An industrial building constructed in the industrial zone of Alexandaria, has a foot print area of 52m x 84m and comprises 2 halls: a factory hall and a packaging hall. The 2-bay steel skeleton of the building is shown in the attached figure. The factory bay has a column-truss frame system of 32 m span, and is provided with a 20-ton capacity overhead crane. The packaging bay has a rigid frame system of 20 m span, and has an internal mezzanine floor for storage of products. Spacing between frames is 6 m. The building is provided with horizontal bracing systems at levels DEF, FL, and CH. Vertical bracing systems are provided in the planes of columns ABCD, FHIJ, LMN and QP. In the plane of the frames, the columns are fixed at A & J and hinged at N. The column PQ is a hinged hinged column capable of only taken axial load.

Loads:

1. Own weight of steel structure (assumed): = 50 kg/m^2 for the column-truss frame
   = 30 kg/m^2 for the rigid frame
   = 100 kg/m^2 for the storage area
2. Covering material:
   = 15 kg/m^2 for the sandwich panels of the roof and sides of the column-truss frame
   = 6 kg/m^2 for the corrugated sheets of the roof and exterior side of the rigid frame
   = 12 cm RC slab cast on metal sheet (10 kg/m^2) for the floor of storage area
3. Piping, HVAC systems and lighting fixtures for the column-truss bay = 30 kg/m^2
4. Live load:
   = 500 kg/m^2 for the floor of storage area
   = according to the Egyptian Code for Loads for the roofs
5. Crane data:
   = Two wheels on each side of Crane Bridge, spaced 2.5 m apart
   = Maximum wheel load = 18 tons
   = Minimum wheel load = 6 tons
6. Wind load is to be taken according to the Egyptian Code for Loads

Requirements:

1- Draw a general layout of the building (roof plan, main system elevation, end gable elevation, and side views for vertical bracings and side girts) showing the different components. Use an A1 sheet and a scale of 1:200.
2- Calculate the dead and live loads applied on the main system.
3- Calculate the crane and wind loads applied on the main system.
4- Compute the maximum straining actions for the truss members and frame sections, given in the attached sheet, using ASD combinations (Tables 1 and 2).
5- Design the marked truss tension members and zero member (refer to Table 3 for design forces).
6- Design the marked truss compression members and tension/compression members (refer to Table 3 for design forces).
7- Design column QP whose design force is equal to -40 tons (Case II). Choose an HEA cross section and an open section formed from 2 UPN back to back 100 mm apart.
8- Design the members of the wind bracing systems.
9- Design the roof purlins and side girts.
10- Check the safety of the crane track girder (built-up section with different top and bottom flange dimensions) and design the monorail crane girder.
11- Design intermediate secondary and main floor beams.
12- Design the beam-columns NML subjected to M = 23 m.t., and N = -25 t (II) (L_{in} = 22-m, L_{out} = L_u= 5.5-m, C_B=1, sidesway permitted).

Table 1 - Truss Member Forces (units in tons)

