space and explain its purpose.
Discuss: Define and explain the following terms: storage mass, AHU, glazing, partition.
Perform: Specify the daily and yearly temperature ranges you are going to use for the analysis and briefly describe why you are using those values.

Section 2 – External Loads – Wall Specifications

Discuss: What is the difference between a U-value and an R-value?
Discuss: How are U-values calculated for walls made from a series of layers of differing materials?
Discuss: How does outdoor wind speed affect U-values for a given material?
Perform: Calculate and report the U-values for all surfaces in shops T.0.6 and MM.0.3.
Perform: Using NCC 2016 Volume One, determine the minimum R-values for a typical wall, roof and floor (Hint: Sections J1.3, J1.5 and J1.6).
Discuss: Why does the BCA provide minimum R-values?
Perform: For any surface which does not meet the minimum requirements add increments of R=0.5 insulation until the surface meets the minimum specification. Provide a list of the updated U-values for all surfaces.
Perform: Calculated and report the storage masses.

Section 3 – External Loads – Solar Transmission

Discuss: Determine which surfaces will experience solar transmission loads.
Discuss: Surfaces external to the structure use a modified temperature difference when calculating their contribution to the heat loads, why is this used and what is its effect on the heat loads (increase/decrease)?
Discuss: How is the heat load for external glazing calculated? Provide the full formula and explain each component.
Perform: Calculate and report the heat load for all external surfaces.

Section 4 – External Loads – Partitions

Discuss: What is the difference between partitions and external surfaces and how does the heat load calculation differ between them?
Perform: Calculate and report the heat load for all partitions.

Section 5 – External Loads – Winter

Discuss: Discuss three key differences between calculating external loads for cooling (summer) and heating (winter).
Perform: Calculate and report the external loads under winter conditions.

Section 6 – Internal Loads – Summer

Discuss: Not including infiltration what are the three main forms of internal loads and how would the heat load be calculated from the provided information?
Perform: Calculate and report all internal loads and infiltration loads.

Section 7 – Internal Loads – Winter

Discuss: Discuss three key differences between calculating internal loads for cooling (summer) and heating (winter).
Perform: Calculate and report all internal and infiltration loads under winter conditions.

Section 8 – Cooling and Heating Load Summary

Perform: Report a summarized version of your findings for both shops and determine the total heating and cooling load required for the space.

Section 9 – Psychrometric Charts (Summer only)

Discuss: Discuss the features of psychrometric charts and the information they can provide.
Perform: Produce psychrometric charts for the peak summer loading cases for both shops reporting any intermediate values and clearly indicating all points on the chart and their values.
Perform: Calculate the reheat capacity (if required) and the total cooling coil load

Section 10 - CAMEL heat load simulation and validation for shops T.0.6 and MM.0.3

Perform: Simulate and report the heating and cooling loads of the shops T.0.6 and MM.0.3. In the body of your report provide screenshots of your CAMEL simulation which as a minimum should show any pages including data entry. The results of the simulation should be placed in an appendix but a summary of your findings should be in the body of the report similar to the hand calculations.
Perform: Provide a quantitative comparison between both methods used in calculating the heat loads for shops T.0.6 and MM.0.3.
Discuss: Comparing your calculations in part A are you results the same for shops T.0.6 and MM.0.3? If they are not, why? (Hint: there are different result types produced by CAMEL).

Part B

Section 1 - Produce conditioned/ventilated space maps and thermal zone plans

Discuss: Define and compare conditioned and ventilated spaces, also give two examples of spaces/room types for each.
Perform: Using two different colours, preferably blue for conditioned and red for ventilated, produce an overlay of the building floor plans showing all conditioned spaces and all ventilated spaces. Are there any spaces on the building plan which are neither conditioned nor ventilated?
Discuss: What is thermal zoning and what information does it provide when setting up heat load calculations?
Perform: Produce and overlay of the building floor plans showing your thermal zoning plan for all conditioned spaces.

Section 2 - Ventilated space calculations

Perform: Using AS 1668.4 – 2012 determine if the carpark can be classed as naturally ventilated or if it must be mechanical ventilated. If the carpark must be mechanically ventilated calculate and report the exhaust rate using the methods outlined in AS 1668.2 - 2012.
Discuss: Consulting table 3.2 in AS 1668.2 – 2012, what is the smallest number of exhaust systems that can be installed to serve all ventilated spaces.
Perform: Using the appropriate appendices from AS 1668.2 – 2012 calculate and report the exhaust rate (L/s) for each ventilated space within the building.

