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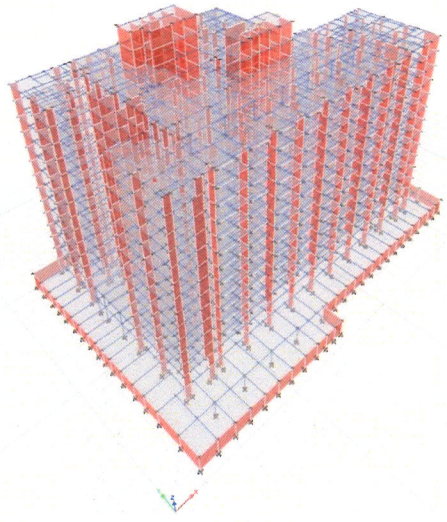


STRUCTURAL DESIGN CALCULATION REPORT

PLAN SHOWING THE PROPOSED CONSTRUCTION OF RESIDENTIAL HIGHRISE BUILDING COMPRISING OF 3 BLOCKS; BLOCK -1 HIGHRISE BUILDING WITH 42M HEIGHT CONSISTING OF BASEMENT FLOOR + STILT FLOOR + 13 FLOORS WITH 180 DWELLING UNITS; BLOCK- 2 NON HIGH RISE BUILDING WITH 18M HEIGHT CONSISTING OF BASEMENT FLOOR +STILT FLOOR + 5 FLOORS (MULTIPURPOSE HALL, INDOOR GAMES, GYM, GUEST ROOM); BLOCK -3 NON HIGH RISE BUILDING WITH 4.76M HEIGHT CONSISTING OF GROUND FLOOR TEMPLE BUILDING AT DARKAS ROAD TAMBARAM WEST COMPRISED IN OLD S. NO. 36/1B, 36/2B, 36/3A2A & 262/1A OF TAMBARAM VILLAGE, T.S. No: 19/1, 19/2, 19/6, 19 /7, BLOCK NO. 19, WARD-C OF TAMBARAM TOWN & TALUK CHENGALPATTU DISTRICT.

CLIENT:

LML HOMES
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R0	17-07-2023	Design Basis Report	OK	SATHISHKUMAR M	PERAM	PERAM
REV	**DATE**	**DESCRIPTION**	**STATUS**	**PREPARED BY**	**REVIEWED BY**	**APPRVD. BY**

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- 3D Model & Analysis summary report
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- Design of Columns
- Design of Beams
- Design of Slabs

DESIGN INFORMATION AND CRITERIA

1. INTRODUCTION

M/s. LML Homes has proposed to construct Residential Building comprises Basement + Stilt Floor + 13 Floors +Roof at Kiskinta Main Road, Kannadapalayam, Tambaram, Chennai- 600 045. Architecturally, it is designed with single Basement + Stilt + 13 Floors + Roof structure. In which, the basement floor and Stilt floors are designed to facilitate parking whereas 1st floor to 13th floor are designed for Residential use.

This report covers design basis of Residential development which includes two buildings, comprises a Residential Tower having single Basement+Stilt Floor+1st Floor to 13th Floor+Roof and a commercial building which is a Basement+stilt+5 Storey structure. In the Residential tower the Basement & Stilt floors accommodates car/two-wheeler parking and 1st floor to 13 floors are designed for residential use. Architecturally, the tower is designed to be a linear & rectangular in shape. Structurally the building is designed to be a framed structure with Shear walls & Colums, Beams and slabs are directly connected to the shear walls/columns which are together forms a lateral load resisting system. Foundation is designed to be Raft with depth of foundation around 4.5m below existing ground level. The raft is connected monolithically with Basement wall forms the water tight basement structure shall be protected by applying the approved water proofing on positive side.

This report provides the information on Codes of Practice, Design loadings, Material Strength considered for the Design and Analysis of the building. In addition, this report includes information on Structural system, Foundation system, Parameters & Method statement of structural analysis which will be adopted for design and analysis of the building.

2. CODES OF PRACTICE

In the analysis, design and detailing of the building, the following Indian Standard codes will be used.

2.1 Design Loads (Other Than Earthquake Loads)

IS Code	Description
IS 875 (Part 1): 1987	Dead Loads (Unit Weight of Building Material and Stored Material)
IS 875 (Part 2): 1987	Imposed Load
IS 875 (Part 3): 2015	Wind Load
IS 875 (Part 5): 1987	Special Loads and Combinations

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2.2 Design for Earthquake Resistance

IS Code	Description
IS 1893(Part-1):2016	Criteria for Earthquake Resistance design of structures.
IS 4326: 1993	Earthquake Resistant Design and Construction of Buildings – Code of Practice
IS 13920: 2016	Ductile Detailing of Reinforced Concrete Structures subject to Seismic Forces - Code of Practice.

2.3 Design of Steel Structural Elements

IS Code	Description
IS 800: 2007	Code of Practice for General Construction in Steel
IS 2062: 1999	Steel for General structural purposes

2.4 Design of Concrete Elements

IS Code	Description
IS 456: 2000	Plain and Reinforced Concrete - Code of practice
IS 6403 -1981	Code of practice for determination of bearing capacities of shallow foundations.
IS 8009 -1976 (Part I):	Code of practice for calculation of settlement of foundations – Shallow foundation
IS 1904	Indian Standard Code of practice for design & construction foundations in Soil : General Rééquipements
IS 2950 (Part 1):1981 (Reaff. Nov 2013)	Code of practice for design and construction of raft foundations : Part 1 Design (second revision).
IS 2911-(Part1-Sec2)	**Indian Standard Code of Practice for Design and Construction of Pile Foundation-Bored Cast In situ Piles**
IS 2911-(Part-4)	Load Tests on Pile
IS 2974	Code of practice for design & construction of machine foundation
SP 16	Structural use of concrete, Design charts for singly reinforced beams, doubly reinforced beams and columns.
SP 34	Handbook on Concrete Reinforcement & Detailing
SP 7(Part IV)-2015	National Building code of India
IS 1786-2007	Specification for high strength deformed bars and wires for

	concrete Reinforcement.
IS 432 (Part 2) 1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete reinforcement – Hard Drawn Steel Wire
IS 3370 (part I)	Code of practice for concrete structure for the storage of liquids

3. DESIGN PARAMETERS

3.1 Materials of Construction

The building comprises of Columns connected with frame/slab. The lateral load resisting system of Columns/Shear walls are well connected in orthogonal direction. All vertical elements comprise Shear Walls/Columns are connected by floor slab which acts as diaphragm in redistribution of lateral forces.

3.1.1 Concrete Grade

Concrete grade shall be M35 all structural elements which includes Raft, Shear wall, Column, Beam, slab, Basement wall, underground sump etc., with minimum 28-day strength of 35 MPa.

Concrete Mix M10 has been used in filling, plum concrete, leveling courses (PCC) and other non-structural items.

Density of reinforced concrete is assumed as 25 kN/cu.m.

Minimum cement content, water cement ratio etc. shall conform to IS 456:2000 code provisions for durability and strength criteria. The approved design mix shall be used for producing concrete.

Grade of Concrete for various structural elements:

Raft	M35
R.C Columns	M50
Shear Wall	M50
R.C Slab/Beam	M35
Basement Wall	M35
Underground sump	M35
Parapet Wall & any other Structural members	M25

3.1.2 Cement

Ordinary Portland cement of grade 43 or higher confirming to IS 8112 and IS 12269 is specified for concrete M35 for all structural elements including Raft, Shear wall, Column, Beam, slab, Basement wall etc., with cement content appropriate to the grade. The design mix using the intended brand of cement together with material test report including test report on other raw materials shall be submitted to the consultant's review and obtain the consent before the construction.

3.1.3 Aggregates

The sizes of coarse aggregates confirm to IS 383. Nominal maximum size of coarse aggregate to be 20 mm, suitably graded as per the requirement of mix design. The fine aggregates confirm to the specifications of IS 383.

3.1.4 Water

Water used for construction shall complied with stipulations given in IS 456: 2000.

3.1.5 Reinforcement

High yield strength deformed bars conforming to IS 1786 with f_y = 500 N/ sq.mm has been used with elongation not less than 14.5 %.

3.1.6 Structural Steel

MS steel with yield strength f_y = 250 N/ sq.mm has been used for Structural steel work shall conform to IS 226 and IS 2062 for Indian steel sections.

3.1.7 Concrete Cover

Cover to reinforcement considered for various elements with Fire rating considered - 2hrs. are as follows.

a. Raft = 60mm
b. Column = 40mm
c. Shear Wall = 30mm
d. Beam = 30mm (Bottom and sides)
e. Slab = 25mm (Top and Bottom
f. Water tanks / Sump tank
   On water face = 40mm (Top and Bottom)
   On other face = 40mm (Top and Bottom)

3.1.8 Development Length

Unless otherwise specified in the good for construction drawing, the Development length of 50 times diameter of bar is to be considered in the BBS & Fabrication.

3.1.9 Soil Parameters

Based on the soil report No. AA/DEC/2021/65 dated 11th Jan, 2022, there are 5 no. of bore holes were done at different locations of the plot spreaded across the building foot print. In which BH-1 is located in Groudn+2 storey of commercial building and BH-2 to BH-5 are located in the 13-storey residential tower structure. The bore holes are terminated in the range of 7m to 11.7m at very dense layer with "N" value more than 100. As per the bore log data, the top layer upto 1.5m is filled up soil and loose to medium dense silty gravel exists up to 3m with "N" value ranging from 11 to 21. Below 3m and up to 4.5m, it is very dense clayey sand layer exists with "N" value ranging from 70 to 100. Weathered rock encountered from the depth of 4.5m with a "N" value more than 100 and it continues up to the termination depth. there is very dense partially to completely weathered rock having "N" value more than 100. From the depth of 6.5m, there is Soft rock drilled using diamond bit. From the depth of 7.22m there is Hard rock drilled by T.C bit. The boreholes were terminated at very dense stratum with "N" value more than 100. Ground water table was met with at the depth of 1.5m from existing ground level during the borehole operations.

3.2 Loading Standards

Table: Structural Configuration and Floor heights:

Residential Apartment building	**Basement + Stilt + 13 Floors + Roof**
Basement Floor height	3.6m
Stilt Floor height	3.0m
1st to 13th Floor height	3.0m
Roof	3.0m
Head Room	3.0m
OHT	3.0m
Type of Foundation	**Raft**
Grade of concrete Raft	M35
Grade of concrete for Columns/Shear Walls	M50
Grade of concrete for RC beams	M35
Grade of concrete for RC slabs	M35
Grade of Steel	**Fe 500**

Table: Unit Weight of Materials:

Material	**Density**
Reinforced Cement Concrete	25.00 kN/m^3
Plain Cement Concrete	24.00 kN/m^3

Screed Concrete	24.00 kN/m^3
Cement Mortar	20.00 kN/m^3
Structural Steel	78.50 kN/m^3
Concrete solid block wall	**20.00 kN/m^3**
Dry soil	18.00 kN/m^3
Wet Soil	22.00 kN/m^3
Landscape soil	16.00 kN/m^3
Glass	28.00 kN/m^3
water	10.00 kN/m^3

Table: Gravity Load Calculations:

Floor Slab:	
Self weight of 125 mm thick Slab	0.125x25 = 3.125 kN/Sq.mt.
Self weight of 150 mm thick Slab	0.150x25 = 3.750 kN/Sq.mt.
Self weight of 175mm thick slab	0.175x25 = 4.375 kN/Sq.mt.
Self weight of 200mm thick slab	0.200x25 = 5.000 kN/Sq.mt.

Residential building External/Internal Wall Line Load:	
Stilt Floor to 13th Floor	= (0.20x2.55x20) +(0.03x2.55x20) = 12.00kN/m
Stilt Floor to 13th Floor	= (0.10x2.55x20) +(0.03x2.55x20) = 6.6 kN/m
Terrace Parapet Wall	= (0.2x1.2x20)+(0.03x2.55x20) = 5.5 kN/m

3.2.1 Imposed Loads on Slab

The following are the imposed loads in the structural slabs, in addition to the self-weight and the floor finishes. *(Self-weight of slab will be as per the thickness mentioned in the respective drawings Floor finishes of 50/75 mm thickness have been considered on all floors)*

Table: Superimposed Dead Load (SDL) & Live Load (LL)

Basement & Stilt Floors (Car/Two wheeler Parking)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	0.0	0.0
Services	2.4	-
Live Load	0.0	3.0
Partition Load	-	0.0
Total	**2.4**	**3.0**

Basement Floor (Electrical Room)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	0.0	0.0
Services	7.5	-
Live Load	0.0	3.0

Partition Load	-	0.0
Total	**7.5**	**3.0**
Extended Basement Roof (Fire Driveway)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	3.0	0.0
Services	0.0	-
Live Load	0.0	15.0
Partition Load	-	0.0
Total	**3.0**	**15.0**
Stilt to 13th Floor (Lobby / Corridor)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	2.4	0.0
Services	0.0	-
Live Load	0.0	4.0
Partition Load	-	0.0
Total	**2.4**	**4.0**

1st to 13th Floor (Rooms)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes	1.2	0.0
Services	0.0	-
Live Load	0.0	2.0
Partition Load	0.0	0.0
Total	**1.2**	**2.0**
1st to 13th Floor (Toilet)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	4.0	0.0
Services	0.0	-
Live Load	0.0	2.0
Partition Load	-	0.0
Total	**4.0**	**2.0**
1st to 13th Floor (Balcony/Service)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	4.0	0.0
Services	0.0	-
Live Load	0.0	3.0
Partition Load	-	0.0
Total	**4.0**	**3.0**
1st Floor (Courtyard)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	6.6	0.0
Services	0.0	-
Live Load	0.0	5.0
Partition Load	-	0.0

Total	**6.6**	**5.0**
Stilt Floor (STP Pump Room)		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes+Filling	1.2	0.0
Services	0.0	-
Live Load	0.0	7.5
Partition Load	-	0.0
Total	**1.2**	**7.5**
Roof Terraces		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes (weathering courses)	3.0	-
Services	-	-
Live Load	-	3.0
Partition Load	-	-
Total	**3.0**	**3.0**
LMR		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes	3.0	-
Services	-	-
Live Load	-	15.0
Partition Load	-	-
Total	**3.0**	**15.0**
OHT		
	SDL (kN/Sq.mt.)	**LL (kN/Sq.mt.)**
Finishes	3.0	-
Services	-	-
Live Load	-	20.0
Partition Load	-	-
Total	**3.0**	**20.0**

Permissible reduction in imposed load on each floor is considered for design of columns and foundation as per IS 875 Part (2), clause.3.2.

The proposed structure is a RCC framed structure, with columns and shear walls forming vertical components. In which, the vertical structural systems are formed such that the RC wall & columns are transfers its base shear in proportion to its stiffness in their loading direction of wind & seismic.

3.3 Thermal Effects

Temperature variation produces stresses in the structure, as it tends to expand and contract. In the structures, with large geometrical dimensions, the effect of temperature is important in the behavior and final design. Due to deformation of expansion & contraction - between Day

time and nights, and between winter and summer - the effect on the durability of structure and on the supported finishes is significant to produce considerable results.

3.3.1 Expansion Joints

Expansion joints are normally provided when the structure is more than 45m length as per IS-456-2000, clause 27.2. In this building the size of superstructure is 65m x 55m. The temperature effect over the building design has been captured by applying the differential temperature over the exposed area like roof & terraces as the length of the building falls close to the limitation stimulated in IS 456: 2000, clause.27.2. The differential temperature of 15º C has been applied over the exposed areas like Roof & Terraces.

4. PROPOSED APPROACH OF STRUCTURAL ANALYSIS

The building comprises of R.C.C columns connected by beams as framed structure. Slabs acting as rigid in-plane diaphragms have been considered. After preliminary sizing of various structural members, a computer model of the structural frame of the building is generated for carrying out computer analysis for the effects of vertical and lateral loads that are likely to be imposed on the structure.

The building structure has been analyzed using the ETABS v21 software for the following computer models of the building floor analysis of all floors - for vertical loads with the entire building space frame. ETABS v21 have been thoroughly tested, validated and recognized internationally by several organizations and are well suited for the analysis of building systems.

Geometrical dimensions, member properties and member-node connectivity, including eccentricities will be modeled in the analysis problem. Variation in material grades, if present, will also be considered. The permissible values of the load factors and stresses will be utilized within the purview of the Indian Standards.

The computer analysis will produce accurate individual member forces, reactions at foundation level and deflection pattern of the entire structure as well as individual members. This data will then be used to confirm/review the member sizes and arrive at the most appropriate design of the structural members. Some re-runs of the analysis program might be required for arriving at the optimum structural space frame characteristics that satisfy the strength and stability criteria in all respects.

Design of different structural elements will be carried out using In-house developed spreadsheets and packages.

The following model assumptions used in E-TABS 3D modeling and the load applications are done as listed below,

Column	: Shell Element
RC Wall	: Shell Element
Beam Element	: Frame Element
Slab	: Shell Element

- Modulus of Elasticity of Concrete -5000√fck
- Consideration of Diaphragm - Rigid Diaphragm.
- Slab/Wall element considered as Shell element

The structural model and its behavior have been checked for the following

a) Storey Drift.

b) Storey Weight/Column Loading.

c) Soft Storey Effect.

d) Deformation.

e) Design Forces.

The following methods of modeling are adopted in creating ETABS 3D model,

- The 3D ETABS model generated based on the shuttering drawing prepared using preliminary sizes.
- Sectional properties are assigned to all the structural elements as per the preliminary shuttering drawing.
- Mesh size assigned in size of 1m x 1m appx.
- External & Internal filler wall loads are assigned as uniformly distributed line load on beams and as area load if the wall is intended to distribute on slab directly. These loads are assigned under SDL type load case.
- Slabs are modelled as shell element in Flat slab area and the same has been modelled as membrane in Beam-slab system which are assigned with horizontal diaphragms.
- Live Load reduction is considered in the design of Foundation and Column as per the Code: IS 875-1987 (Part-II), clause.3.2.1.
- Area design load i.e. Live load/SIDL or any other load is applied at floor relevant to its usage.
- All lateral loads & parameters are assigned as per Codes IS 1893-2016 & IS 875-2015.
- Temperature loads are applied on to the terraces which are directly exposed to sun includes podium, Roof etc.
- Beams under Torsion is required to maintain Equilibrium will be designed for Torsion in accordance with IS 456-2000, clause 41.1 to 41.4 and for all other beams torsional

stiffness is neglected in the analysis by applying stiffness modifier as 0.01 to torsional constant "J". Hence no specific design for Torsion is required for these beams.

- **Chennai is Zone-III**. Hence ductile detailing is followed in the design and detailing of structural elements.
- Concrete cover to reinforcement complied accordance with IS 456-2000, Table16 & 16A.
- All vertical wall elements are assigned with auto meshing/manual meshing appropriately in order to achieve accuracy in results.
- UG Sump is designed for 0.2mm and STP is designed for the crack width of 0.1mm.
- Secondary beams are not designed for ductile detailing.
- Long term deflections are checked by manual calculation using excel spread sheet wherever necessary. Crack width calculation will be done using spread sheet wherever necessary.

Area Load & Application: Applied as uniformly distributed area load with intensity proportionate to its usage as mentioned in the Loading items in the DBR.

Line (Wall) Load & Application: Filler wall loads are calculated appropriately considering Solid block Blocks and Applied as uniformly distributed line load.

Lateral Load Resisting Systems: The vertical structural systems are formed by both RC wall & columns which are responsible in transferring its base shear in proportion to its stiffness in their loading direction for both wind & seismic forces.

