SEN767

Composite Structures

Project: Design one floor only from the shopping mall building using full composite steel concrete design for one SSB and one slab panel in the floor

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Introduction

Civil engineering is an interesting and vast topic which is covering the essential elements of daily routine. In this paper we are discussing about the opportunities and potential in shopping malls by getting assigned one floor to make it perfectly designed by concrete and beam support. This floor needs to perfrom with a slabpanel and beam associated to support the building and get the floor acquainted with proper civil works. A series of tasks and pocedures are performed for the respective floor where the inputs are properly designed and an architectural help is taken to make it adequate and reliable. The architecture has provide dimesnions and directions with proper measurement in metres and millimetres to make the exact fittings and furnishings for the best space utilization. The requirements of the buildings are considered well brofre the procurement of the supplies and other materials to make the structural implementation of the elements in the building. Also the gaps, and assumptions are well taken care of as well as the documentation and other necessary filings have been submitted earlier. After the framework has been elaborated and situated the work has initiated for the floor in the mall. The present frame layout of the floor is covering the composite slabs and beams of steel which are supported by the columns of steel and other walls of concrete materials. Also labelled grids and other structured elemehts are utilized everywhere where the typical dimesions and other layouts are prescribed by the requirements of the assignee. It is taken a proper care that each beam should be specified by the unique code to make the comprehensive usage of the member. For example, B1, B2 are specified for each member like a column which are C1. C2, etc.

Shopping mall Building: The client's brief

The model was prepared under the adequate and comprehensive guidelines of clients where all the specifications were personally taken care of to make the project reliable and authenticate. The following points were classified which are as follows:

1. The prime specification is including a building of shopping mall where small house shops will exist. There should be spaces for corporate offices, an assembly area should be included, and an area for having refreshment or dining sort. Figure 1 is covering all the details.
2. The new construction should be with the least disruption and hence the construction should take care of the shopping mall and its existing parts, the new construction should at minimum include a flat roof to make the arrangements accordingly.
3. The size for the premises is fixed and it should be 36.0m x 36.0m where the storage of plant and other equipments with all the operational construction activity should include and completed.
4. The circulations areas should be free with the columns as it should be keep to zero in these area for better utilization of spaces, and the assembly areas and dinig area should be very limited with the columns spaces. Only 1 internal column is recommended.
5. The structural elements of concrete should be equipped with fire resistance devices and equipments to a minimum of 2 hours services, so that emergencies can handle properly and adequately.
6. The area of the assembly should be well equipped with the 200 seatings to make the maximum occupancy of the seating. Also the dining area should be available with a 50 seatings to make the guest and clients confortable.

Imposed Loadings

7. Loadings imposition

Roofs Loadings imposition.	Loadings imposition 1.5kN/m^2
Shops Loadings imposition.	Loadings imposition 3.0kN/m^2
Circulation areas, roof terrace, dining areas Loadings imposition.	Loadings imposition 4.0kN/m^2
Assembly area Loadings imposition	Loadings imposition 5.0kN/m^2

Allowances of the ceilings, partitions, services and other finishing are included in loading.

Site Conditions

8. The site location is comprehensive and adequate for the massive response, it is flat, and in level with the location of centre which is situated in small town. Here the requirements of the basis elements including are the speed of basic wind is 42 m/s which is based on a 3-second gust. Hence the mean hourly speed quivalent with the basic wind speed is 21m/s