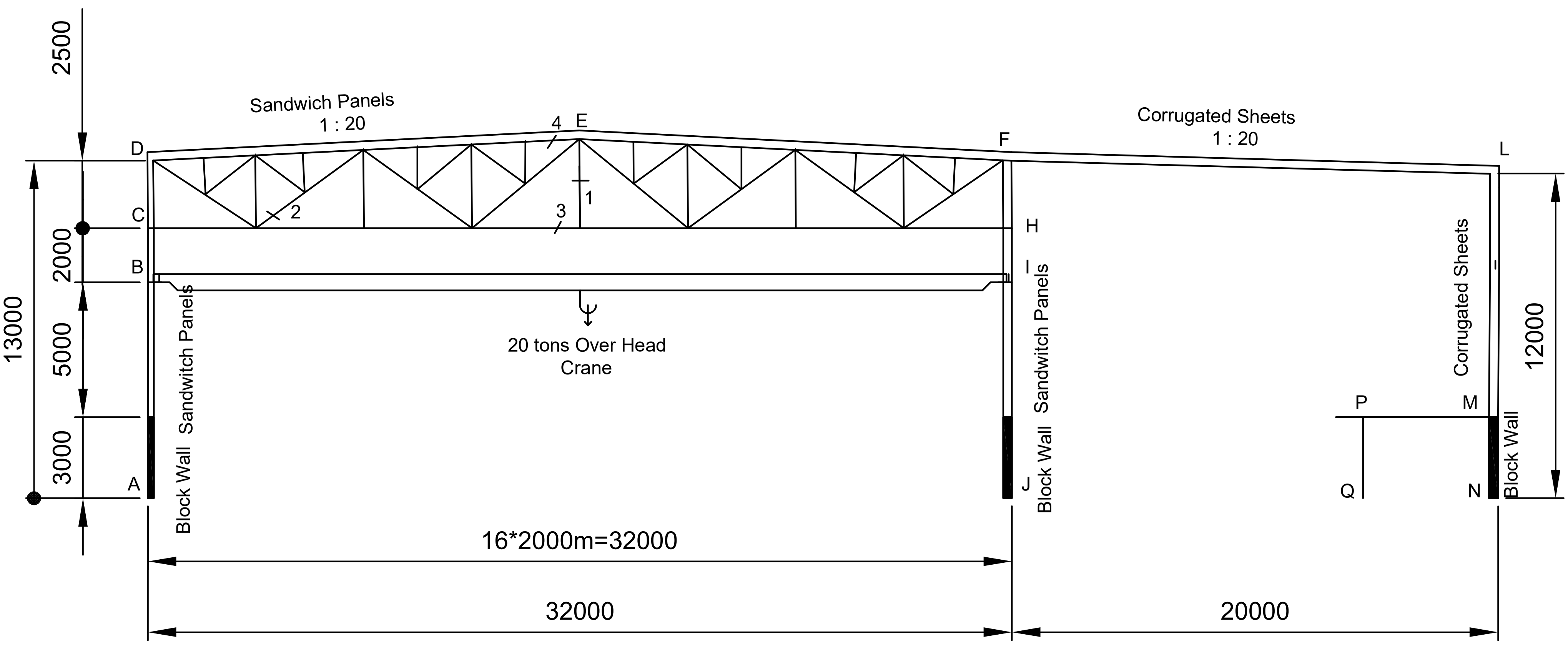
Member No.	DL	LL		Crane Left			Crane Right			Monorail			Wind	
		(1)	(2)	V	H (L)	H (R)	V	H (L)	H (R)	V	H (L)	H (R)	Left	Right
a	-10	-5	-1	3	2	-2	-3	-2	2	2	-1	1	3	1
b	18	7	6	-3	-2	2	3	2	-2	3	-1	1	-4	-3
c	12	7	4	-4	-1	1	4	1	-1	1	-1	1	-4	3
d	22	10	-5	2	3	-3	-2	-3	3	-2	2	-2	-8	-6

Table 2 - Frame Section Straining Actions (units in meter and tons)

Section		DL	LL		Crane Left			Crane Right			Monorail			Wind	
			(1)	(2)	V	H (L)	H (R)	V	H (L)	H (R)	V	H (L)	H (R)	Left	Right
1	M	-12	-8	-2	4	2	-2	-4	-2	2	2	-1	1	8	-3
	N	-18	-9	-4	-3	-1	1	3	1	-1	-2	1	-1	-9	5
2	M	15	7	-4	-5	-3	3	4	3	-3	2	-1	1	-7	3
	N	-26	-12	16	2	1	-1	-2	-1	1	-2	1	-1	11	-9

Table 3 - Marked Truss Member Design Forces

Member	Design Force (ton)	
	-ve	+ve
1	-	-
2	18 (I)	-
3	-	50 (II)
4	40 (I)	50 (II)


Sandwich Panels
1 : 20
Corrugated Sheets
1 : 20
D
E
F
L
C
H
B
I
A
J
P
M
Q
N
1
2
3
4
20 tons Over Head
Crane
Block Wall
Sandwich Panels
Corrugated Sheets
2500
2000
5000
3000
13000
12000
16*2000m=32000
32000
20000