5.0. LATERAL LOADS

5.1 Wind Loads

The wind pressure shall be calculated based on the basic wind speed and other provisions laid in IS 875 (part 3) – 2015. The basis wind speed considered in the analysis for **Chennai, TN** is 50 m/sec. The design parameters for wind load calculation are as follows,

Design Wind Pressure Vz = 0.6 Vz^2

But Vz = Vb*k1*k2*k3*k4

Where Vz - Design Wind Speed

k1 – 1.0 probability factor or risk coefficient

k2 – 1.16, Terrain height (45.6m), structure size factor

(measured from Basement floor) with terrain Category–2

k3 – 1.0, Topography factor

k4 – 1.0, Importance factor for the cyclonic region, for all other

Structure as per IS 875-Part3, clause 6.3.4.

Hence the Wind Pressure = 0.6x (50x1.0*1.16*1.0*1.0)^2

= 2019 N/m^2 ≈ 2.02 kN/m^2

Design Wind Pressure (Pd) = Kd*Ka*Kc*Pz

Where Kd - 0.9, wind directionality factor

Ka - 0.8, area averaging factor

Kc - 0.9 , combination factor

Design Wind Pressure (Pd) = 0.9*0.8*0.9*2.02

= 1.41 kN/m^2

The design wind load will be calculated based on the surface area with the calculated design wind pressure and it shall be applied on surface area of the building in both the orthogonal direction.

5.2 Earthquake Loads

Chennai is classified under Earthquake **Zone III** (Moderate) as per the latest classification. The loading due to earthquake shall be assessed based on the provisions of IS 1893 – 2016 The design parameters adopted are as follows:

Seismic Zone III with seismic zone factor Z = 0.16 (Moderate) and Response reduction factor is to be 5.0 considering RC Building with SMRF as per IS: 1893-2016, Table-7 and Soil considered as Type-I Hard soil.

Base Shear Calculation for Static Analysis

As per IS 1893:2016, the total design lateral force or design seismic base shear (V_b) is determined by the following expression.

$$V_b = A_h W$$

Where Ah is Design horizontal acceleration spectrum value using fundamental natural period and W is Seismic weight of the building.

The Seismic weight is estimated based on Full dead load + 25 % Live load for Residential building i.e. for Live Load < 3 kN/Sq.mt. the reduction considered is 25%.

The Fundamental natural period of vibration (Ta) in seconds of a RC building is estimated by using the following formula, Ta = 0.09*h/(d)^0.5.

Where h is the height of the building in meters. d is the base dimension of the building at the plinth level, in m along the considered direction of the lateral force.

Height of the building = 45.6 m (measured from Basement floor)
d (along-y, length of the building) =35.05 m
b (along-x breadth of the building) = 65.53 m
Ta (along x) = 0.09 x45.6/(65.53)^0.5
= 0.5 Sec.
Ta (along y) = 0.09 x45.6/(35.05)^0.5
= 0.7 Sec.

From IS 1893: 2002, Clause 6.4.2, Design horizontal seismic coefficient

$$Ah = \frac{Z\ I\ Sa}{2\ R\ g}$$

Where,
Z for Zone III = 0.16
I for Important buildings = 1.2 (Refer to IS 1893-2016, Table.8)
R for RC Building with Special Moment resisting Frame i.e. SMRF = 5.0 as per (Table 9).
Sa/g (Hard soil) X-Dir. = 2.12 (Refer to IS 1893-2016, page 13, Fig 1)
Sa/g (Hard soil) Y-Dir. = 1.67 (Refer to IS 1893-2016, page 13, Fig 1)

Design horizontal seismic coefficient Ah_x = 0.041
Base Shear Vb_x = 0.041W

Design horizontal seismic coefficient Ah_y = 0.032
Base Shear Vb_y = 0.032W

5. LOAD COMBINATIONS

The various loads shall be combined in accordance with the stipulations in IS 875 (Part 5) 1987 and IS 456: 2000. The structural elements shall be designed for the combination that produces most unfavorable effect out of the following combinations.

The results obtained from the computer analysis in the form of member forces and reactions will be used for design the structural members. Following load combinations of the member forces will be considered for arriving at the design forces. The analysis considered load factor is as follows,

Load Combination	LOAD FACTORS								
	D.L.	I.L.	T.L	EQX	EQY	SPECX	SPECY	WX	WY
Limit State Of Serviceability (LSS) Combinations									
LC1	1.0	-	1.0	-	-	-	-	-	-
LC2	1.0	1.0	1.0	-	-	-	-	-	-
LC3	1.0	-	1.0	1.0	-	-	-	-	-
LC4	1.0	-	1.0	-1.0	-	-	-	-	-
LC5	1.0	-	1.0	-	1.0	-	-	-	-
LC6	1.0	-	1.0	-	-1.0	-	-	-	-
LC7	1.0	-	1.0	-	-	-	-	1.0	-
LC8	1.0	-	1.0	-	-	-	-	-1.0	-
LC9	1.0	-	1.0	-	-	-	-	-	1.0
LC10	1.0	-	1.0	-	-	-	-	-	-1.0
LC11	1.0	-	1.0	-	-	1.0	-	-	-
LC12	1.0	-	1.0	-	-	-1.0	-	-	-
LC13	1.0	-	1.0	-	-	-	1.0	-	-
LC14	1.0	-	1.0	-	-	-	-1.0	-	-
LC15	1.0	0.8	1.0	0.8	-	-	-	-	-
LC16	1.0	0.8	1.0	-0.8	-	-	-	-	-
LC17	1.0	0.8	1.0	-	0.8	-	-	-	-

LC18	1.0	0.8	1.0	-	-0.8	-	-	-	-
LC19	1.0	0.8	1.0	-	-	-	-	0.8	-
LC20	1.0	0.8	1.0	-	-	-	-	-0.8	-
LC21	1.0	0.8	1.0	-	-	-	-	-	0.8
LC22	1.0	0.8	1.0	-	-	-	-	-	-0.8
LC23	1.0	0.8	1.0	-	-	0.8	-	-	-
LC24	1.0	0.8	1.0	-	-	-0.8	-	-	-
LC25	1.0	0.8	1.0	-	-	-	0.8	-	-
LC26	1.0	0.8	1.0	-	-	-	-0.8	-	-
Limit State Of Collapse (LSC) Combinations									
COMB1	1.5	-	1.0	-	-	-	-	-	-
COMB2	1.5	1.5	1.0	-	-	-	-	-	-
COMB3	1.2	1.2	1.0	1.2	-	-	-	-	-
COMB4	1.2	1.2	1.0	-1.2	-	-	-	-	-
COMB5	1.2	1.2	1.0	-	1.2	-	-	-	-
COMB6	1.2	1.2	1.0	-	-1.2	-	-	-	-
COMB7	1.2	1.2	1.0	-	-	-	-	1.2	-
COMB8	1.2	1.2	1.0	-	-	-	-	-1.2	-
COMB9	1.2	1.2	1.0	-	-	-	-	-	1.2
COMB10	1.2	1.2	1.0	-	-	-	-	-	-1.2
COMB11	1.2	1.2	1.0	-	-	1.2	-	-	-
COMB12	1.2	1.2	1.0	-	-	-1.2	-	-	-
COMB13	1.2	1.2	1.0	-	-	-	1.2	-	-
COMB14	1.2	1.2	1.0	-	-	-	-1.2	-	-
COMB15	1.5	-	1.0	1.5	-	-	-	-	-
COMB16	1.5	-	1.0	-1.5	-	-	-	-	-
COMB17	1.5	-	1.0	-	1.5	-	-	-	-
COMB18	1.5	-	1.0	-	-1.5	-	-	-	-
COMB19	1.5	-	1.0	-	-	-	-	1.5	-
COMB20	1.5	-	1.0	-	-	-	-	-1.5	-
COMB21	1.5	-	1.0	-	-	-	-	-	1.5
COMB22	1.5	-	1.0	-	-	-	-	-	-1.5
COMB23	1.5	-	1.0	-	-	1.5	-	-	-
COMB24	1.5	-	1.0	-	-	-1.5	-	-	-
COMB25	1.5	-	1.0	-	-	-	1.5	-	-
COMB26	1.5	-	1.0	-	-	-	-1.5	-	-
COMB27	0.9	-	1.0	1.5	-	-	-	-	-
COMB28	0.9	-	1.0	-1.5	-	-	-	-	-
COMB29	0.9	-	1.0	-	1.5	-	-	-	-
COMB30	0.9	-	1.0	-	-1.5	-	-	-	-
COMB31	0.9	-	1.0	-	-	-	-	1.5	-
COMB32	0.9	-	1.0	-	-	-	-	-1.5	-
COMB33	0.9	-	1.0	-	-	-	-	-	1.5
COMB34	0.9	-	1.0	-	-	-	-	-	-1.5
COMB35	0.9	-	1.0	-	-	1.5	-	-	-
COMB36	0.9	-	1.0	-	-	-1.5	-	-	-
COMB37	0.9	-	1.0	-	-	-	1.5	-	-
COMB38	0.9	-	1.0	-	-	-	-1.5	-	-

DL: Dead Load **EQX** : Earthquake Load in X-dir. **WX**: Wind Load in X-dir.
IL: Imposed Load **EQY** : Earthquake Load in Y-dir. **WY**: Wind Load in Y-dir. **TL**: Temperature Load

6. COVER AND FIRE RATING

Fire rating considered - 2hrs. Cover to reinforcement considered for various elements are as follows.

Raft	60 mm
Columns	40 mm
Shear Wall	30 mm
Beams	30 mm
Slabs	25 mm

7. DEFLECTION CRITERIA

7.1 Lateral Deflection (Wind)

Overall Deflection	<	Height/500
Storey Deflection	<	Storey height/500

7.2 Lateral Deflection (Seismic)

Overall Drift	<	H / 250
Storey Drift	<	0.004 times storey height

7.3 Vertical Deflection of Beams and Slabs due to Gravity Loads

Total Deflection (DL + LL)	< Span/250 up to 20 maximum
Deflection including the effects of Temperature, Creep and Shrinkage Occurring after erection of partitions and the application of finishes	< Span/350 or 20mm whichever is less

8. CONSTRUCTION JOINT

Construction joints and shrinkage strips will be planned with the contractor and only be used in locations pre-approved by consultants.

1) No construction joint is allowed in the sunken portion
2) Construction joint shall be provided in slab/beam at l/3 from support.
3) Construction joint shall be placed at accessible location for maintenance purpose.
4) Joints are common source of weakness, therefore it is desirable to avoid or at least minimize them.

9. DESIGN OF STRUCTURAL ELEMENTS

For the design of R.C.C. elements, the Limit State Method will be used as per IS 456-2000. Materials of construction will be predominantly concrete with consideration for strength and durability. The grade of concrete adopted in the Analysis and Design is M35 for all structural elements which includes Raft, Shear wall, Column, Beam, slab, basement wall, underground sump etc., considering the level of stresses to be borne by the members both in compression as well as flexural.

High Yield Strength Deformed bars conforming to IS: 1786 with F_y = 500 MPa will be used as reinforcement. Structural steel, if any with Fy = 250 Grade shall be used.

Covers to reinforcement shall be in accordance with IS: 456:2000 corresponding to **moderate exposure conditions** for the super-structure or severe exposure conditions for the sub-structure and to satisfy a fire rating of 2 hrs as per National building code of India- SP7 (part IV).

10. FOUNDATION

As per the column load intensity and the Soil consultant recommendation laid down in the report, the building is designed with Raft Foundation. The foundation is designed to be a Raft with the thickness of 1000mm with the plan size of 75m X 55m over weathered Rock stratum with the "N" value more than 100 at a depth of 3m & below from existing ground level. If any soft layer below the base of the Raft will be removed and it will be back filled using GSB or plum concrete such that the load is transferred to the suitable dense soil layer. Raft Foundation has been designed in SAFE software considering Safe Bearing Capacity of 250 kN/m^2 and with using the subgrade modulus of reaction of 25000 kN/m/m^2.

For the extended basement roof area necessary amount of filling will be done to resist the possible uplift pressure for the permanent condition. If necessary, ground anchors or its equivalent system shall be deployed to prevent the base slab from uplift due to hydrostatic water pressure. The tower area has adequate self-weight to prevent the uplift in the permanent condition. However, the possibility of uplifting of structure shall be protected by lowering ground water table by deploying the suitable dewatering system.

11. STABILITY OF STRUCTURES

1. For the purpose of stability of the structure as a whole against overturning, the restoring moment shall not be less than 1.2 times the maximum overturning moments due to dead load plus 1.4 times the maximum overturning moments due to imposed loads. In case where dead load provides the restoring moments only 0.9 times in dead

load shall be considered. The restoring moments due to imposed loads shall be ignored.

2. The factor of safety against sliding shall not be less than 1.40.
3. Factor of safety against buoyancy shall be not less than 1.20 ignoring the superimposed loading.

12.0 OTHER DATA

Specific requirements of floor and wall cutouts for services, sinking (extent & depth) of floors in services, kitchen, utility and toilet areas, external architectural features, and entrance canopies are provided as required by Architects and Service Consultants. The relevant information is obtained from them in the form of drawings.

Lift loads and lift machine room equipment and cut out layouts will be obtained from the lift manufacturers. An impact factor of 100% will be considered in the lift supporting structures.

13.0 R.C Design

The structures are analyzed for the various load combinations as per IS: 456-2000. The design of structural elements are carried out by ETABS/ RCDC Connect V11 for all structural elements for the worst forces extracted from the ETABS analysis output whereas the slab design is being done using in house spread sheet. For the design of R.C.C structural elements carried out, the recommendations stipulated in IS: 456-2000 is followed. Limit State method of design is adopted with appropriate load factors with the various load combinations for the different structural elements appropriately.

13.1. Foundation

The building is designed with Raft Foundation. The foundation is designed to be a Raft with the thickness of 1000mm with the plan size of 75m X 55m over weathered Rock stratum with the “N” value more than 100 at a depth of 4.6m from existing ground level. Raft Foundation has been designed using Safe Bearing Capacity of 250 kN/m^2 with using the subgrade modulus of reaction of 25000 kN/m/m^2. The foundation is designed considering the load intensity of the columns and the SBC recommended in the soil Investigation Report No. AA/DEC/2021/65 dated 11th Jan, 2022. Soil Investigation carried out by Aravind Associates, Chennai.

13.2. Column/Wall

Vertical elements carry both gravity and lateral loads like Columns/RC Walls are designed for the worst combination results using ETABS/RCDC/in house spread sheet.

13.3. Beam

Beams are designed for the worst combination results using ETABS/RCDC/in house spread sheet.

13.4. Slab

Slabs are designed using in house spread sheet as per IS-456 Annexe-D, Table-26.

14.0 COMPUTER PROGRAMS USED

The following Software / spreadsheet are used to carry out Structural design.

14.1 PROKON Ver 3.0 - Basement Wall & STP design

14.2 ETABS V21 - Three-Dimensional FEM analysis and Design Programs

14.3 SAFE Ver 20.3.0 - Raft Slab Analysis & Design

14.4 In-House Spreadsheet - One way/ Two-way slab design

14.5 RCDC Connect Edition V11 - Design Software for all Structural Elements except Raft

3D MODEL
&
ANALYSIS SUMMARY REPORT

ETABS®

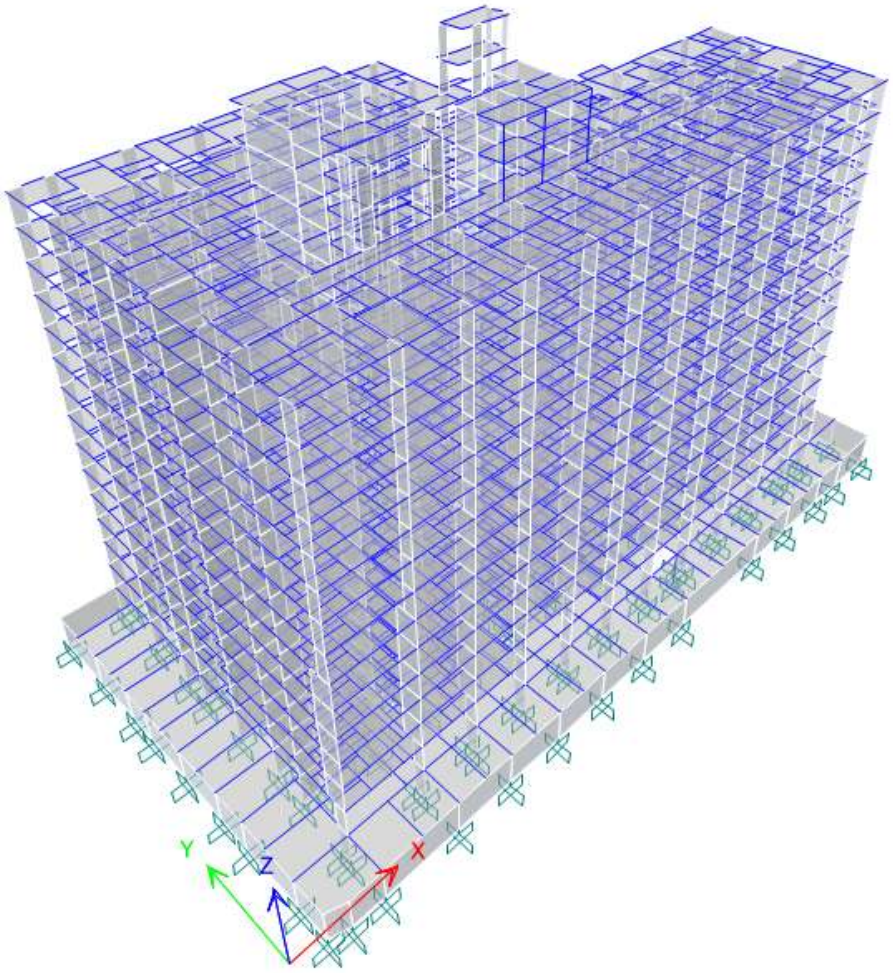


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1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

1.1 Story Data

Table 1.1 - Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	OHT	3	No	None	No	Green
T1	LMR	3	No	None	No	Green
T1	TERRACE	3	No	None	No	Cyan
T1	13TH FLOOR	3	No	None	No	Red
T1	12TH FLOOR	3	No	None	No	Magenta
T1	11TH FLOOR	3	No	None	No	Yellow
T1	10TH FLOOR	3	No	None	No	Gray8Dark
T1	9TH FLOOR	3	No	None	No	Blue
T1	8TH FLOOR	3	No	None	No	Green
T1	7TH FLOOR	3	No	None	No	Cyan
T1	6TH FLOOR	3	No	None	No	Red
T1	5TH FLOOR	3	No	None	No	Magenta
T1	4TH FLOOR	3	No	None	No	Yellow
T1	3RD FLOOR	3	No	None	No	Gray8Dark
T1	2ND FLOOR	3	Yes	None	No	Blue
T1	1ST FLOOR	3	No	None	No	Green
T1	STILT FLOOR	3.6	No	None	No	Red

2 Properties

This chapter provides property information for materials, frame sections, shell sections, and links.

2.1 Materials

Table 2.1 - Material Properties - General

Material	Type	SymType	Grade	Color	Notes
M30	Concrete	Isotropic	M30	Red	
Fe415	Rebar	Uniaxial	HYSD Grade 415	Magenta	
Fe500	Rebar	Uniaxial	HYSD Grade 500	Blue	
M35	Concrete	Isotropic	M35	Yellow	

3 Loads

This chapter provides loading information as applied to the model.