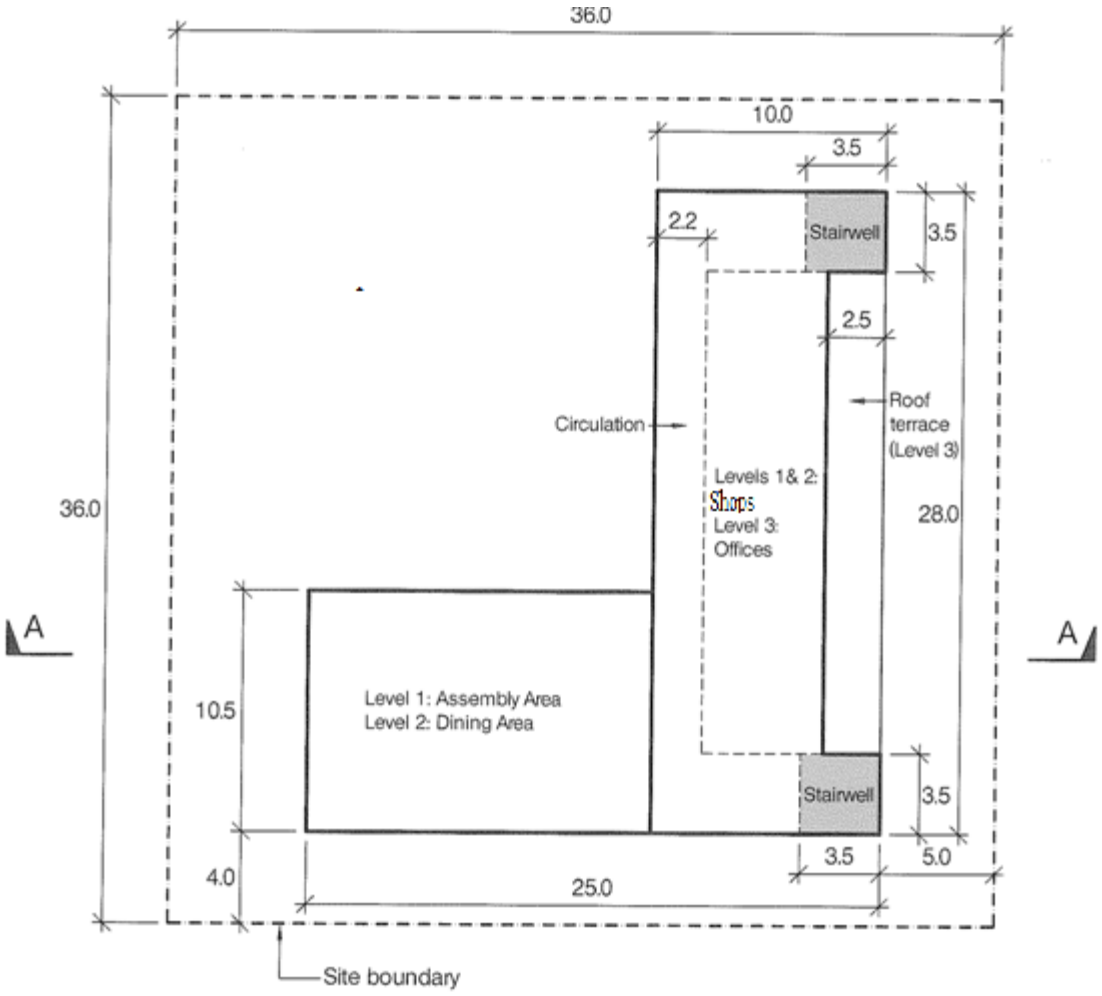
9. Condiitons of the ground typically:

Ground level – 1.50 m	Made ground (fill).
1.50m – 15.00m	Very stiff clay
	C_u values very approximately linearly with depth from 300 – 500kN/m^2
Below 15.00m	Rock. Allowable bearing pressure= 5000kN/m^2

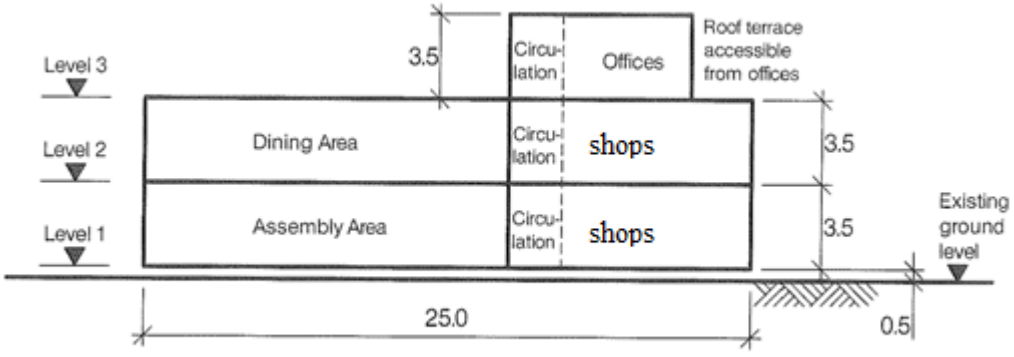
In the ground investigation there were no signs of ground water and hence the water feasibility should be equipped with the other sources.