Section 3 - CAMEL heat load simulation

Discuss: This project uses the comfort temperature conditions defined by CAMEL. What are the critical conditions, how are they measured and under what circumstances would you use them?
Discuss: Briefly discuss the following features of the building: where are the partitions (those that will add to the heat load), which rooms will have roof loads, how many skylights are there and which spaces to they interact with.
Perform: Simulate and report the heating and cooling loads of the entire building. In the body of your report provide screenshots of your CAMEL simulation which as a minimum should show the features in

the above discussion question and the food court façade glazing. The results of the simulation should be placed in an appendix but a summary of your findings should be in the body of the report.
Discuss: The specification states that safety factors and diversity will not be used. Define each term and discuss the impacts on duct, AHU and system cost for the introduction of each.

Section 4 - Air schematics

Discuss: What is the purpose of an air schematic? What information can it provide?
Produce: Construct a separate or combined full air schematics for the supply and ventilation of the entire building. All equipment serving these rooms must be represented on the schematic, complete with all the spaces they serve. The schematic should again show at a minimum the airflow into each space, and the flow rates for all relevant AHUs and fans.

Section 5 - Duct Design

Discuss: Why are different maximum airspeeds used for main ducts and branch ducts?
Discuss: What are the pros/cons of reducing duct size for the same airflow? What are the pros/cons of increasing duct size for the same airflow?
Discuss: What is a riser, what is the purpose of a riser?
Perform Construct a single line layout and preliminary duct sizes for all exhaust systems, indicating duct size and flow rate.
Perform: Using the single line layout provided construct a double line duct layout as an overlay of the shops floor plan indicating duct size, flow rate and any other data required to avoid clashes in each section of duct (whenever the duct size, height or flow rate changes).
Discuss: Briefly discuss three important factors/considerations in duct design and how these could be/have been implemented in the duct layout produced for the previous section.

Section 6 - Pressure loss calculations and fan selection (Ventilated spaces only)

Discuss: In terms of duct pressure loss calculations what is an index run (equal friction method)?
Discuss: Why is the index run pressure drop used as the pressure drop for the entire system? How can we achieve this pressure drop at each outlet to ensure the correct airflow (equal friction method)?
Perform: Indicate the index run on the previously drawn supply system and all exhaust duct systems.
Discuss: Pressure losses are due to two main causes, straight duct and duct fittings, provide the formula for both and explain each term.
Perform: For ventilated spaces only, calculate and report the pressure loss (equal friction method) along the index run. Only the losses for the rigid duct should be counted i.e. ignore any pressure losses associated with intakes, grilles, flexible connections, etc. To compensate for this assumption add 100Pa pressure drop onto your final value.
Discuss: Discuss three important factors when selecting a fan.
Perform: Select and report fans for each pressure loss calculation and justify their selection based of the previous discussion question. (Hint: you only need to provide at least pressure drop and flow rate)