3.1 Load Patterns

Table 3.1 - Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
~SPEC-X(D)ECC	Yes	Other	0	
~SPEC-Y(D)ECC	Yes	Other	0	
Dead	No	Dead	1	
EQ-X	No	Seismic	0	IS 1893:2016
EQ-Y	No	Seismic	0	IS 1893:2016
Live<3	No	Reducible Live	0	
Live>3	No	Reducible Live	0	
ROOF LIVE	No	Roof Live	0	
SDL	No	Super Dead	0	
TEMP	No	Other	0	
WALL	No	Super Dead	0	
WI-X	No	Wind	0	Indian IS 875:2015
WI-Y	No	Wind	0	Indian IS 875:2015

3.2 Auto Wind Loading

Table 3.2 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 1 of 3)

Name	Exposure Set	Is Auto Load	Exposure Source	Top Story	Bottom Story	Include Parapet	Parapet Height m	Cp Windward	Cp Leeward
WI-X	1	No	Diaphragms	TERRACE	BASEMENT FLOOR	Yes	1.2	0.8	0.5
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-X	1	No							
WI-Y	1	No	Diaphragms	TERRACE	BASEMENT FLOOR	Yes	1.2	0.8	0.5
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							

Table 3.2 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 1 of 3, continued)

Name	Exposure Set	Is Auto Load	Exposure Source	Top Story	Bottom Story	Include Parapet	Parapet Height m	Cp Windward	Cp Leeward
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							
WI-Y	1	No							

Table 3.2 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 2 of 3)

Name	Exposure Set	Wind Speed meter/sec	Terrain Category	Importance Factor	Risk Coefficient	Topography	Width Type	Direction Angle deg	Story
WI-X	1	50	2	1.00	1	1	Auto	0	TERRACE
WI-X	1								13TH FLOOR
WI-X	1								12TH FLOOR
WI-X	1								11TH FLOOR
WI-X	1								10TH FLOOR
WI-X	1								9TH FLOOR
WI-X	1								8TH FLOOR
WI-X	1								7TH FLOOR
WI-X	1								6TH FLOOR
WI-X	1								5TH FLOOR
WI-X	1								4TH FLOOR
WI-X	1								3RD FLOOR
WI-X	1								2ND FLOOR
WI-X	1								1ST FLOOR
WI-X	1								STILT FLOOR
WI-Y	1	50	2	1.00	1	1	Auto	90	TERRACE
WI-Y	1								13TH FLOOR
WI-Y	1								12TH FLOOR
WI-Y	1								11TH FLOOR
WI-Y	1								10TH FLOOR
WI-Y	1								9TH FLOOR
WI-Y	1								8TH FLOOR
WI-Y	1								7TH FLOOR
WI-Y	1								6TH FLOOR
WI-Y	1								5TH FLOOR
WI-Y	1								4TH FLOOR
WI-Y	1								3RD FLOOR
WI-Y	1								2ND FLOOR
WI-Y	1								1ST FLOOR
WI-Y	1								STILT FLOOR

Table 3.2 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 3 of 3)

Name	Exposure Set	Width m	Depth m	X m	Y m
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	34.7	64.4	40.3	20.25
WI-X	1	43.975	75.16	40.58	20.8625
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	64.4	34.7	40.3	20.25
WI-Y	1	75.16	43.975	40.58	20.8625

3.3 Auto Seismic Loading

Table 3.3 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 1 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Is Auto Load	X Dir?	X Dir Plus Ecc?	X Dir Minus Ecc?	Y Dir?	Y Dir Plus Ecc?	Y Dir Minus Ecc?
EQ-X	0.5	0.06	308654.3158	18519.259	No	Yes	No	No	No	No	No
EQ-Y	0.7	0.046629	308654.3158	14392.1098	No	No	No	No	Yes	No	No

Table 3.3 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 2 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Ecc Ratio	Top Story	Bottom Story	Period Type	User T sec	Z
EQ-X	0.5	0.06	308654.3158	18519.259	0.05	TERRACE	STILT FLOOR	User Defined	0.5	0.16
EQ-Y	0.7	0.046629	308654.3158	14392.1098	0.05	TERRACE	STILT FLOOR	User Defined	0.7	0.16

Table 3.3 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 3 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	I	R
EQ-X	0.5	0.06	308654.3158	18519.259	1.2	4
EQ-Y	0.7	0.046629	308654.3158	14392.1098	1.2	4

IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ-X according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.5\ sec$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] $Z = 0.16$

Response Reduction Factor, R [IS Table 9] $R = 4$

Importance Factor, I [IS Table 8] $I = 1.2$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = 2.5$ $\frac{S_a}{g} = 2.5$

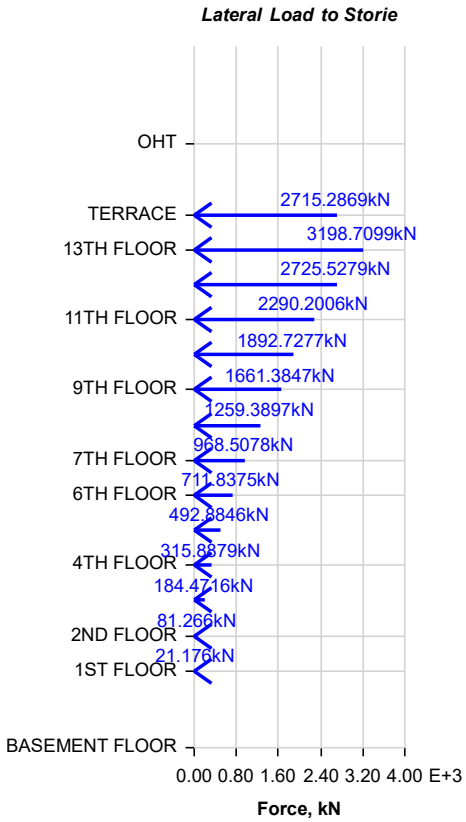
Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{Z\, I \frac{S_a}{g}}{2\, R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	0.5	308654.3158	18519.259

Applied Story Forces


Lateral Load to Storie
OHT
TERRACE
13TH FLOOR
11TH FLOOR
9TH FLOOR
7TH FLOOR
6TH FLOOR
4TH FLOOR
2ND FLOOR
1ST FLOOR
BASEMENT FLOOR
2715.2869kN
3198.7099kN
2725.5279kN
2290.2006kN
1892.7277kN
1661.3847kN
1259.3897kN
968.5078kN
711.8375kN
492.8846kN
315.8879kN
184.4716kN
81.266kN
21.176kN
0.00 0.80 1.60 2.40 3.20 4.00 E+3
Force, kN

IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ-Y according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = Y

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.7\ sec$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] $Z = 0.16$

Response Reduction Factor, R [IS Table 9] $R = 4$

Importance Factor, I [IS Table 8] $I = 1.2$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = \frac{1.36}{T}$ $\frac{S_a}{g} = 1.942857$

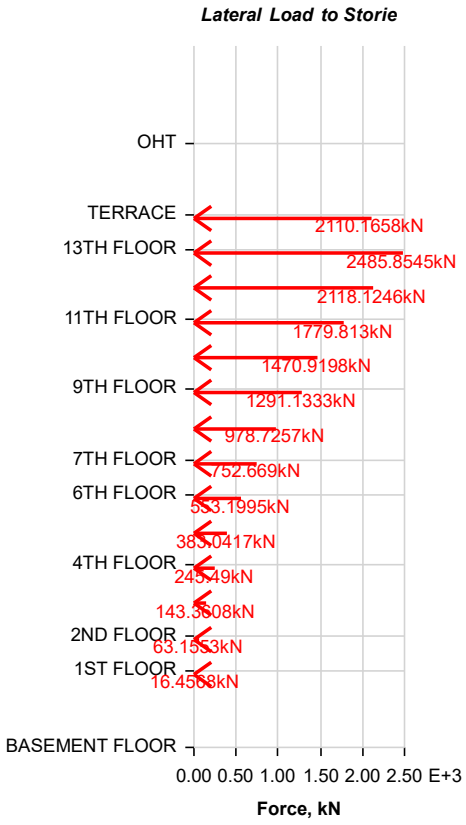
Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{Z\, I \frac{S_a}{g}}{2\, R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	0.7	308654.3158	14392.1098

Applied Story Forces


Lateral Load to Storie
OHT
TERRACE
13TH FLOOR
11TH FLOOR
9TH FLOOR
7TH FLOOR
6TH FLOOR
4TH FLOOR
2ND FLOOR
1ST FLOOR
BASEMENT FLOOR
2110.1658kN
2485.8545kN
2118.1246kN
1779.813kN
1470.9198kN
1291.1333kN
978.7257kN
752.669kN
553.1995kN
383.0417kN
245.49kN
143.3608kN
63.1553kN
16.4568kN
0.00 0.50 1.00 1.50 2.00 2.50 E+3
Force, kN

3.4 Load Cases

Table 3.6 - Load Case Definitions - Summary

Name	Type
Modal	Modal - Ritz
Dead	Linear Static
Live	Linear Static
Live>3	Linear Static
SDL	Linear Static
WALL	Linear Static
EQ-X	Linear Static
EQ-Y	Linear Static
ROOF LIVE	Linear Static
TEMP	Linear Static
SPEC-X(D)	Response Spectrum
SPEC-Y(D)	Response Spectrum
SPEC-X(S)	Response Spectrum
SPEC-Y(S)	Response Spectrum
WI-X	Linear Static
WI-Y	Linear Static

4 Analysis Results

This chapter provides analysis results.

4.1 Story Results

Table 4.1 - Story Stiffness

Story	Output Case	Case Type	Step Type	Shear X kN	Drift X mm	Stiff X kN/m	Shear Y kN	Drift Y mm	Stiff Y kN/m
OHT	EQ-X	LinStatic	Step By Step	6.952E-07	3.151	0.0002206	1.817E-06	1.358	0.001
LMR	EQ-X	LinStatic	Step By Step	2.039E-05	5.568	0.004	2.024E-06	0.989	0
TERRACE	EQ-X	LinStatic	Step By Step	2715.2861	11.156	243387.268	7.122E-06	1.256	0
13TH FLOOR	EQ-X	LinStatic	Step By Step	5913.9762	13.04	453511.819	0.0004	1.414	0
12TH FLOOR	EQ-X	LinStatic	Step By Step	8639.4848	14.767	585041.83	0.0007	1.473	0
11TH FLOOR	EQ-X	LinStatic	Step By Step	10929.6681	16.365	667855.452	0.0009	1.533	0
10TH FLOOR	EQ-X	LinStatic	Step By Step	12822.3774	17.689	724886.786	0.0012	1.582	0
9TH FLOOR	EQ-X	LinStatic	Step By Step	14483.749	18.581	779482.574	0.0014	1.594	0
8TH FLOOR	EQ-X	LinStatic	Step By Step	15743.123	19.064	825825.35	0.0016	1.523	0
7TH FLOOR	EQ-X	LinStatic	Step By Step	16711.6211	19.176	871483.207	0.0017	1.486	0
6TH FLOOR	EQ-X	LinStatic	Step By Step	17423.449	18.779	927813.028	0.0018	1.428	0
5TH FLOOR	EQ-X	LinStatic	Step By Step	17916.3266	17.833	1004680.167	0.0019	1.341	0
4TH FLOOR	EQ-X	LinStatic	Step By Step	18232.2075	16.11	1131740.401	0.0019	1.208	0
3RD FLOOR	EQ-X	LinStatic	Step By Step	18416.6752	12.976	1419241.391	0.002	0.962	0
2ND FLOOR	EQ-X	LinStatic	Step By Step	18497.9396	10.79	1714347.543	0.002	0.639	0
1ST FLOOR	EQ-X	LinStatic	Step By Step	18519.1124	5.767	3210994.75	0.002	0.375	0
STILT FLOOR	EQ-X	LinStatic	Step By Step	18519.1138	0.369	50125789.273	0.002	0.035	0
OHT	EQ-Y	LinStatic	Step By Step	0	0.486	0	3.609E-05	7.61	0.005
LMR	EQ-Y	LinStatic	Step By Step	5.339E-07	0.49	0	3.924E-05	8.077	0.005
TERRACE	EQ-Y	LinStatic	Step By Step	2.422E-05	0.653	0	2110.1657	7.728	273044.098
13TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0001	0.797	0	4596.0267	8.551	537494.288
12TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0001	0.863	0	6714.1568	9.285	723151.559
11TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0002	0.928	0	8493.9751	9.906	857497.428
10TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0003	0.997	0	9964.9008	10.345	963223.923
9TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0004	1.054	0	11256.0375	10.537	1068223.422
8TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0007	1.096	0	12234.7663	10.356	1181392.36
7TH FLOOR	EQ-Y	LinStatic	Step By Step	0.001	1.094	0	12987.4382	10.227	1269955.617
6TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0011	1.06	0	13540.6392	9.938	1362530.919
5TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0013	1.016	0	13923.6831	9.359	1487760.194
4TH FLOOR	EQ-Y	LinStatic	Step By Step	0.0015	0.925	0	14169.174	8.505	1665888.547
3RD FLOOR	EQ-Y	LinStatic	Step By Step	0.0016	0.798	0	14312.5358	6.994	2046472.927
2ND FLOOR	EQ-Y	LinStatic	Step By Step	0.0017	0.64	0	14375.6911	5.714	2515666.503
1ST FLOOR	EQ-Y	LinStatic	Step By Step	0.0017	0.399	0	14392.1481	3.493	4119729.808
STILT FLOOR	EQ-Y	LinStatic	Step By Step	0.0017	0.036	0	14392.1484	0.575	25023919.999

4.2 Modal Results

Table 4.2 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX
Modal	1	2.704	0.4498	0.0604	0	0.4498	0.0604	0	0.0396	0.2855	0.115	0.0396
Modal	2	2.451	0.1715	0.2509	0	0.6213	0.3113	0	0.1628	0.1045	0.201	0.2025
Modal	3	2.011	0.0057	0.3066	0	0.6271	0.6179	0	0.2	0.0031	0.2679	0.4025
Modal	4	0.809	0.1036	0.0043	0	0.7307	0.6222	0	0.0058	0.1662	0.0096	0.4083
Modal	5	0.725	0.0084	0.0612	0	0.739	0.6834	0	0.0809	0.0151	0.0293	0.4892
Modal	6	0.7	0.0037	0.0026	0	0.7428	0.6859	0	0.005	0.0062	0.0294	0.4942
Modal	7	0.586	0.0003	0.0679	0	0.7431	0.7539	0	0.0886	0.0007	0.0476	0.5828
Modal	8	0.427	0.035	0.0002	0	0.7781	0.754	0	0.0002	0.0298	0.0002	0.5831
Modal	9	0.351	0.0028	0.0147	0	0.7809	0.7687	0	0.0169	0.0039	0.0186	0.6
Modal	10	0.338	0.0193	0.0066	0	0.8002	0.7753	0	0.0077	0.0243	0.003	0.6077
Modal	11	0.288	0.0007	0.0344	0	0.801	0.8097	0	0.0403	0.001	0.0097	0.648
Modal	12	0.225	0.0321	0.0011	0	0.833	0.8108	0	0.0016	0.0491	0.0001	0.6496
Modal	13	0.19	0.0013	0.0345	0	0.8343	0.8453	0	0.0539	0.0019	0.0003	0.7035
Modal	14	0.095	0.0742	0.0161	0	0.9085	0.8615	0	0.0297	0.1277	6.405E-06	0.7332
Modal	15	0.085	0.0138	0.0913	0	0.9223	0.9527	0	0.1683	0.0244	0.0026	0.9014

Table 4.2 - Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	SumRY	SumRZ
Modal	1	0.2855	0.115
Modal	2	0.39	0.316
Modal	3	0.3931	0.5839
Modal	4	0.5593	0.5935
Modal	5	0.5744	0.6228
Modal	6	0.5806	0.6522
Modal	7	0.5813	0.6998
Modal	8	0.6111	0.7
Modal	9	0.615	0.7186
Modal	10	0.6392	0.7216
Modal	11	0.6402	0.7313
Modal	12	0.6893	0.7313
Modal	13	0.6912	0.7317
Modal	14	0.8189	0.7317
Modal	15	0.8434	0.7343

COLUMN DESIGN

ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
1ST FLOOR	P1	9100	37600	1200	300	0.5

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	500

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	8500	37600	9700	37600	1200	300
Bottom	Leg 1	8500	37600	9700	37600	1200	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	2891	0.008	0.0069	Comb25	-588.9437	-66.5921	122.2466	360000
Bottom	7303	0.0203	0.0069	Comb16	4704.6517	167.5179	-1169.8829	360000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	805.93	Comb25	-588.9437	122.2466	-408.4574	129.2548	408.4574
Bottom	Leg 1	750	Comb16	470.3494	1061.2039	-417.4003	215.6653	475.4914

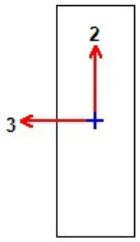
Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	Comb15	4664.1636	-101.8754	14.37	7
Top–Right	Leg 1	300	Comb15	4664.1636	127.3394	14.72	7
Bottom–Left	Leg 1	600	Comb15	4704.6517	-1169.8829	29.32	7
Botttom–Right	Leg 1	600	Comb15	4704.6517	1061.2039	27.81	7

BEAM DESIGN

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
1ST FLOOR	B362	6083	B 200X600	Comb16	0	6350	1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
200	600	200	0	30	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-103.9094	0.0004	86.9795	13.2357

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-103.9094	0.0009	0	-103.9103

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-103.9103		420	0	420	324
Bottom (-2 Axis)		0	210	0	0	210

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
113.1482	0	113.1514	39.3596	550.09

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm²/m
0.0003	86.9795	160	560	0

SLAB DESIGN

PROJECT: KANNADAPALAYAM

DESIGN OF SLAB No:

1.00	Grade of concrete		=	35.00	N/mm^2	
2.00	Grade of steel		=	500.00	N/mm^2	
3.00	Cover to reinforcement		=	25.00	mm	
	Diameter of bar			8.00	mm	
4.00	Aspect ratio $\frac{l_y}{l_x}$ =	3.60	3.70	1.194	< 2	
		3.00	3.10			
5.00	Edge condition:	Interior Panel		Two way slab		
6.00	Modification factor assumed			1.50		
		89.74				
7.00	Depth required for deflection:		D =	125.00	mm	
				125.00	mm	
			d =	96.00	mm	ok
8.00	Dead Load		=	3.00	kN/m^2	qa
9.00	Live load		=	2.00	kN/m^2	
10.00	Partitions & FF		=	1.20	kN/m^2	
11.00	Total load		=	6.20	kN/m^2	
12.00	Factored load		=	9.30	kN/m^2	

Case No: 1

D+(C-D)*(E-A)/(B-A)

	Negative	Positive
A	1.10000	1.10000
B	1.20000	1.20000
C	0.03700	0.02800
D	0.04300	0.03200
E	1.19380	1.19380
Value	0.04263	0.03175

STEP 1

Details	S- SPAN (-ve) support(α_x)	S- SPAN (+ve) span(α_x)	L-SPAN (-ve) support(α_y)	L-SPAN (+ve) span (α_y)
Co-efficent (IS:456, Table :26	0.043	0.032	0.032	0.024
M_u=Co-efficient*w* l_x^2	3.80	2.83	2.85	2.14
K= Mu/bd2	0.41	0.31	0.31	0.23
Percentage of steel required	0.10	0.07	0.07	0.05
Ast required(in mm^2)	92.27	68.48	69.02	51.63
Ast min (in mm^2)	150.00	150.00	150.00	150.00
Ast to be provided (in mm2)	150.00	150.00	150.00	150.00
Provided bars spacing (c/c)	335.24	335.24	335.24	335.24
max spacing	250.00	250.00	250.00	250.00
spacing	250.00	250.00	250.00	250.00
Reqd bars spacing (c/c)	**250.00**	**250.00**	**250.00**	**250.00**
Pvd bars spacing (c/c)	**200.00**	**200.00**	**200.00**	**200.00**
Ast Provided(in mm^2)	**251.43**	**251.43**	**251.43**	**251.43**
Percentage of steel provided	**0.26**	**0.26**	**0.26**	**0.26**