Omit from consideration

10. Staircases design as it is fine as per the consideration and adequacy.



Plan View



Cross Section A – A

Figure 1 – Buidling of shopping mall view plan and cross section element with the sketch view. (designing done with the paameters of Sketches out of scale).

Designing Principles

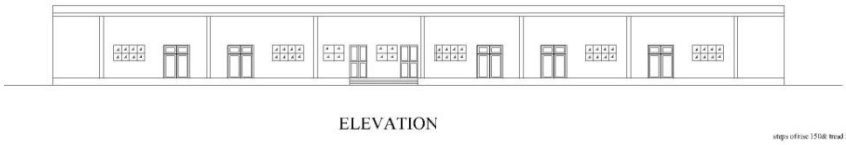
There are prices differences in flat roofs and pitched roofs, hence the flat roofs are recommended generally. Same is with this case where flat roofs will be utilized. Flat roofs are generalkly having a characteritics of a pitch but at a very low height and they are gemerally not flat, the pitch to these floors are 0.25:12 where the water can float easily to the adequate drainage system and proper cleanliness is ensured. The direction of the pitch are generally to the specified drainage with the adequate flow of water. Generally synthetic membranes are used to surface the flat roof surfaces. There are different thoughts of the people, where they assume that New Hampshire is not adequate with the flat surfaces. As this area is accumulated with the snow, the feeling provides this strategic view of the people resifding here. Also there are problems related with the pondling of water when the drainage of the roofs are not adequate which finally leads to challenegs to the living people. Hence the flat roofs requires attention and concentration than the pitched roofs which are not having these types of problems, in the cases of the accumulation of snow in heavy modes it must be removed with immediate basis to make the proper and adequate environment. The staff of the maintenance team should be well acquainted with the depth of the snow and snow load om the roof to make the comfortable and comrpehenosve approach. Scruppers and darin of roofs should regularly be checked and monitored. If the design structure are perfectly fitted and structures the system works fine and perfect. These system are installed in the outer of the roof where tehse are fitted in their container which are generally weatherproof. Also penthouses are an option for these systems for a better protection and safety. Also it is best for utilizing the space. A proper method of safety in terms of walkways should be added to secure the people working in these floors so that their safety is ensured. The walkways are made up of concrete square, general terms to be recognize is pavers. Also a surveillance is there to make a proper mechanism.

Ventilation

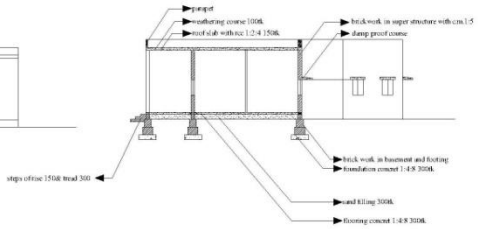
The ventilation facility should be equipped with the shopping malls and it should be planned early as it is useful in removing the pollurtants available in the wind, odors which are unuseful and the carbon dioxide. These ventilation also provides cleanliness to the environment and hence these should be installed properly in the makks and are oplanned accordingly. Air exchange rates are described by the state mechansical code. Standard 62 or ASHRAE which is a national standard accepted with all the authorities or bodies. The air exchange rate is most of the shopping malls is 15 – 20 cfm/occupant to make the reliable approach in the premise. Everywhere it is recommended that the natral ventilation is promoted and prescribed to make an economical approach and operational windows for making the perfect combination with ventilation ate approached. Mechanical ventilators are promoted as the natural ventilators are not able to work in the winter seasons and hence to meet the adequate purpose bith the mechanisms have been intiated.