Section 7 - AHU selection

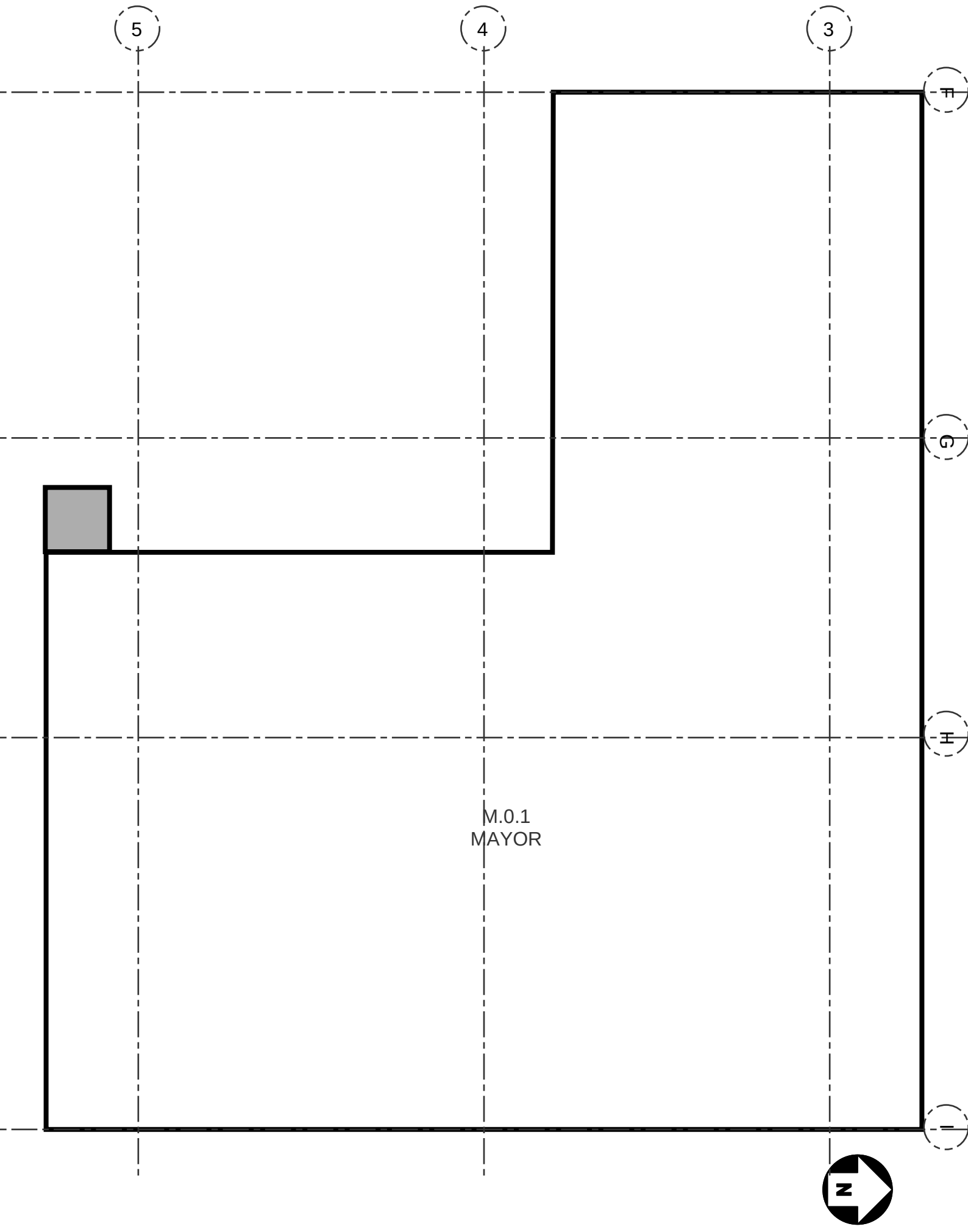
Discuss: What are the most important parameters to consider when selecting an AHU?
Produce: Select appropriate AHU's for each of your nominated thermal zones. Each unit selected should, as a minimum, meet the capacity and airflow required. All units can be assumed to be air cooled or connected to a chiller system based on your AHU selection (Note: you do not need to design or select any associated equipment).
Discuss: What is economy cycle? What is different about AHUs with economy cycle?

Section 8 - Building improvements and sustainable design

Discuss: What are building features have the most significant heat load and what improvements could you make to mitigate their impact? (1 paragraph per feature, minimum 3 features)
Discuss: Would reducing the air off temperature (reducing the coil temperature) reduce the cooling capacity required? Why/why not?
Perform: State 3-5 improvements other than those listed in the previous discuss question to reduce the required cooling capacity of the building. Justify your suggestions by recalculating the CAMEL simulation and report the change in cooling required.
Discuss: Briefly describe two rating schemes that have been implemented in the Buildings industry in order to encourage sustainability. Discuss their impact on HVAC system design and to what extent you think they have been successful. (2 paragraphs maximum)

Assumptions:

- All requirements relating to fire zoning or other fire considerations are out of scope
- All kitchen exhausts are considered out of scope
- The shape of the roof is cosmetic only and the full height (slab to slab) of the first floor can be considered to be 6000mm.
- FCU's and AHU's can be assumed to have the same function and features and so only AHU's need to be used
- All duct is designed to be rectangular/square and in increments of no less than 50mm (e.g. 325x350mm is not allowed but 450x600mm is) and flexible duct is not required to be sized
- All grilles can provide a maximum of 300l/s
- Duct design does not require economy cycle
- "DA09 infiltration" (infiltration through walls and windows only needs to be applied for shops considered in the hand calculations, you still need to consider door infiltration for all shops with external walls which contain doors.
- For Part A only all glass (internal and external) as 6mm plate as defined by DA09.
- For the purpose of hand calculations please assume the false ceiling space to be void (you should still justify why this is appropriate).
- On making your own assumptions: As a general rule of thumb if it is not in the assignment documents just make the assumption that will make your calculations the easiest possible while still being justifiable. Extending from this the assignment helper can be used as a tool to identify the key elements that we are looking for, while you will have to perform some tasks out of the listing try to maximise your use of time by not overdoing or overdetailing these sections.