STEPII

F_s=0.58 *f_y * (Ast required/ Ast provided)		
F_s	78.99	
M.F	1.90	
if assumed modification factor is less than or equal to calculated the section is safe for deflection	safe	

OVERALL DEPTH D 125.00 mm

EFFECTIVE DEPT d 96.00 mm

STEPIII Crack width calculation

m	=	6.8	
E_s	=	200000.0	
Ec	=	29580.4	
Pt	=	0.3	
k	=	0.2	
x	=	16.4	
A_{st}	=	251.4	
I_{cr}	=	12241541.49	
M	=	2.8	
f_{st}	=	124.4	
ε_m	=	0.0	
Spacing		200.0	
a_{cr}	=	103.1	
ω_{cr}	=	-0.02	
		< 0.20	mm (safe)

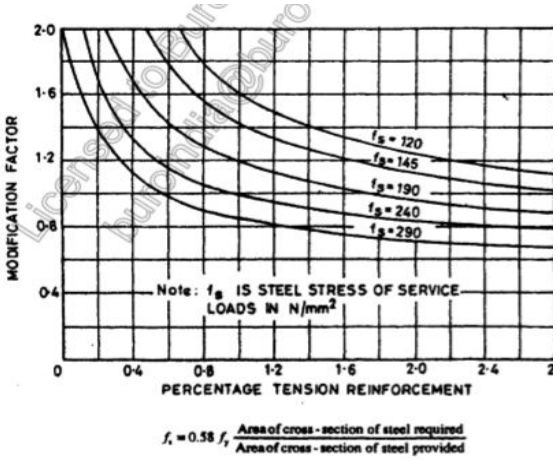


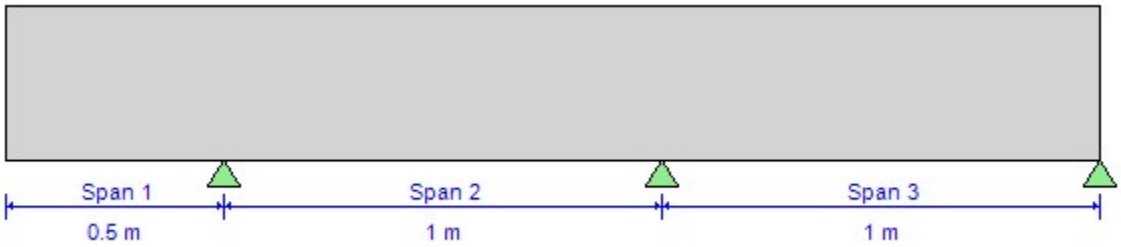
FIG. 4 MODIFICATION FACTOR FOR TENSION REINFORCEMENT

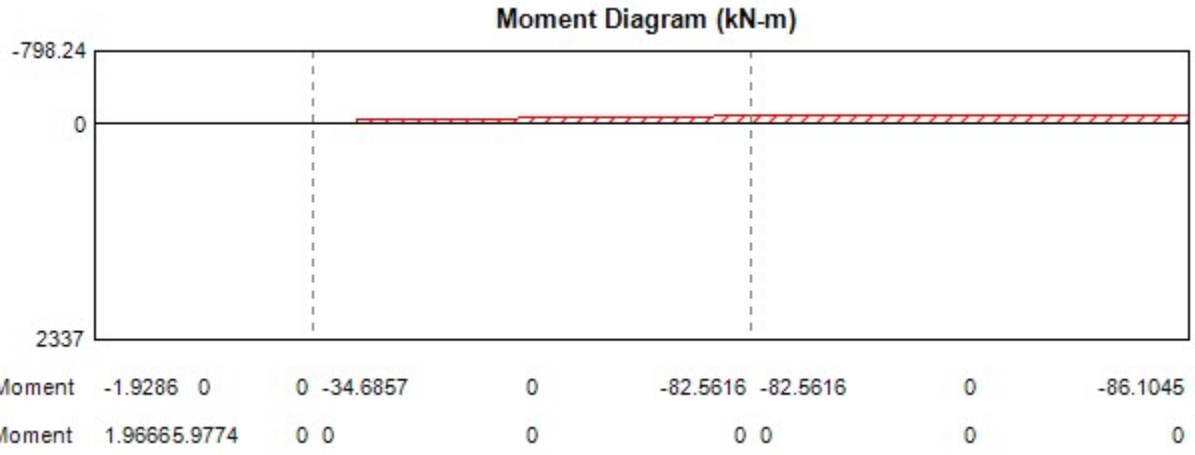
RAFT DESIGN

IS 456:2000 Concrete Strip Design

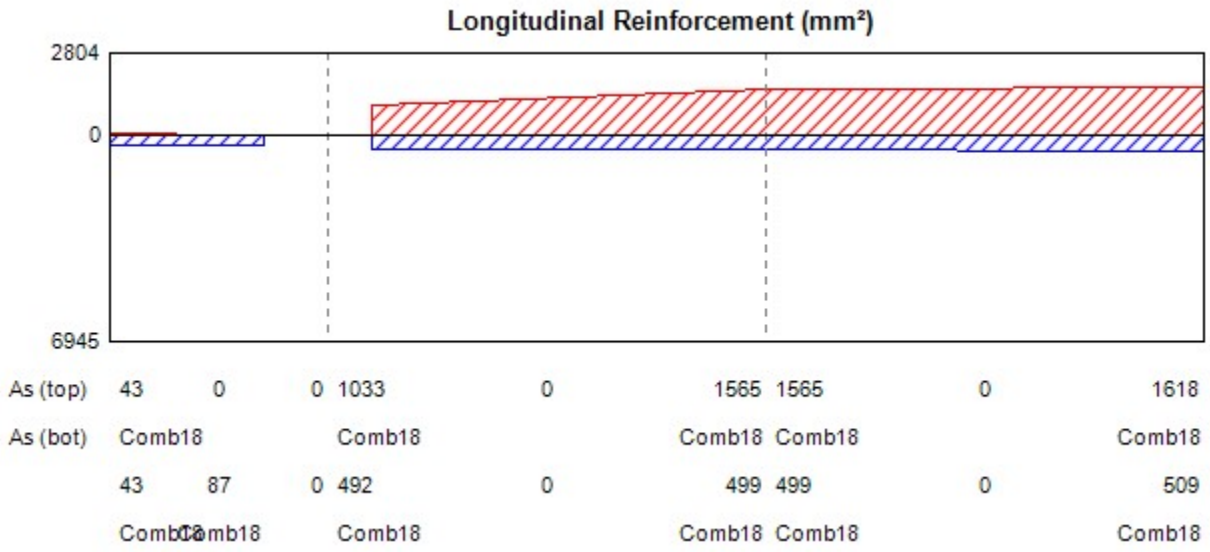
Geometric Properties
Combination = Overall Envelope
Strip Label = SB35
Length = 76 m
Distance to Top Rebar Center = 80 mm
Distance to Bot Rebar Center = 80 mm

Material Properties
Concrete Comp. Strength = 35 MPa
Concrete Modulus = 29580.4 MPa
Longitudinal Rebar Yield = 500 MPa

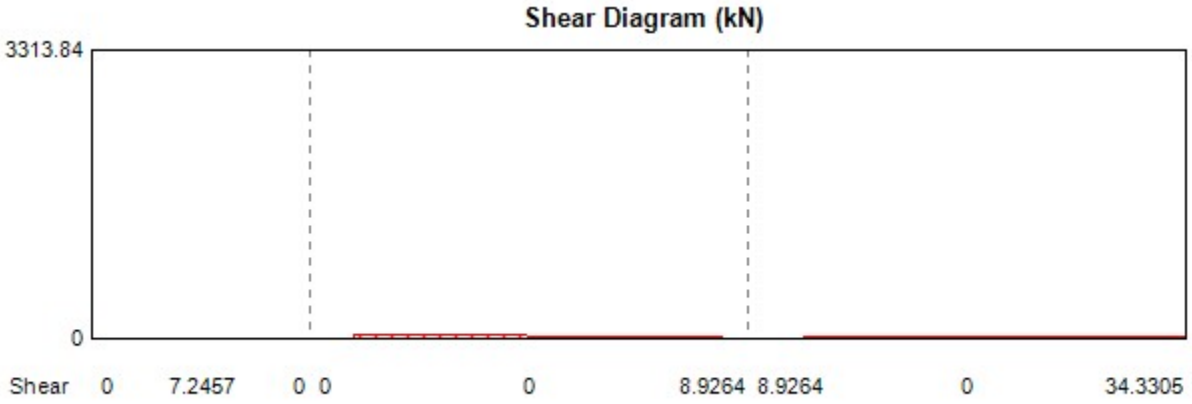




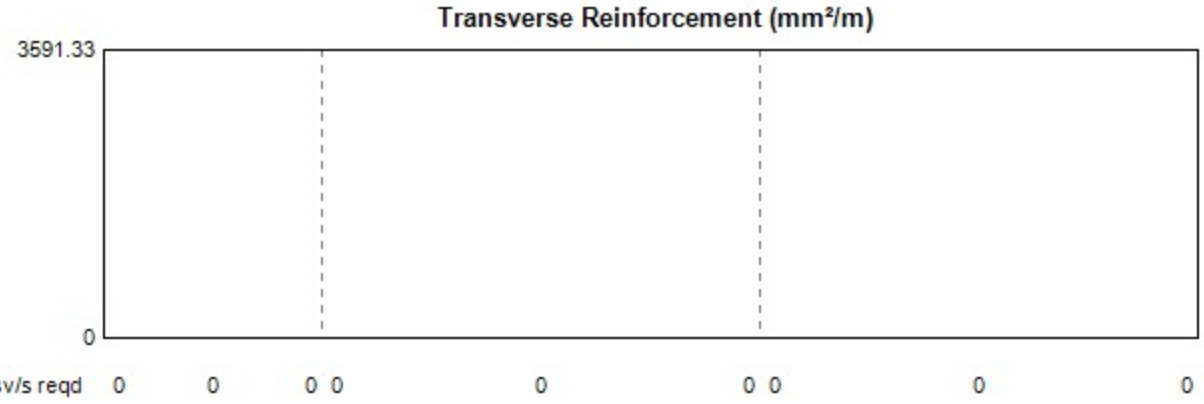
(-)Moment	-1.9286	0	0	-34.6857	0	-82.5616	-82.5616	0	-86.1045
(+)Moment	1.9666	5.9774	0	0	0	0	0	0	0



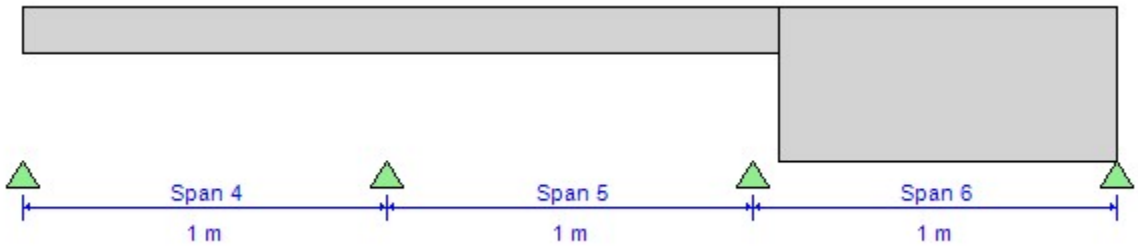
As (top)	43	0	0	1033	0	1565	1565	0	1618
As (bot)	Comb18			Comb18		Comb18	Comb18		Comb18
	43	87	0	492	0	499	499	0	509
	Comb18	Comb18		Comb18		Comb18	Comb18		Comb18



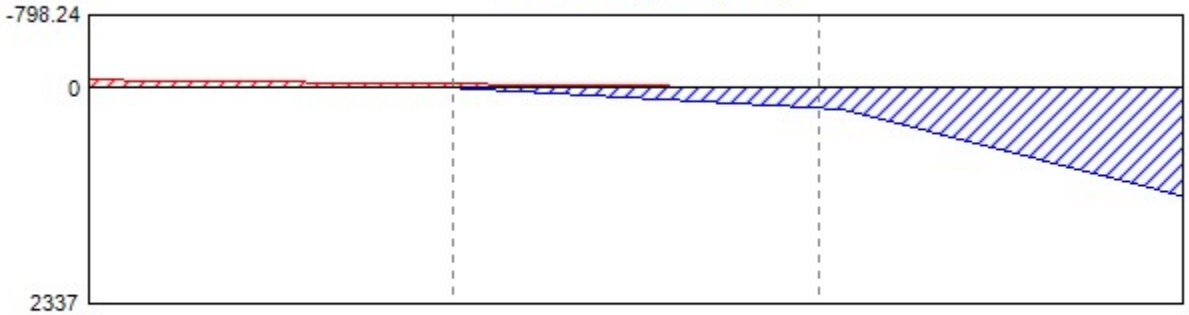
Shear	0	7.2457	0	0	0	8.9264	8.9264	0	34.3305



Asv/s reqd	0	0	0	0	0	0	0	0	0

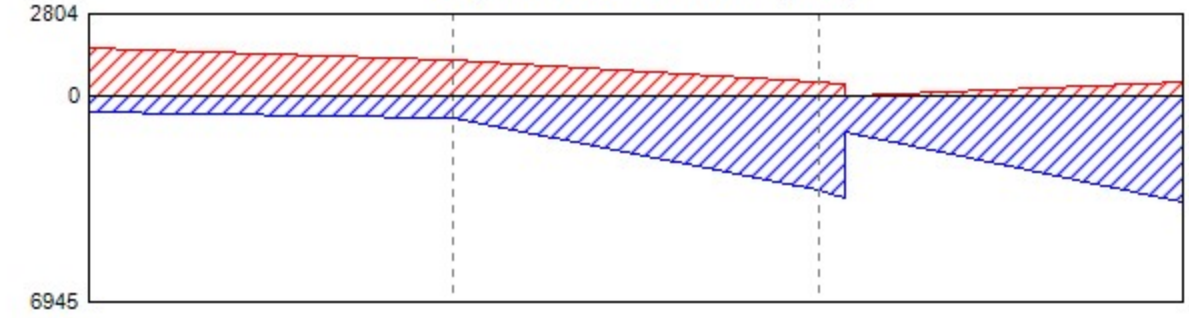


Moment Diagram (kN-m)

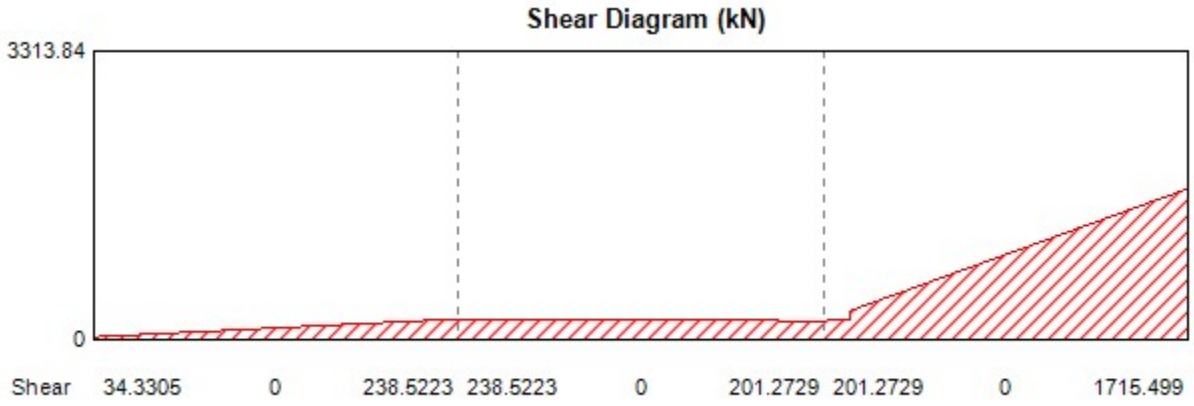


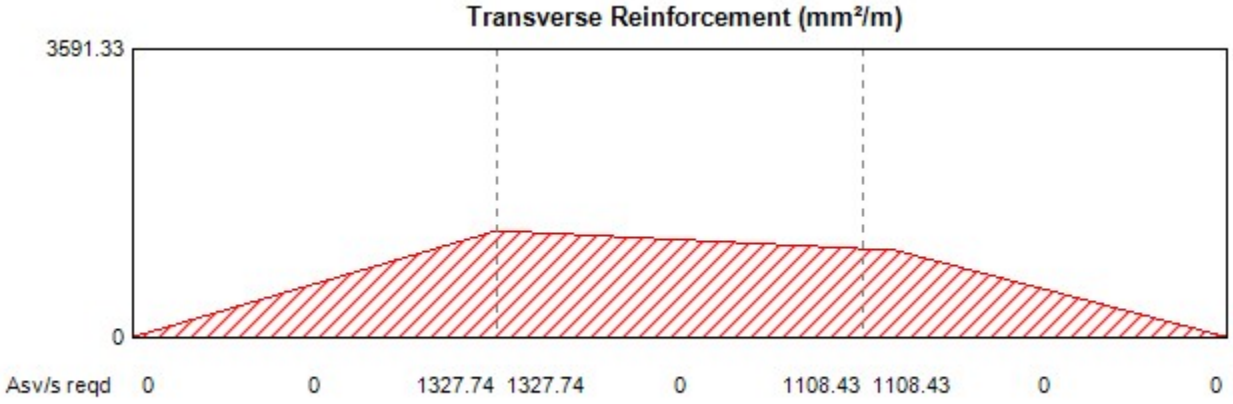
(-)Moment	-86.1045	0	-37.6033	-37.6033	0	-2.6884	-2.6884	0	-5.0352
(+)Moment	0	0	7.783	7.783	0	224.3561	239.5979	0	1193.7801

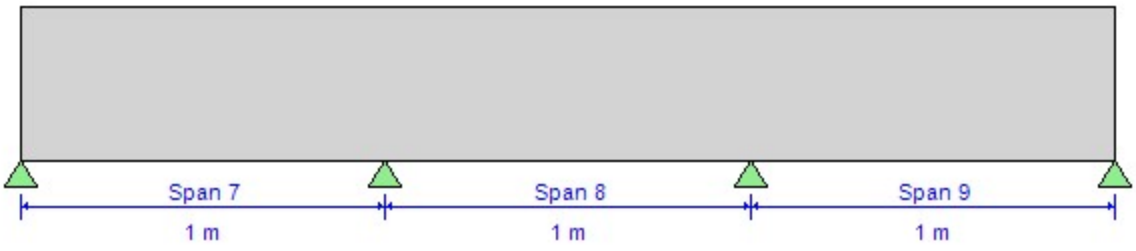
Longitudinal Reinforcement (mm²)



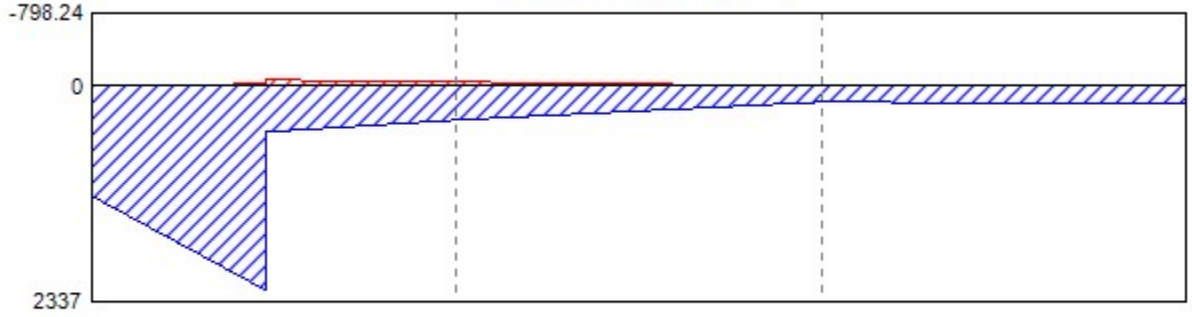
As (top)	1618	0	1235	1235	0	453	453	0	492
As (bot)	Comb18		Comb18	Comb18		Comb18	Comb18		Comb16
	509	0	744	744	0	3187	3428	0	3615
	Comb18		Comb18	Comb18		Comb16	Comb16		Comb16