Screens:

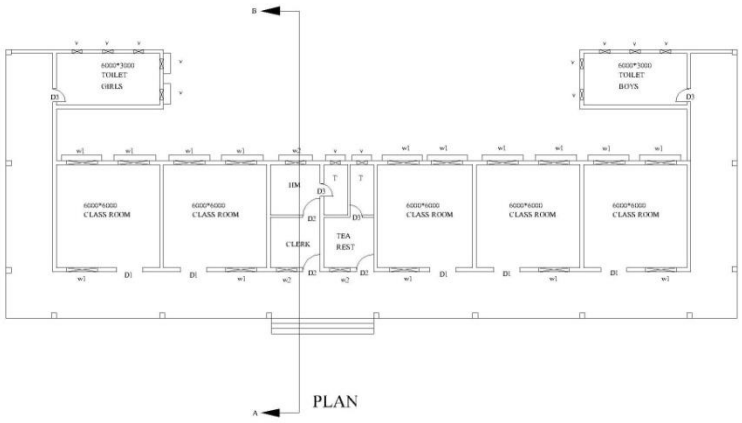
Drawings:



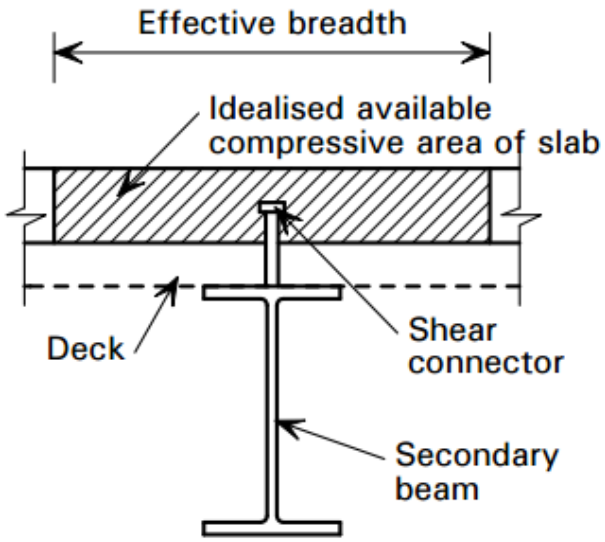
ELEVATION

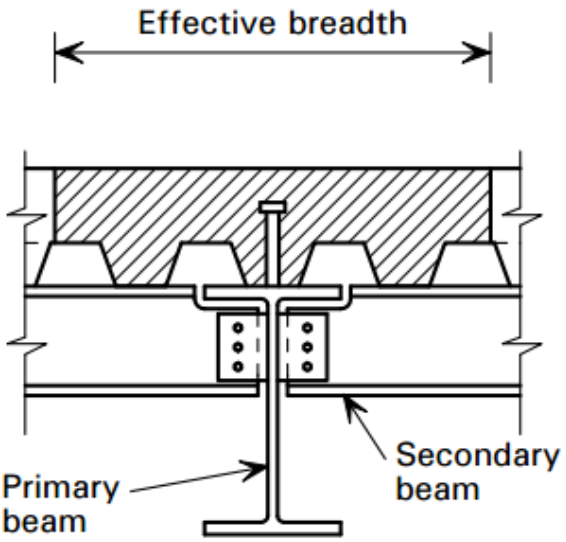


SECTION OF A B



PLAN





Steel Beam – construction stage

The steel sections are normally designed to be ***unpropped*** during construction, and must be sized to support the self-weight of the slab, and other construction loads, in their non-composite state. The weight of extra concrete from ponding of the slab should be allowed for in the design of the beams when the deflection of the decking under the wet weight of the concrete exceeds one

tenth of the depth of the slab, in accordance with both BS EN 1994-1-1 and BS 5950-4. Careful consideration is given to the correct allowance for the weight of the concrete when 'mass flood' levelling techniques are adopted. As well as checking the resistance of the steel beams, this will involve an assessment of their stiffness. Beams that are not suitably stiff will deflect excessively during concrete placement, and the extra concrete should be allowed for in the design.