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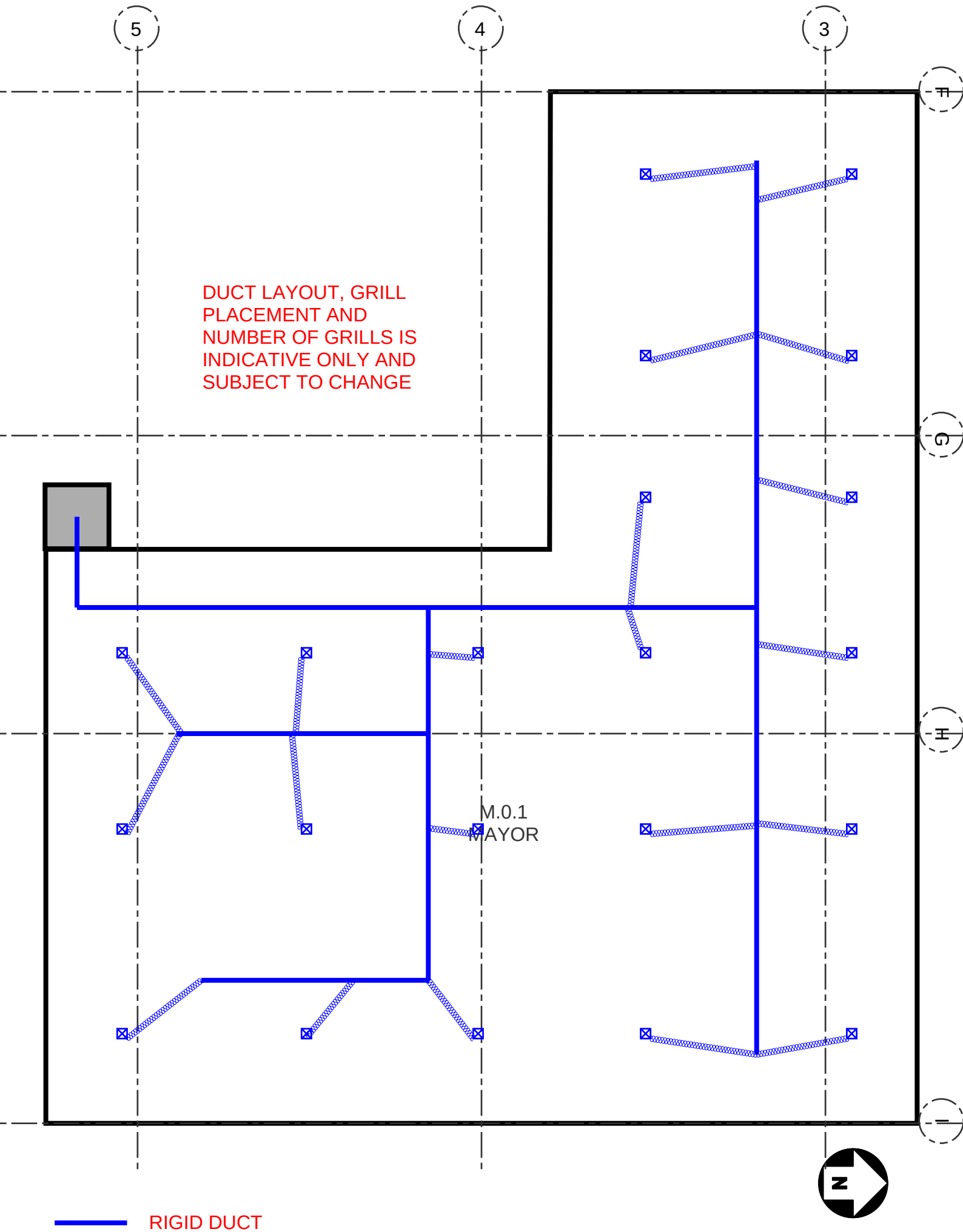