Shear Diagram (kN)
3313.84
0
Shear 34.3305 0 238.5223 238.5223 0 201.2729 201.2729 0 1715.499


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 1327.74 1327.74 0 1108.43 1108.43 0 0

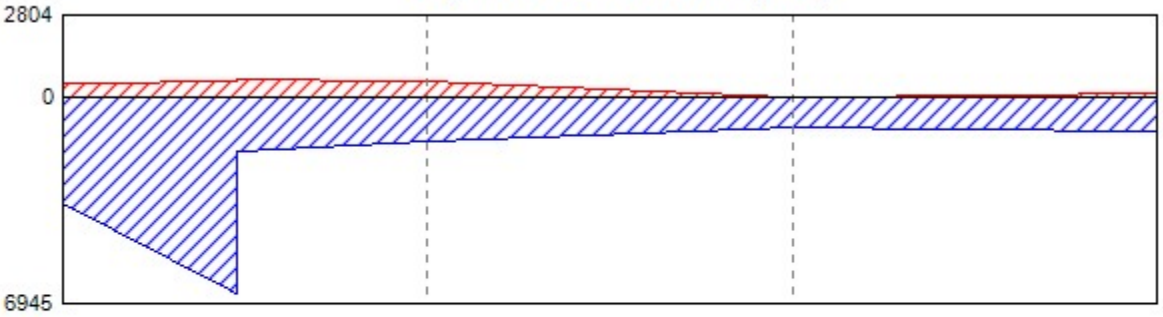

Span 7
1 m
Span 8
1 m
Span 9
1 m

Moment Diagram (kN-m)



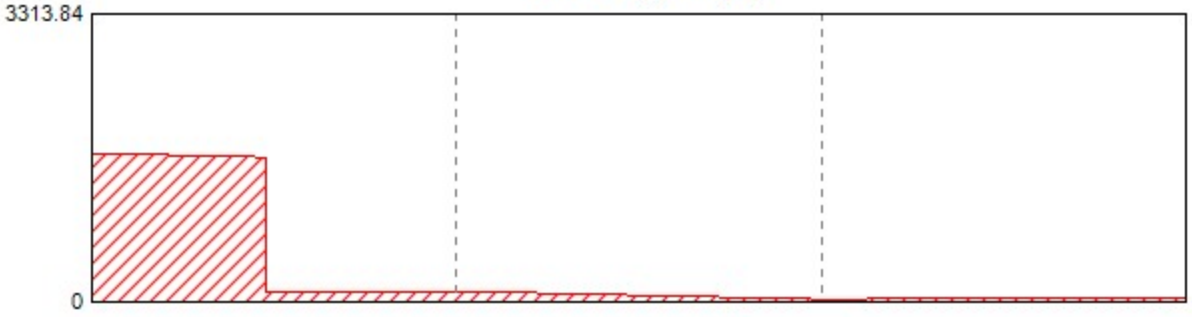
(-)Moment	-5.0352	-59.4074	-39.6897	-39.6897	0	0	0	0	0
(+)Moment	1193.7801	2225.514	375.2639	375.2639	0	177.76	177.76	0	194.9064

Longitudinal Reinforcement (mm²)

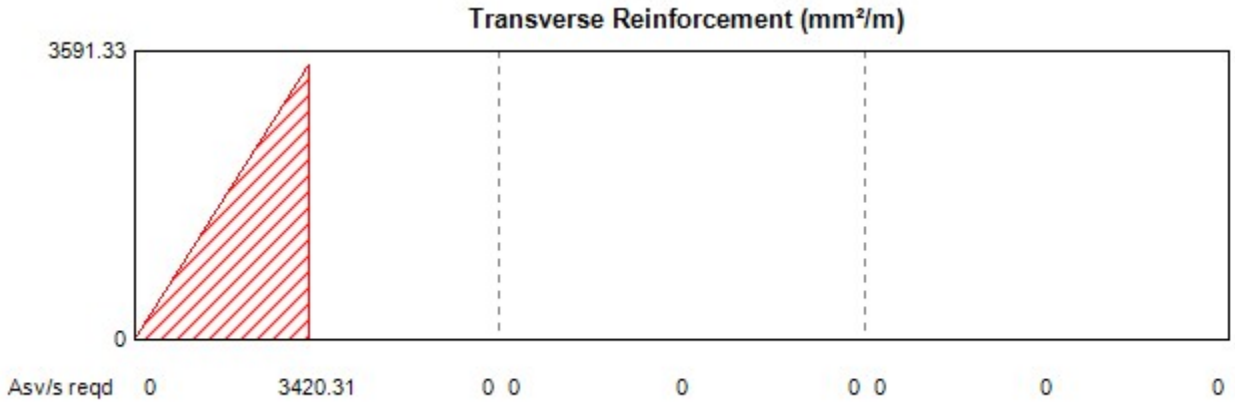


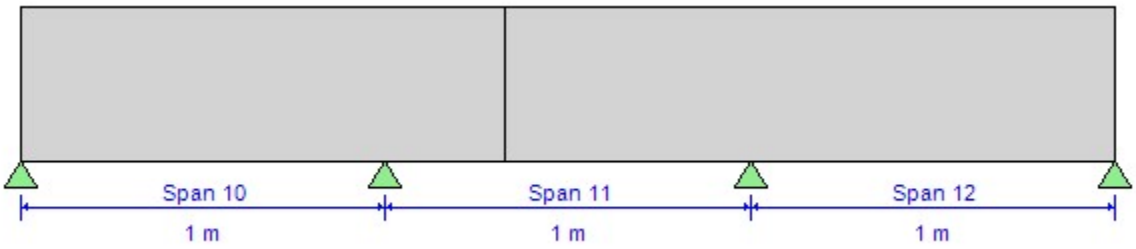
As (top)	492	586	541	541	0	0	0	0	114
As (bot)	Comb16	Comb25	Comb25	Comb25					
	3615	6604	1472	1472	0	1008	1008	0	1181
	Comb16	Comb16	Comb16	Comb16		Comb16	Comb16		Comb16

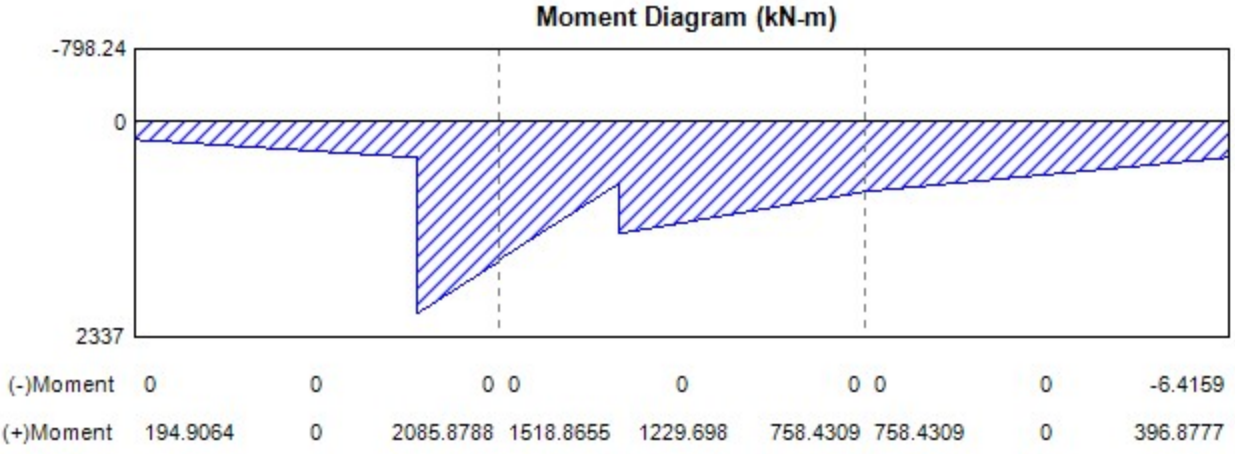
Shear Diagram (kN)

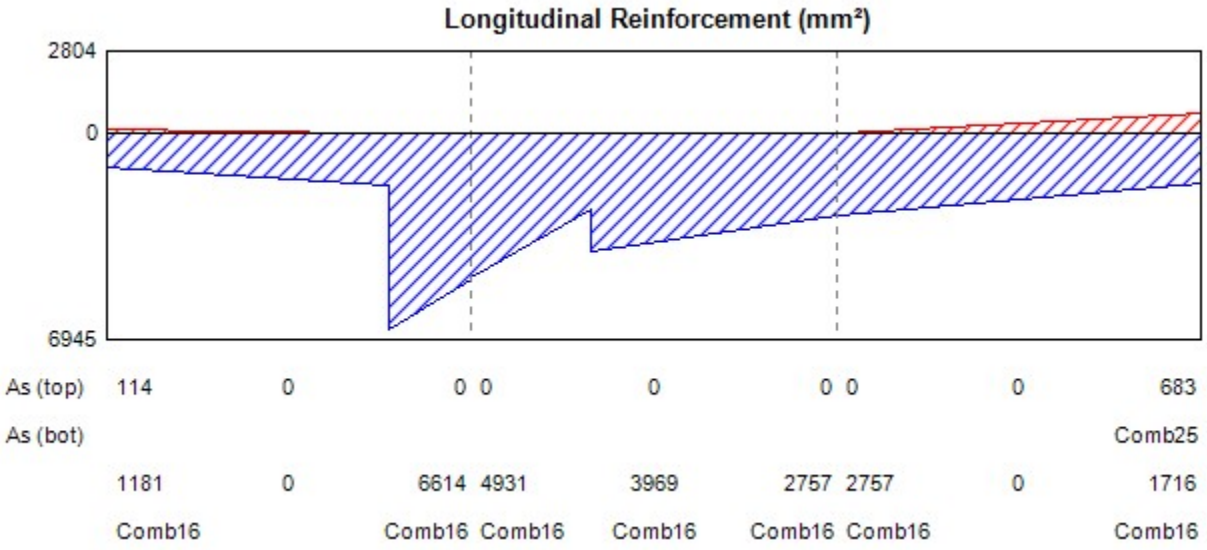


Shear	1715.499	1667.6826	104.7235	104.7235	0	21.8692	21.8692	0	38.9258

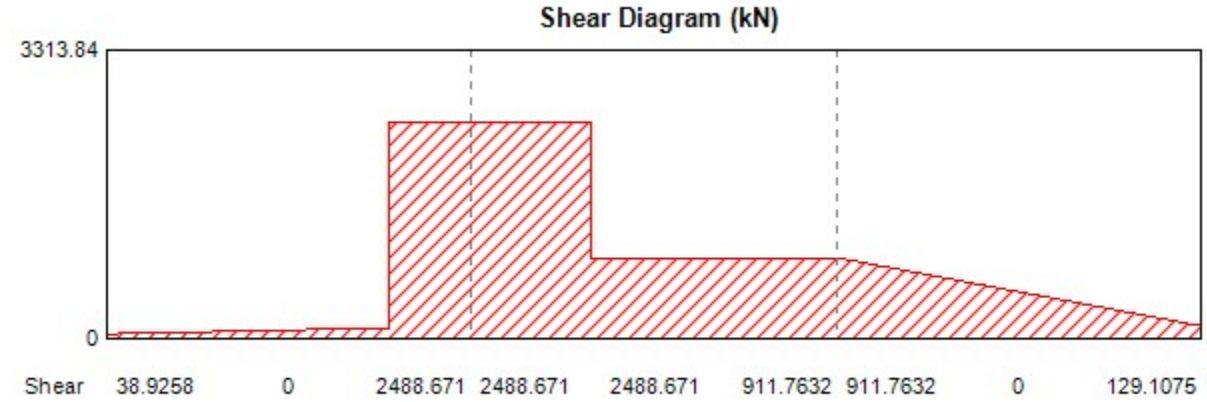

Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 3420.31 0 0 0 0 0 0 0


Span 10
1 m
Span 11
1 m
Span 12
1 m

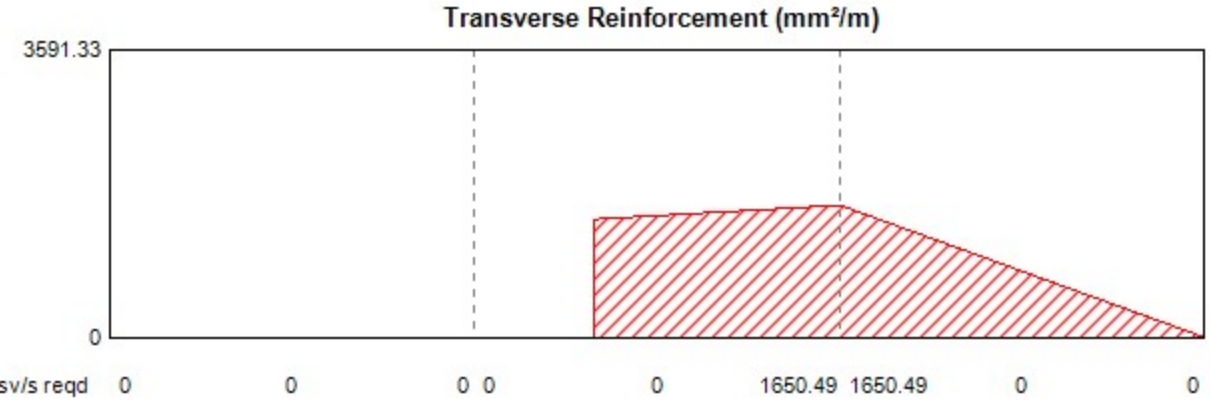

Moment Diagram (kN-m)
-798.24
0
2337
(-)Moment 0 0 0 0 0 0 0 0 -6.4159
(+)Moment 194.9064 0 2085.8788 1518.8655 1229.698 758.4309 758.4309 0 396.8777



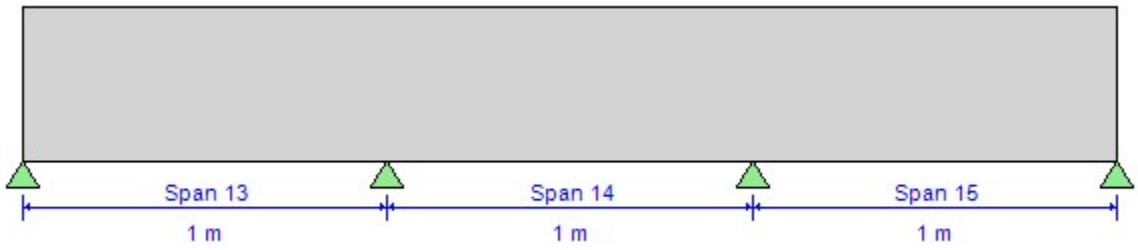
As (top)	114	0	0	0	0	0	0	0	683
As (bot)									Comb25
	1181	0	6614	4931	3969	2757	2757	0	1716
	Comb16		Comb16	Comb16	Comb16	Comb16	Comb16		Comb16



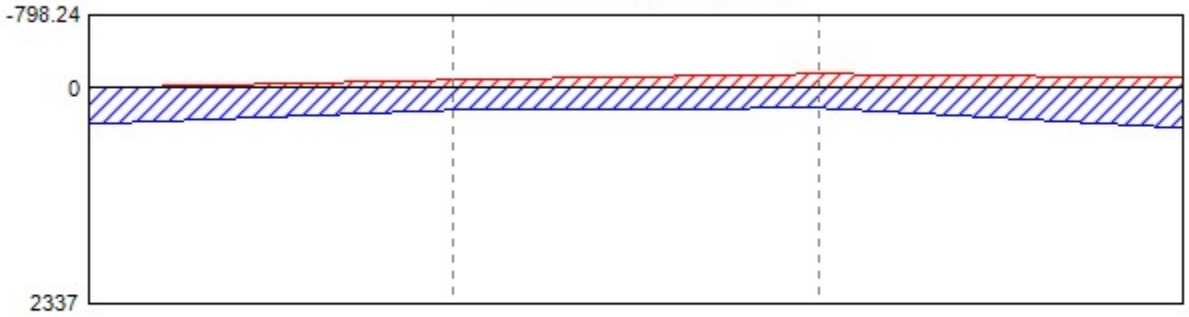
Shear	38.9258	0	2488.671	2488.671	2488.671	911.7632	911.7632	0	129.1075



Asv/s reqd	0	0	0	0	0	1650.49	1650.49	0	0

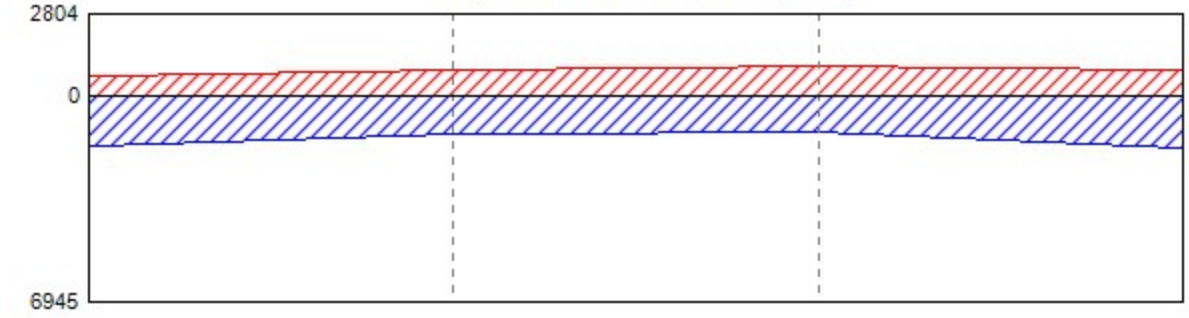


Moment Diagram (kN-m)

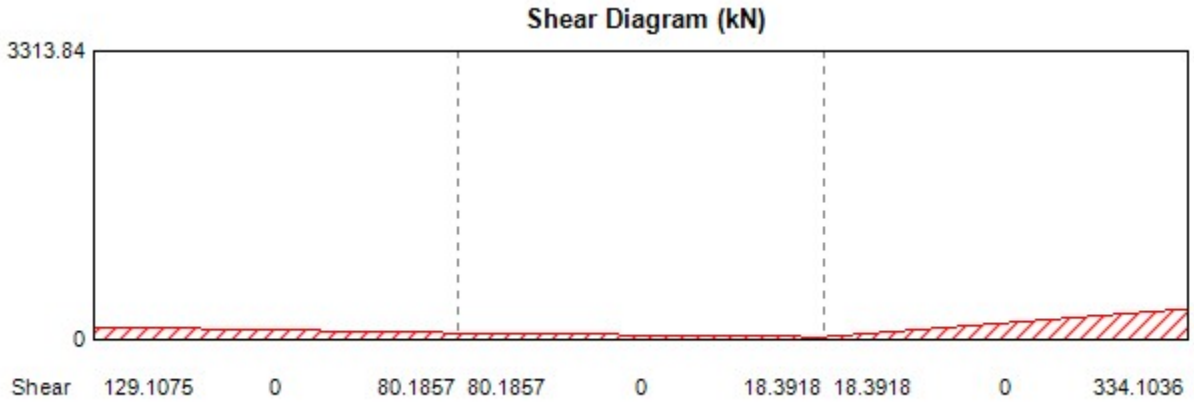


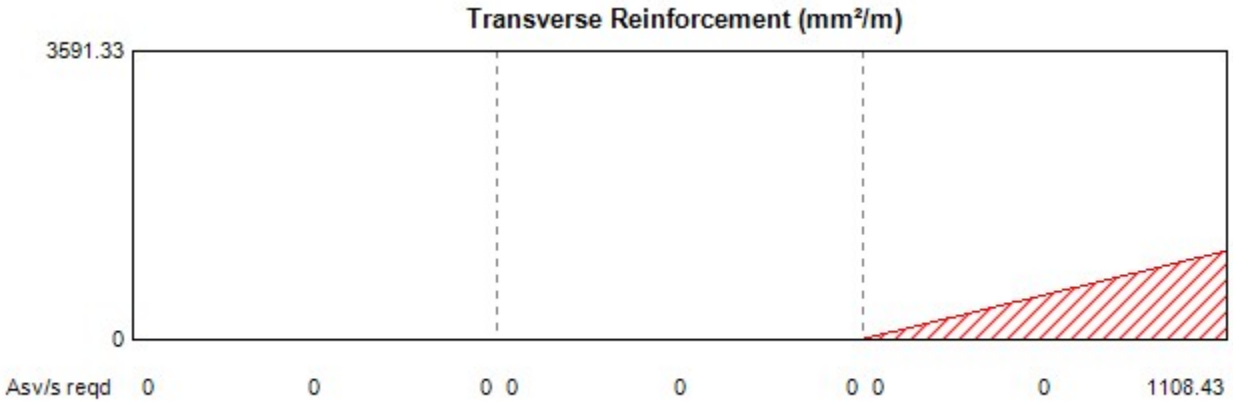
(-)Moment	-6.4159	0	-80.7124	-80.7124	0	-145.3424	-145.3424	0	-101.3722
(+)Moment	396.8777	0	243.8682	243.8682	0	219.8213	219.8213	0	446.58