When designing to the Eurocodes, the construction load is defined in BS EN 1991-1-6 and is taken as the same construction load as for designing the decking. The self weight of the wet concrete is treated as a variable load. The construction loading is significantly more onerous for beams than previous UK practice and, at the time of writing, consideration is being given to address this. When designing to BS 5950, the construction load should be taken as an

'imposed load' of not less than 0.5 kN/m2 applied uniformly over the supported area. The construction loading should be applied in addition to the self weight of the concrete, reinforcement and decking. This non-composite check may dictate the final choice of section size if subsequent imposed loads are low.

To use a steel beam economically, the top (compression) flange needs to be restrained laterally. The restraint provided by the decking to the beams depends on the decking orientation and the fixings. The restraint provided by decking spanning in a direction parallel to a beam is normally assumed to be negligible, but decking spanning perpendicularly to a beam can provide restraint if it is adequately connected. In this latter case, continuous lateral restraint occurs when thru-deck welded shear connectors are provided (irrespective of other fixings), but when there are no shear connectors, restraint is limited by the resistance of the fixings. This will depend not only on the shear resistance of an individual fixing (typically, 0.8 kN to 4.0 kN, according to the type of fixing), but also on their spacing along the beam. The Structural Designer should ensure that the restraint assumed in the design is provided by the fixing arrangement; guidance on the force that must be resisted is given in the SCI publication Lateral stability of steel beams and columns [48] and BS EN 1993-1-1 (or BS 5950-1).

Where dead load deflections are excessive, ***pre-cambering*** may be appropriate (this is normally only adopted for beams longer than 10 m). However, the pre-camber required may be difficult to determine accurately; for example, the stiffening effect of the end connections may be significant, so some pre-camber may remain after casting, and the depth of the slab may not be as intended at the critical point of mid-span. Therefore, a general rule of thumb is to design any ***pre-cambering*** to eliminate no more than two

thirds of the dead load deflection. In some situations, large amounts of pre-camber may possibly hinder the laying of decking.

Composite Beam - Ultimate Moment Capacity

Bare Steel Properties

Beam Size	W16x36	
Fy =	50	ksi
d =	15.9	in
b =	6.99	in
Tf =	0.43	in
Tw =	0.295	in
Area =	10.6	in^2

Stud Properties

Fu =	65	ksi

Concrete Deck

Effective Width =	120	in
Total Thickness =	5	in
Deck Depth =	2	in
Avg Width of Deck Rib =	4.75	in
Parallel or Perpendicular =	pe	(Pa or Pe)
e mid-ht =	2	in(<2" Weak,>=2" Strong)
F'c =	4	ksi
Conc Unit Weight =	145	pcf
Stud Diameter =	0.625	in
Stud Length =	4	in
# of Studs per Decking Rib =	3	(Must equal 1, 2, or 3)
Number of Studs, Half Span	30	

Design

Rg = 0.70

Rp = 0.75

Stud Capacity = 10.5 kips

Sum Qn = 165 Kips

AsFy =530 Kips

0.85*F'c*a = 1224 Kips

Controlling = 165 Kips

Y2 = 4.80 in

Phi Mn = 340 K-ft

Stud

Econc	3644147	
Qn=	18.52029	kips
	19.94175	Kips

Flange Area =	3.0057	in^2	F Force	150.285	
Web Area =	4.4368	in^2	F Area	221.84	
Wr/h=	2.375				
Rg					
Perp	0.7				
Para	1				

Fully Composite

Cc=	165	Arm=	12.74792	Mu=	2102.048	k-in
					175.1707	k-ft

Compression in Concrete & Steel

Cc=	165			In Flg		
As Req'd =	3.651067	in^2		0.522327	" Down	
				In web		
Depth of PNA						
=	2.62	In web		2.617683	" Down	
a=	0.40	in				
Cc=	165	Arm=	7.415608	Mu=	1222.78	k-in
Csf=	150.285	Arm=	2.402683	Mu=	361.09	k-in
Csw=	32.26833	Arm=	1.093842	Mu=	35.30	k-in
Tsfb=	150.285	Arm=	13.06732	Mu=	1963.82	k-in
Tsft=	0	Arm=	0	Mu=	0.00	k-in
Tsw=	189.5717	Arm=	6.426158	Mu=	1218.22	k-in

Mu=	4801.207	k-in
	400.1	k-ft

References:

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