RIGID DUCT

FLEXIBLE DUCT

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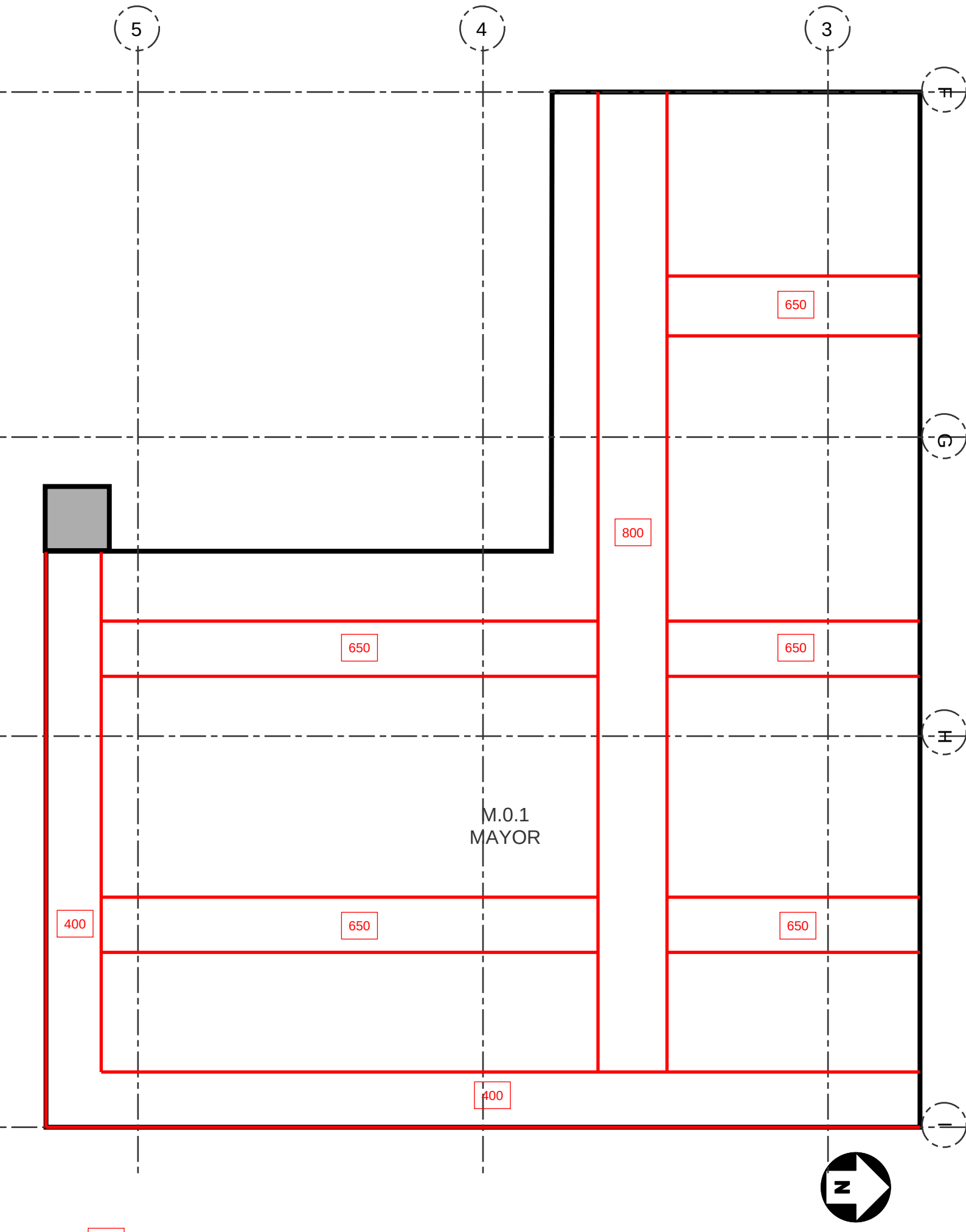
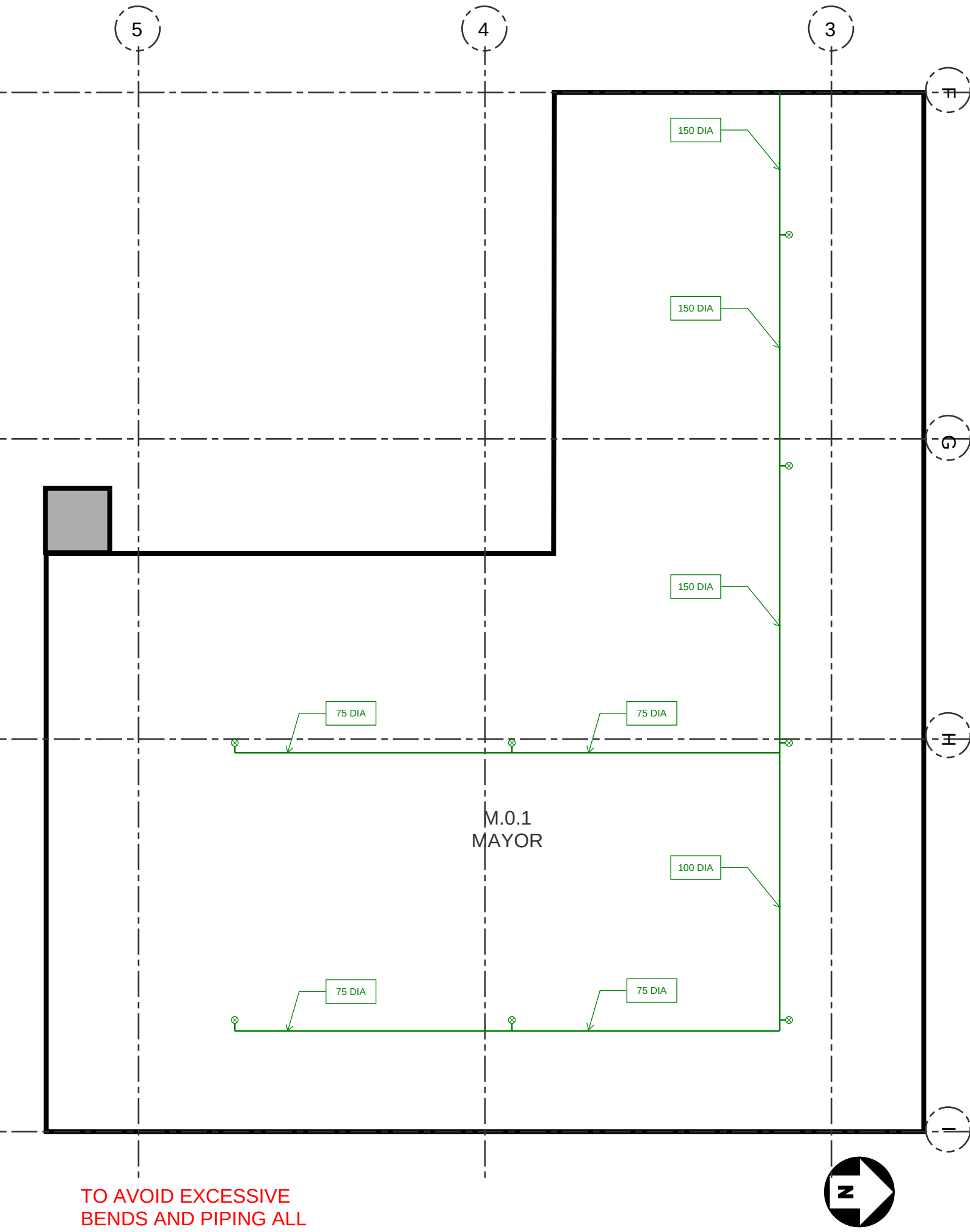
DESCRIPTION	SINGLE LINE	PAGE	1 OF 1	SCALE	1:200



350 - INDICATES BEAM DEPTH FROM BASE OF OVERALL SLAB

SIZE A4	TITLE MAYOR STRUCTURAL	DATE 8/8/2017
DESCRIPTION BEAM LAYOUT	PAGE 1 OF 1	SCALE 1:200



TO AVOID EXCESSIVE BENDS AND PIPING ALL SYPHONICS ARE PLACED SUCH THAT THEY ARE LEVEL AND ARE 50mm CLEAR OF ANY BEAM AT ANY POINT IN THE SYSTEM

SIZE A4	TITLE MAYOR SYPHONICS	DATE 8/8/2017
DESCRIPTION HYDRAULICS LAYOUT	PAGE 1 OF 1	SCALE 1:200