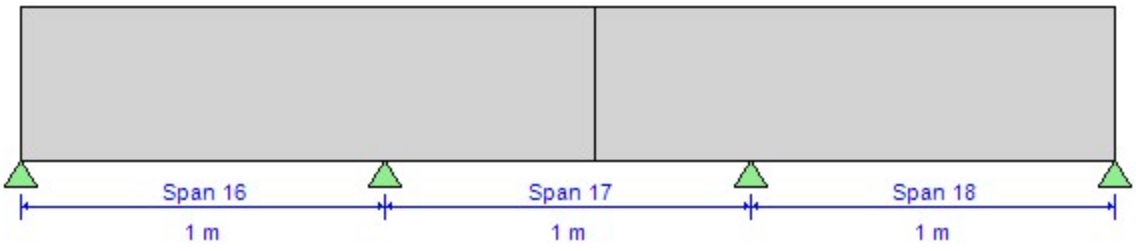
Longitudinal Reinforcement (mm²)



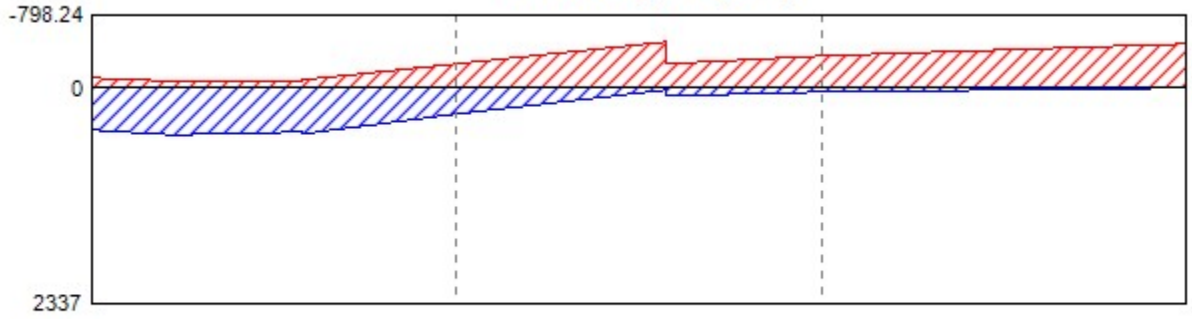
As (top)	683	0	855	855	0	999	999	0	892
As (bot)	Comb25		Comb25	Comb25		Comb25	Comb25		Comb16
	1716	0	1301	1301	0	1207	1207	0	1789
	Comb16		Comb16	Comb16		Comb16	Comb16		Comb16


Shear Diagram (kN)
3313.84
0
Shear 129.1075 0 80.1857 80.1857 0 18.3918 18.3918 0 334.1036


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 0 0 0 0 0 0 1108.43

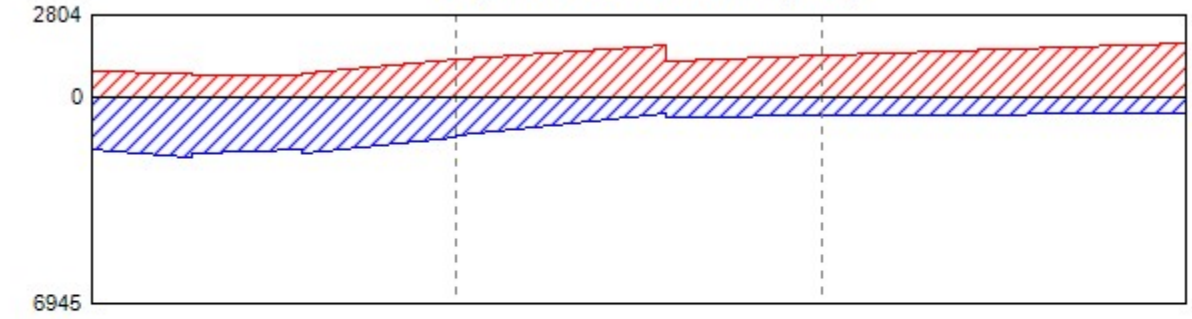

Span 16
1 m
Span 17
1 m
Span 18
1 m

Moment Diagram (kN-m)



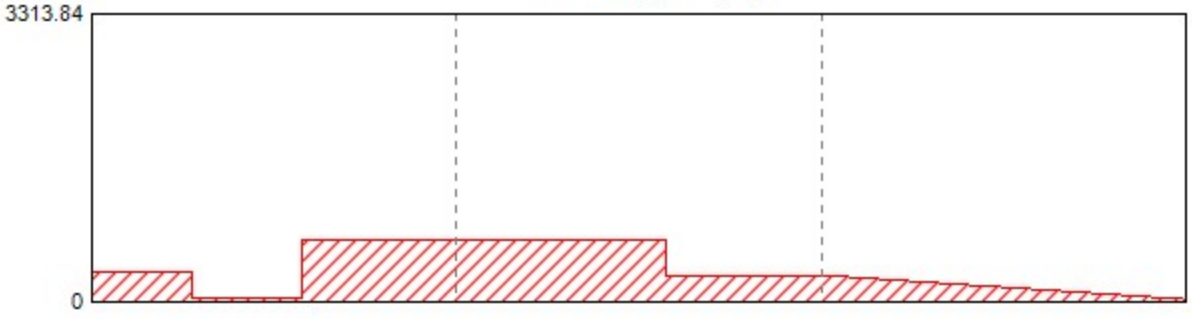
(-)Moment	-101.3722	-78.6985	-260.3781	-260.3781	-504.47	-358.4632	-358.4632	0	-485.905
(+)Moment	446.58	531.4317	284.892	284.892	85.3139	52.6025	52.6025	0	0

Longitudinal Reinforcement (mm²)

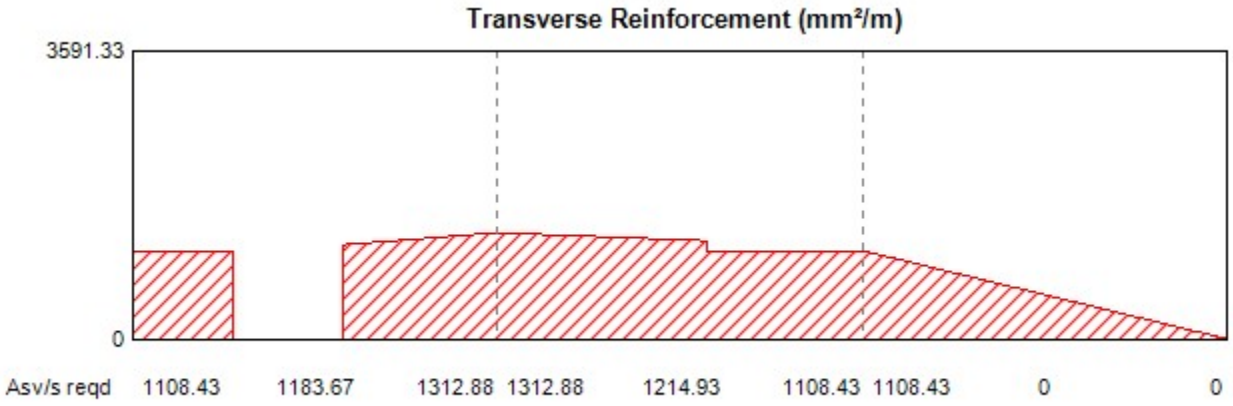


As (top)	892	840	1260	1260	1786	1453	1453	0	1801
As (bot)	Comb16	Comb16	Comb16	Comb16	Comb16	Comb16	Comb16		Comb18
	1789	2020	1322	1322	686	636	636	0	531
	Comb16	Comb16	Comb16	Comb16	Comb25	Comb25	Comb25		Comb18

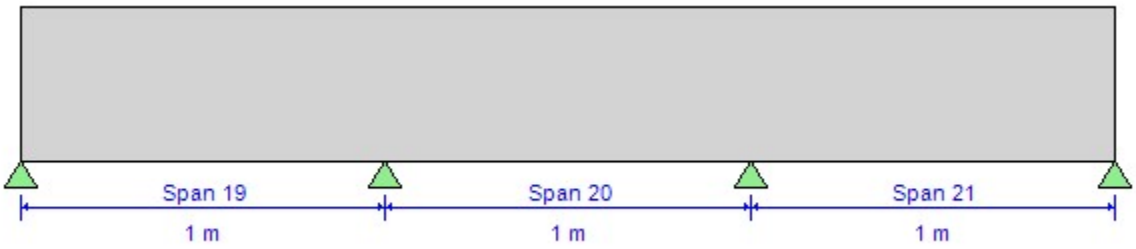
Shear Diagram (kN)

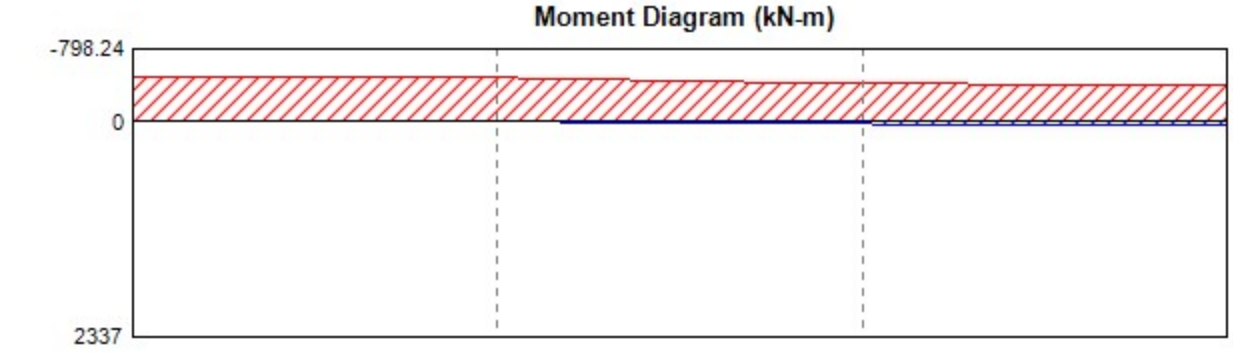


Shear	334.1036	702.6745	702.6745	702.6745	702.6745	303.3236	303.3236	0	27.1132

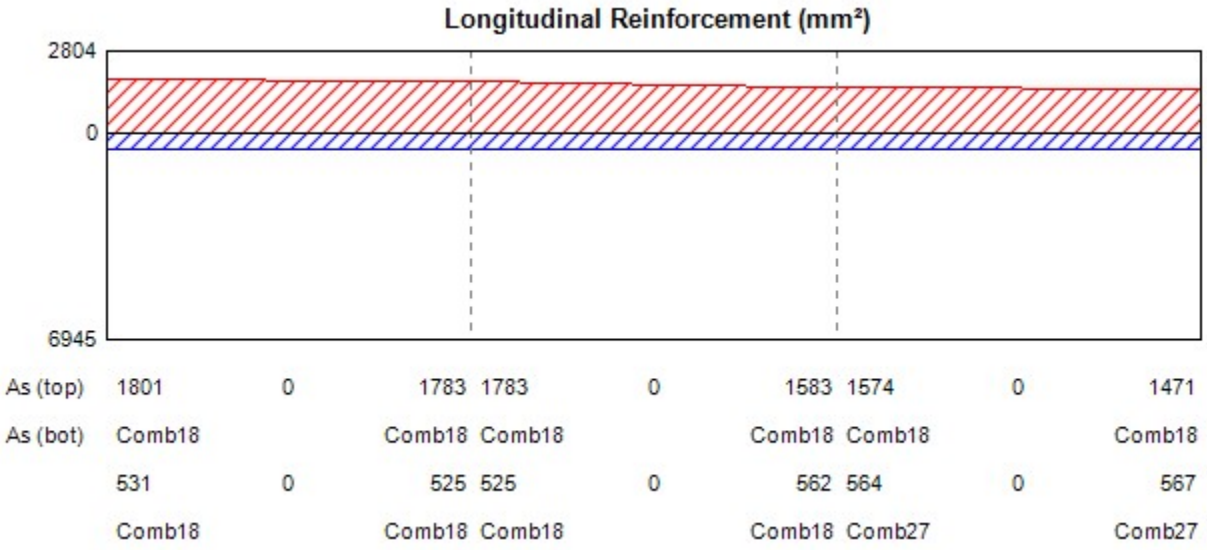


Asv/s reqd	1108.43	1183.67	1312.88	1312.88	1214.93	1108.43	1108.43	0	0

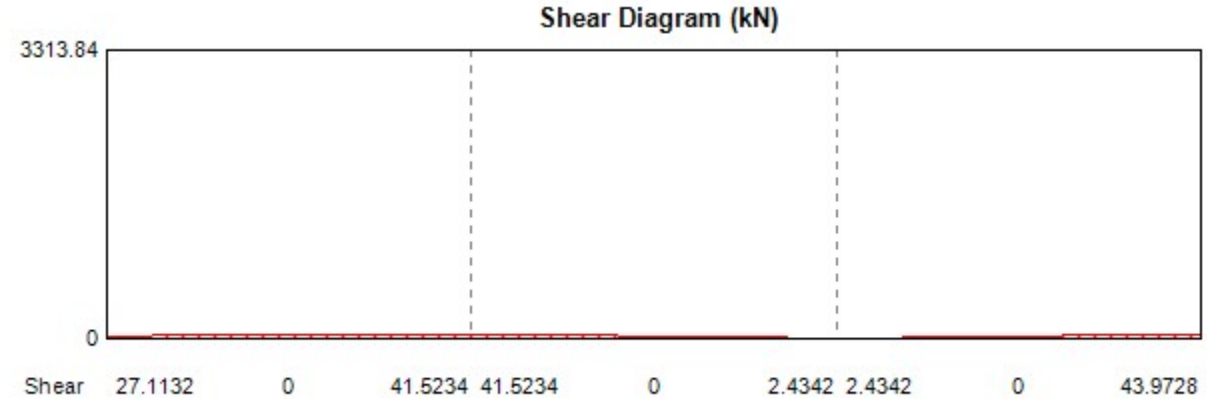




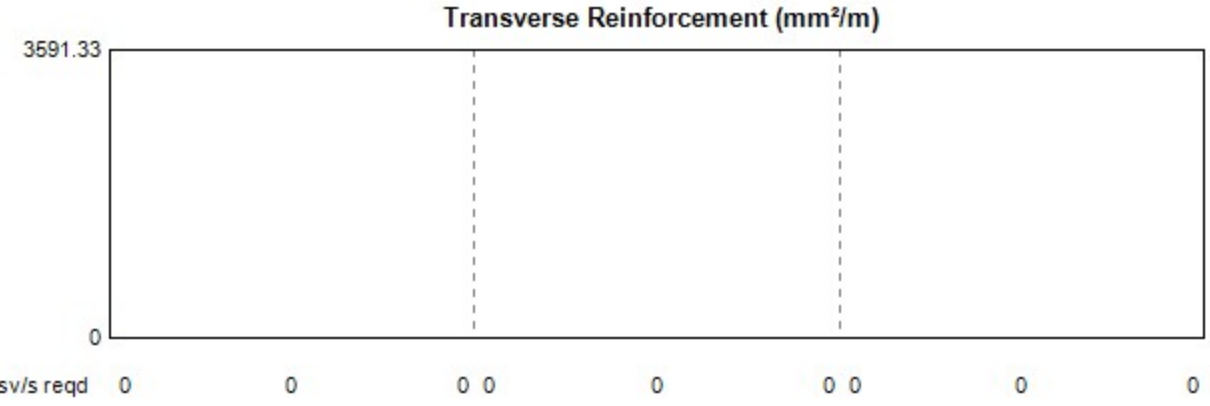
(-)Moment	-485.905	0	-483.6298	-483.6298	0	-412.4818	-409.8317	0	-383.4262
(+)Moment	0	0	2.0809	2.0809	0	21.5119	33.9698	0	45.1387



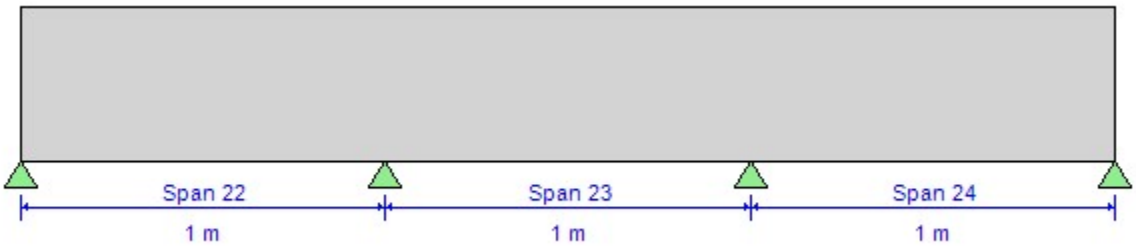
As (top)	1801	0	1783	1783	0	1583	1574	0	1471
As (bot)	Comb18		Comb18	Comb18		Comb18	Comb18		Comb18
	531	0	525	525	0	562	564	0	567
	Comb18		Comb18	Comb18		Comb18	Comb27		Comb27



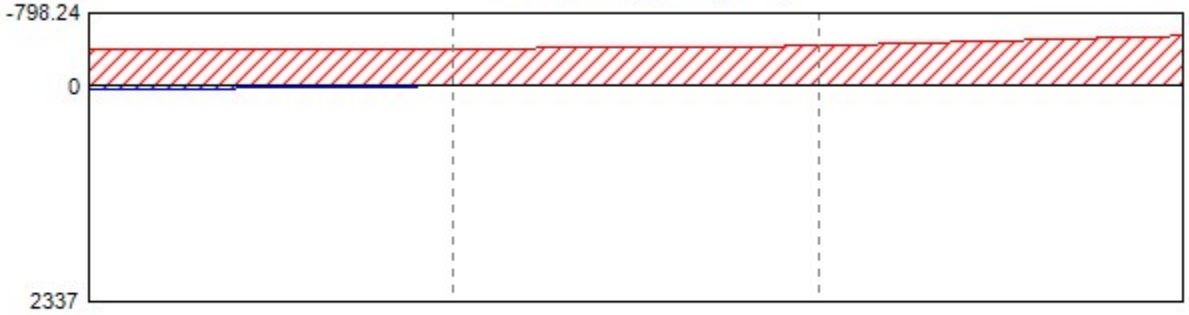
Shear	27.1132	0	41.5234	41.5234	0	2.4342	2.4342	0	43.9728



Asv/s reqd	0	0	0	0	0	0	0	0	0

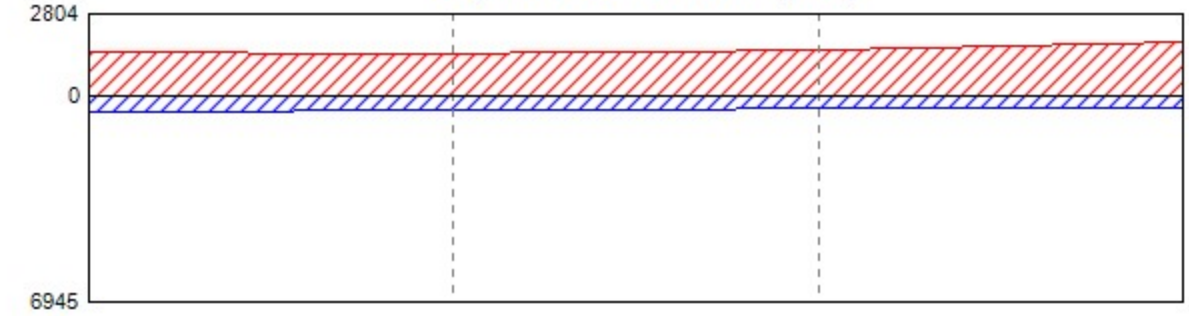


Moment Diagram (kN-m)

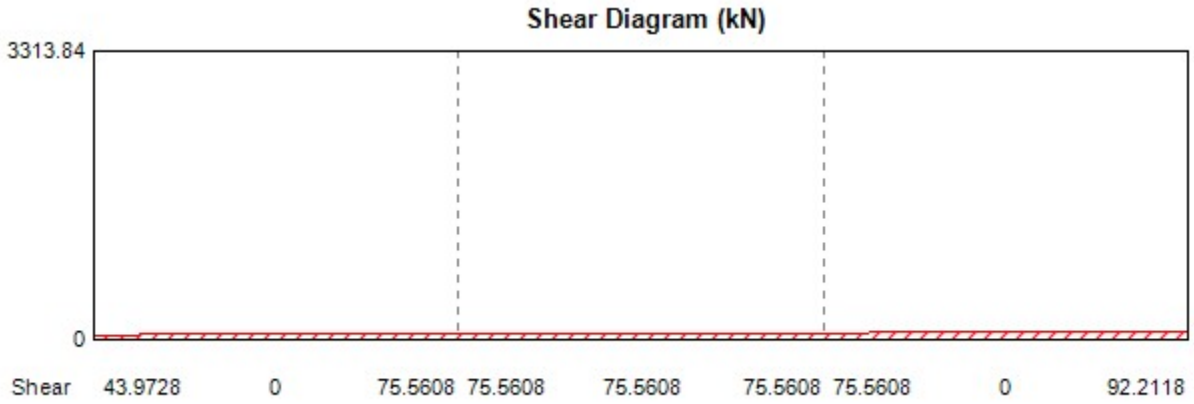


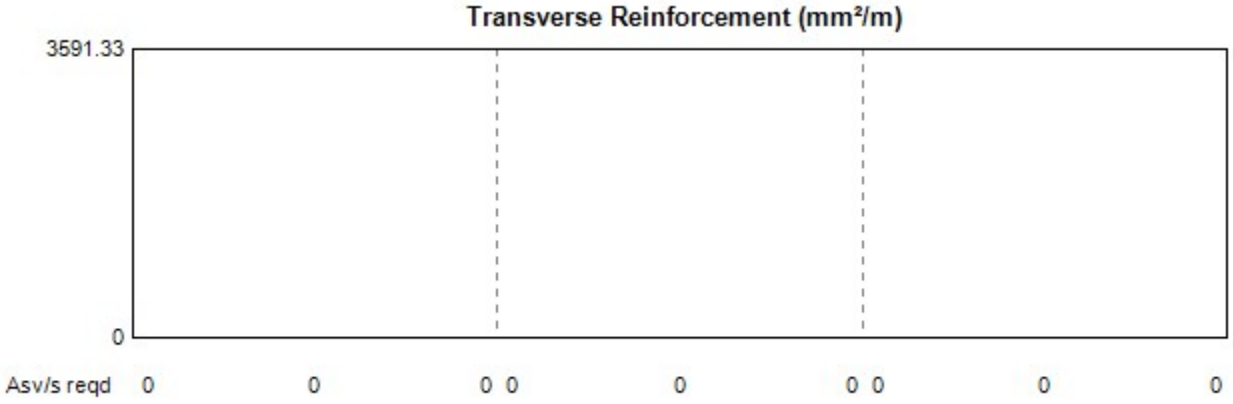
(-)Moment	-383.4262	0	-389.2699	-389.2699	-415.3447	-444.1642	-444.1642	0	-552.6258
(+)Moment	45.1387	0	9.6722	9.6722	7.1438	0.4781	0.4781	0	0

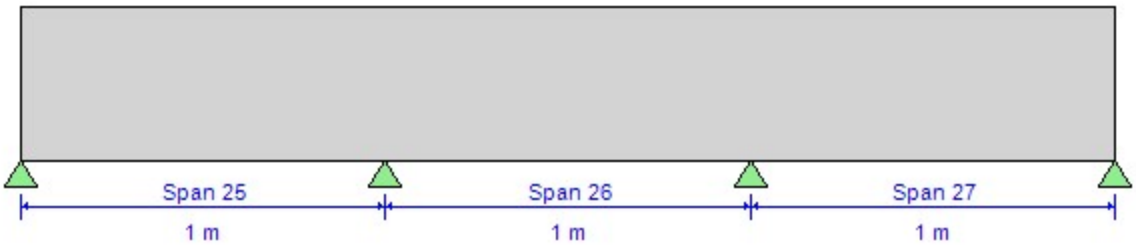
Longitudinal Reinforcement (mm²)

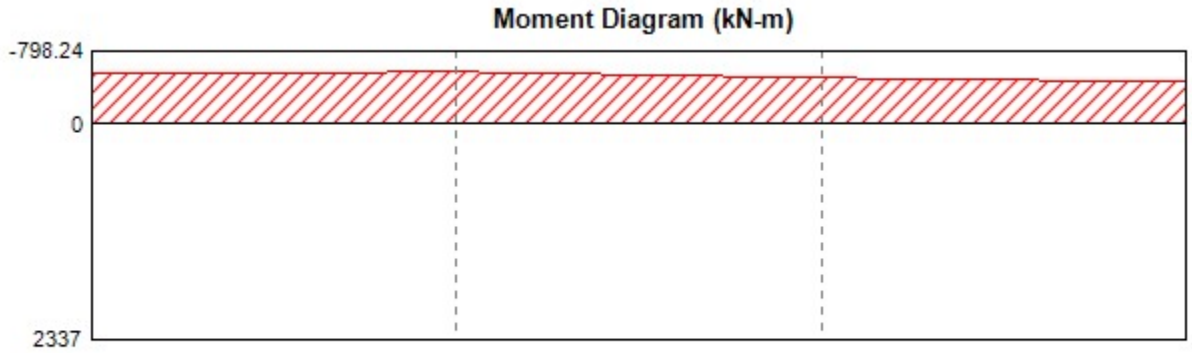


As (top)	1471	0	1449	1449	1510	1577	1577	0	1829
As (bot)	Comb18		Comb18	Comb18	Comb18	Comb18	Comb18		Comb18
	567	0	459	459	449	423	423	0	396
	Comb27		Comb18	Comb18	Comb18	Comb18	Comb18		Comb18

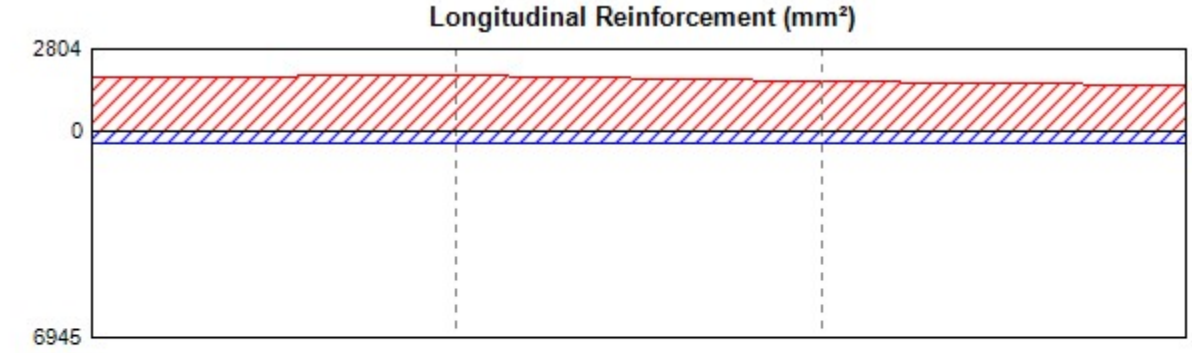

Shear Diagram (kN)
3313.84
0
Shear 43.9728 0 75.5608 75.5608 75.5608 75.5608 75.5608 0 92.2118


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 0 0 0 0 0 0 0

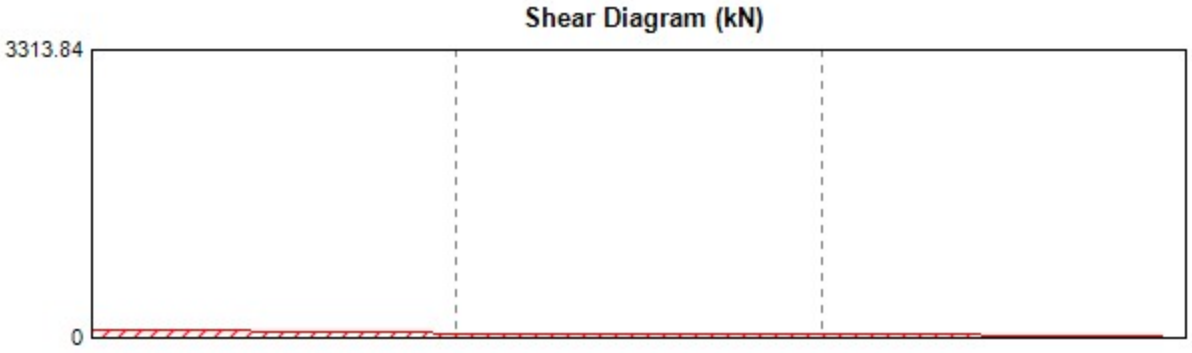

Span 25
1 m
Span 26
1 m
Span 27
1 m



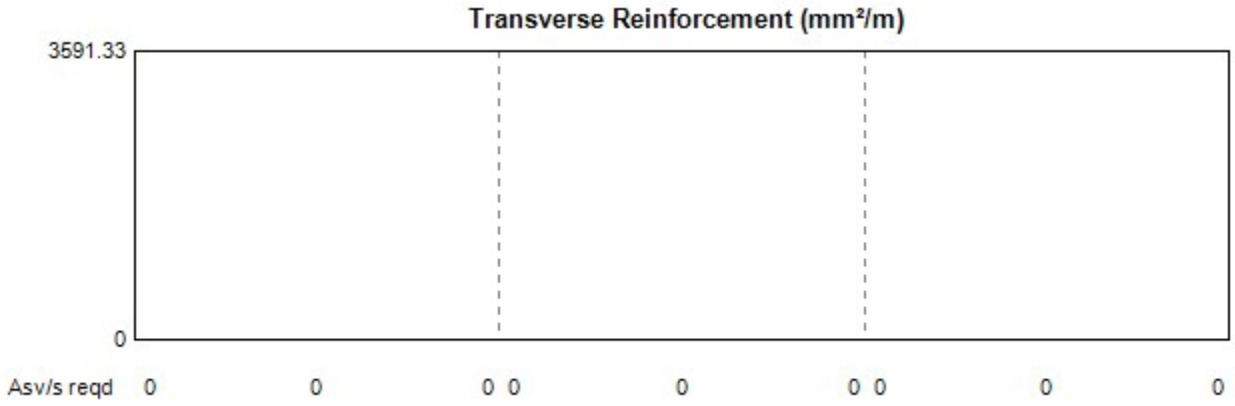
(-)Moment	-552.6258	0	-573.9606	-573.9606	0	-503.3729	-503.3729	0	-459.674
(+)Moment	0	0	0	0	0	0	0	0	0

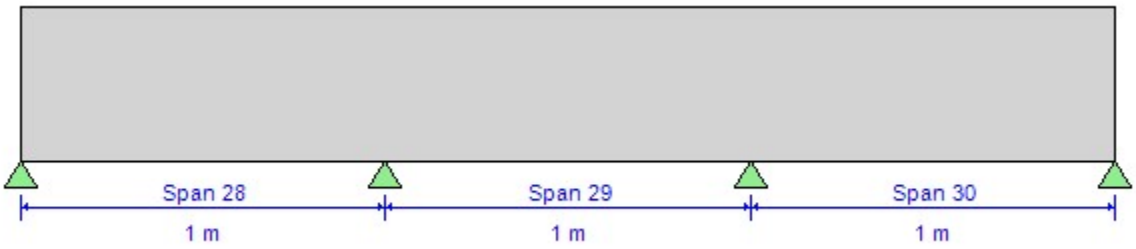


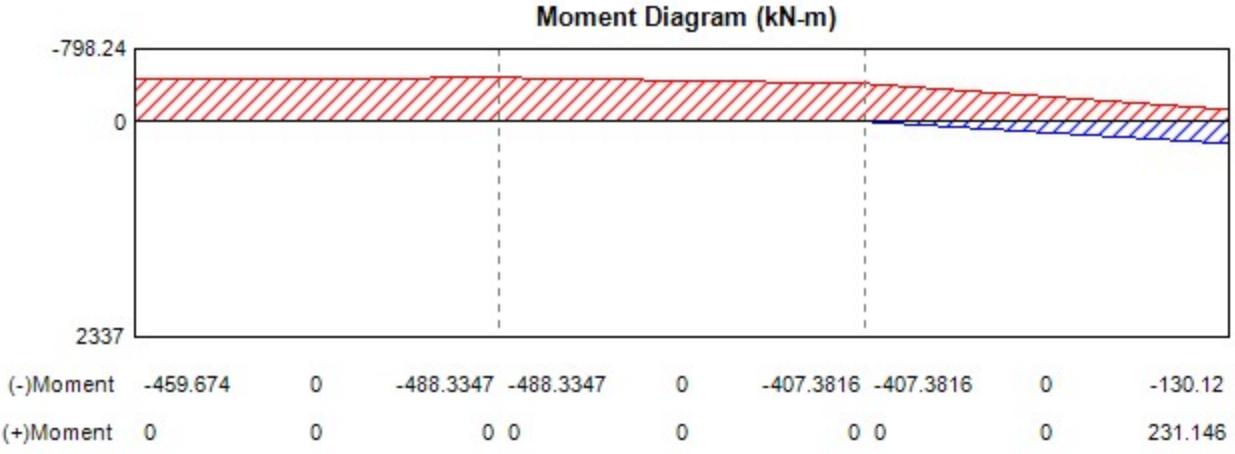
As (top)	1829	0	1882	1882	0	1701	1701	0	1588
As (bot)	Comb18		Comb16	Comb16		Comb16	Comb16		Comb16
	396	0	394	394	0	395	395	0	394
	Comb18		Comb16	Comb16		Comb16	Comb16		Comb16

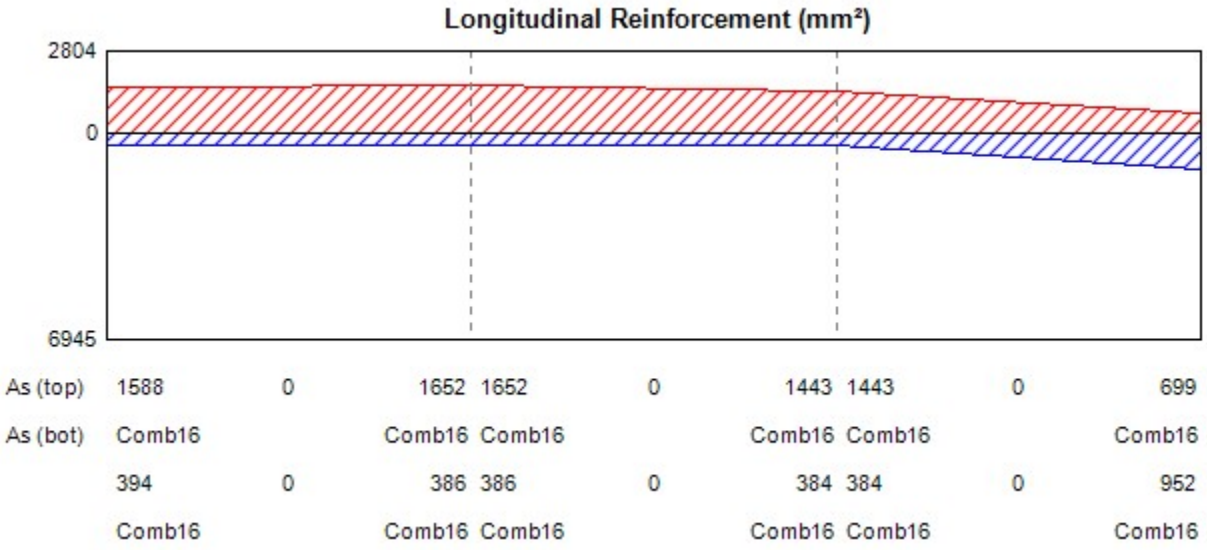


Shear	92.2118	0	49.489	49.489	0	48.5145	48.5145	0	1.4459

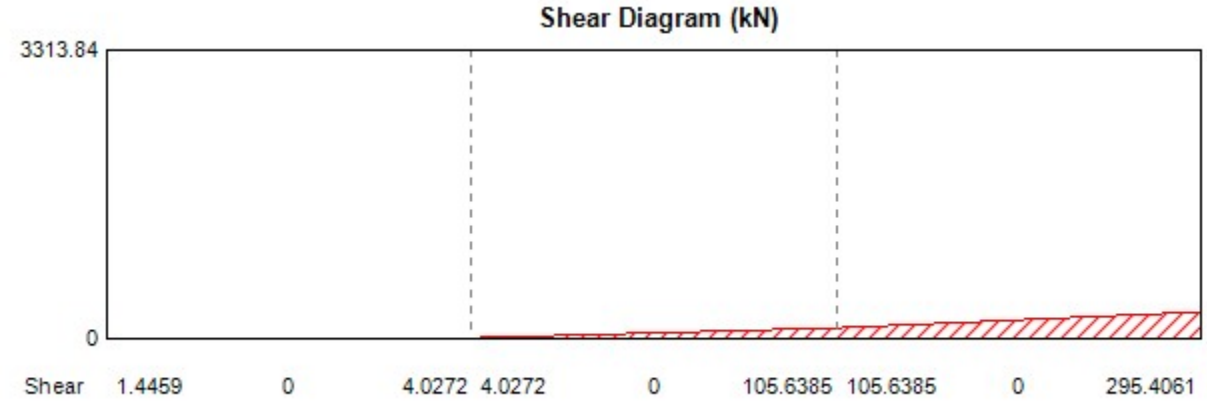

Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 0 0 0 0 0 0 0 0 0 0 0 0


Span 28
1 m
Span 29
1 m
Span 30
1 m

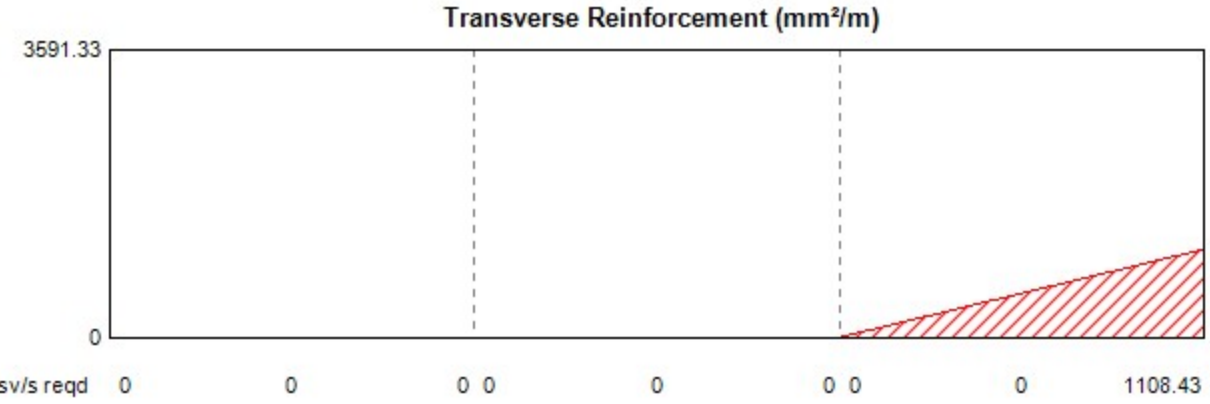

Moment Diagram (kN-m)
-798.24
0
2337
(-)Moment -459.674 0 -488.3347 -488.3347 0 -407.3816 -407.3816 0 -130.12
(+)Moment 0 0 0 0 0 0 0 0 0 0 0 0 231.146



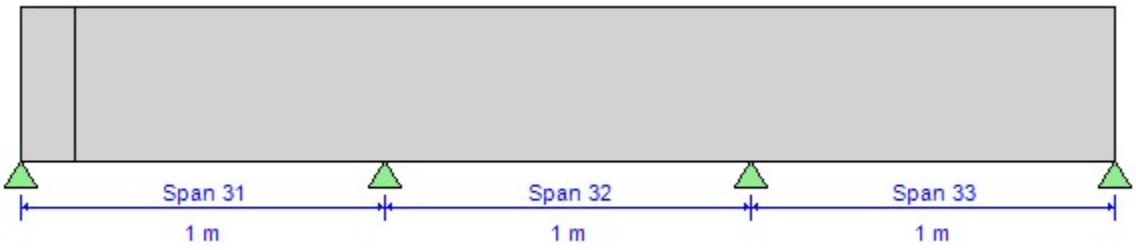
As (top)	1588	0	1652	1652	0	1443	1443	0	699
As (bot)	Comb16		Comb16	Comb16		Comb16	Comb16		Comb16
	394	0	386	386	0	384	384	0	952
	Comb16		Comb16	Comb16		Comb16	Comb16		Comb16



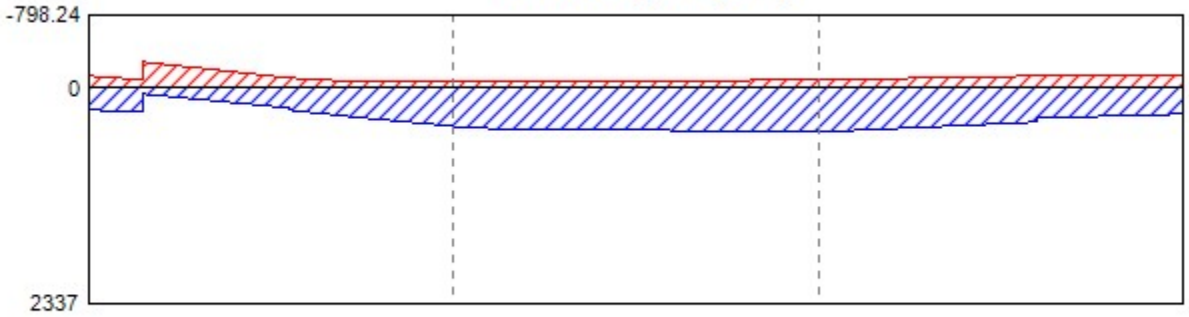
Shear	1.4459	0	4.0272	4.0272	0	105.6385	105.6385	0	295.4061



Asv/s reqd	0	0	0	0	0	0	0	0	1108.43

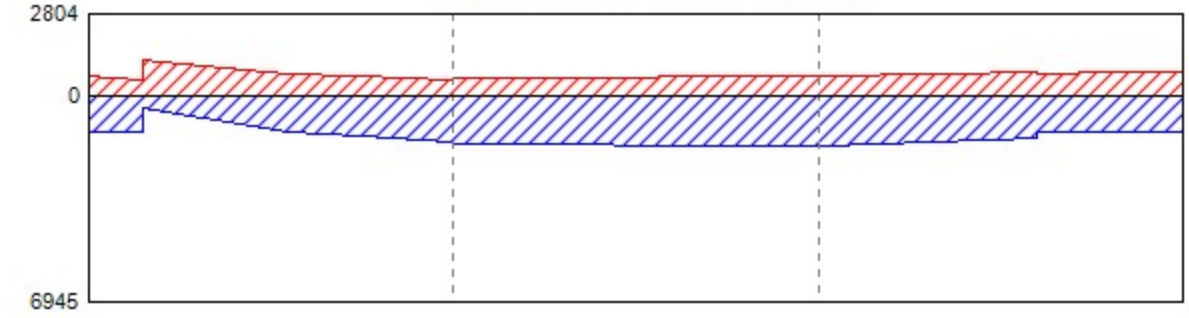


Moment Diagram (kN-m)

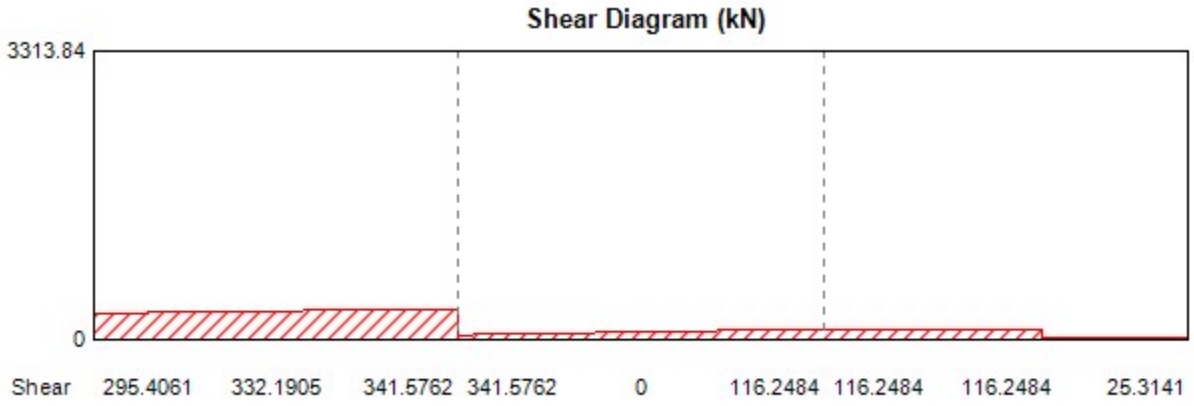


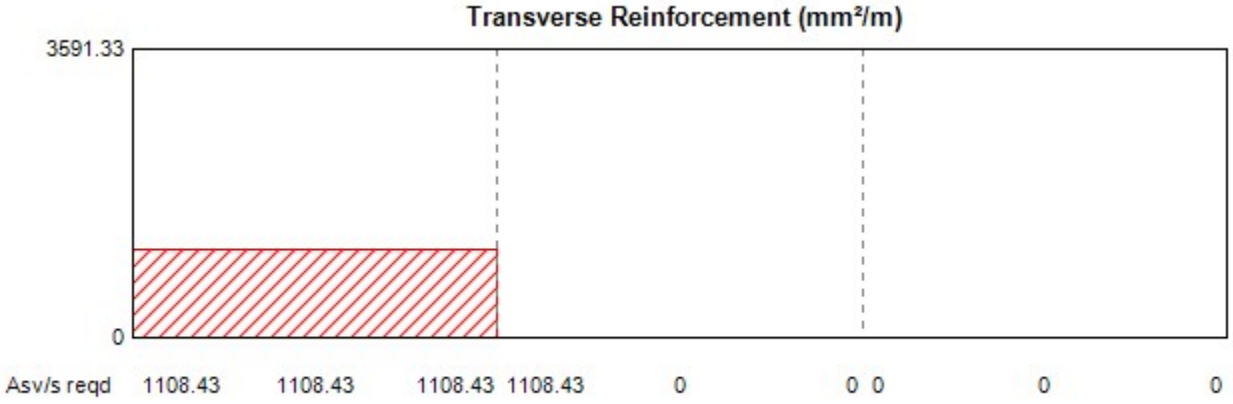
(-)Moment	-281.8532	-115.8988	-67.5565	-66.2069	0	-86.6554	-86.6554	-132.2592	-135.6188
(+)Moment	271.6468	327.2873	446.0173	446.0173	0	485.9758	485.9758	366.0181	301.3201

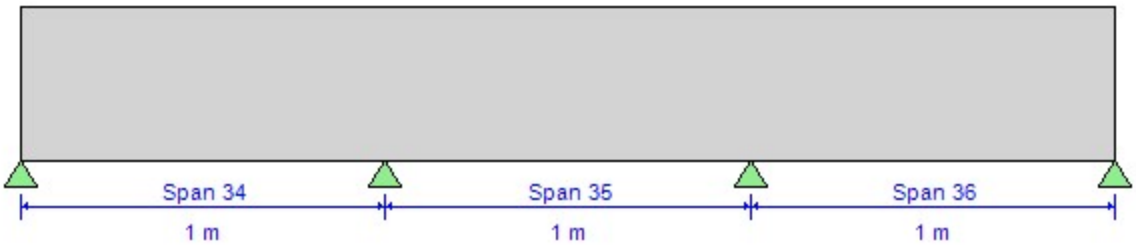
Longitudinal Reinforcement (mm²)



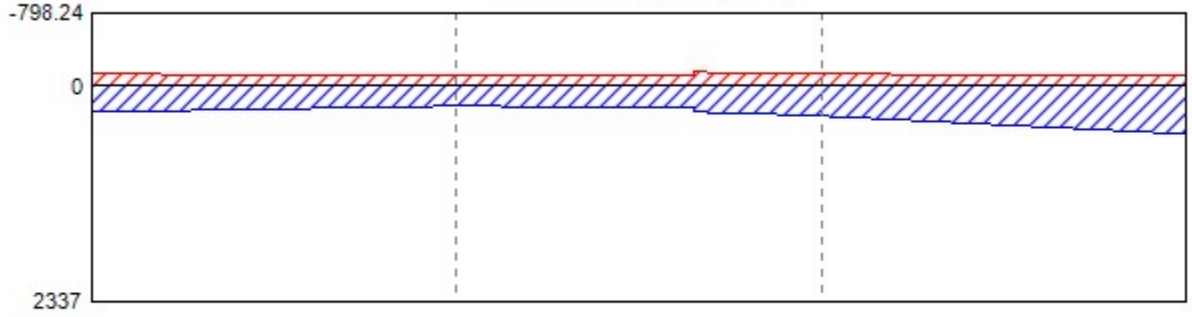
As (top)	1047	719	673	592	0	648	648	801	792
As (bot)	Comb16	Comb16	Comb16	Comb25		Comb25	Comb25	Comb16	Comb16
	1041	1350	1627	1627	0	1713	1713	1396	1211
	Comb16	Comb16	Comb16	Comb16		Comb16	Comb16	Comb16	Comb16


Shear Diagram (kN)
3313.84
0
Shear 295.4061 332.1905 341.5762 341.5762 0 116.2484 116.2484 116.2484 25.3141


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 1108.43 1108.43 1108.43 1108.43 0 0 0 0 0

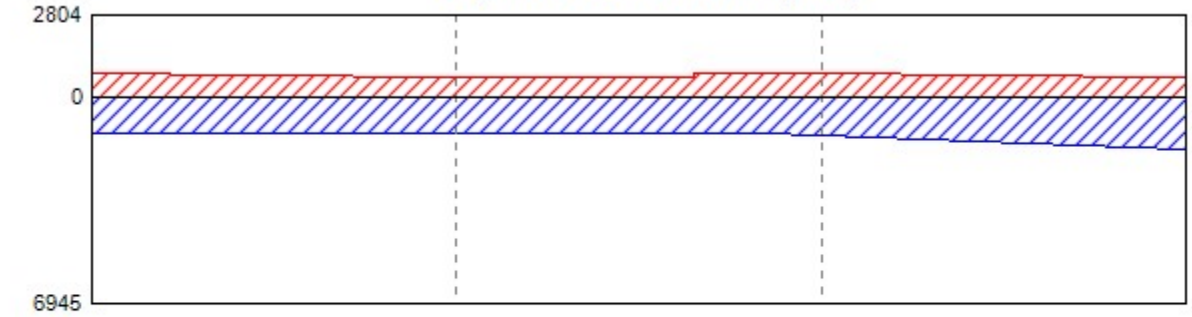

Span 34
1 m
Span 35
1 m
Span 36
1 m

Moment Diagram (kN-m)



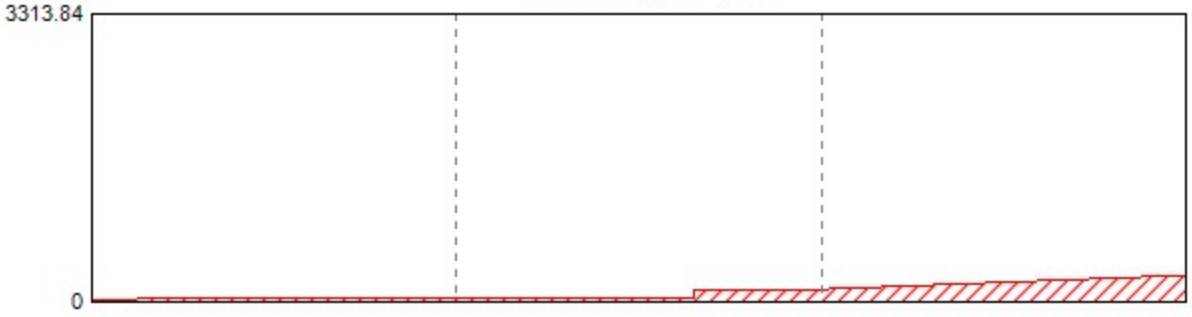
(-)Moment	-135.6188	0	-98.1361	-98.1361	-144.1072	-135.9315	-129.6745	0	-111.0927
(+)Moment	285.1937	0	210.9937	210.9937	275.2473	336.6693	336.6693	0	519.2736

Longitudinal Reinforcement (mm²)

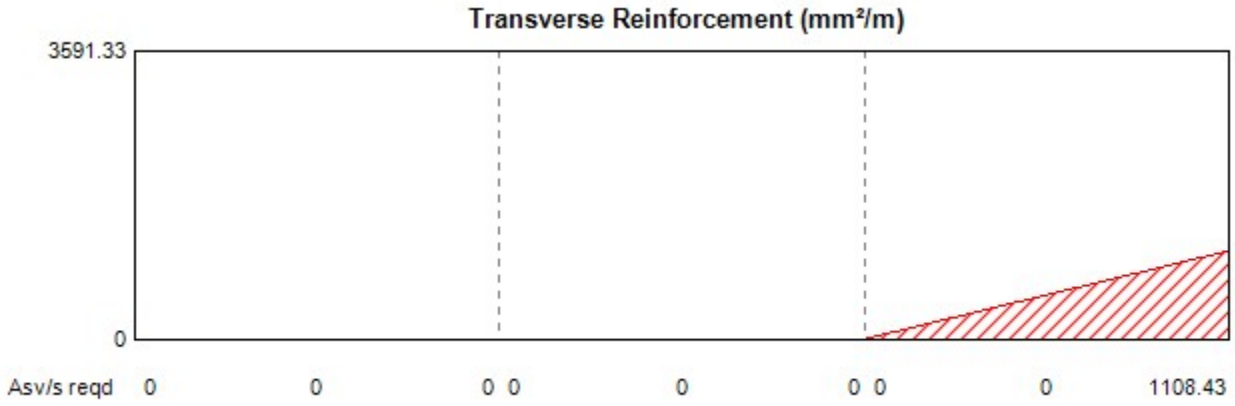


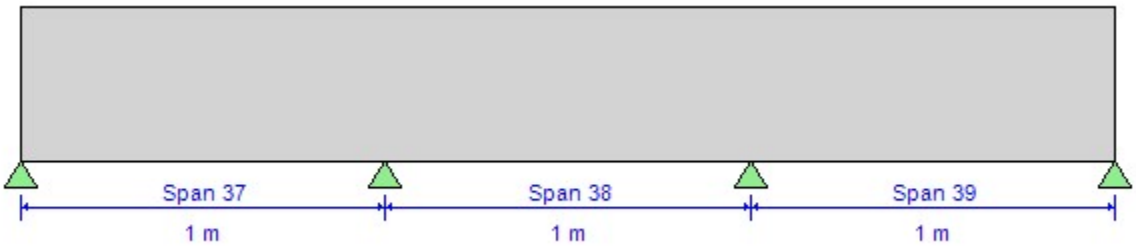
As (top)	792	0	691	691	823	800	783	0	680
As (bot)	Comb16		Comb16	Comb16	Comb16	Comb16	Comb16		Comb25
	1171	0	987	987	1155	1310	1310	0	1764
	Comb16		Comb16	Comb16	Comb16	Comb16	Comb16		Comb16

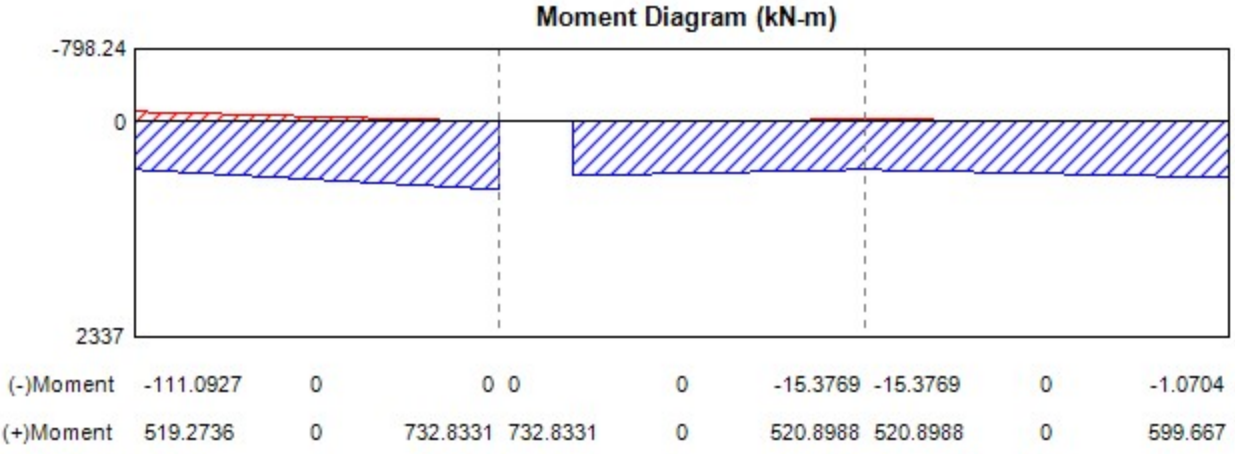
Shear Diagram (kN)



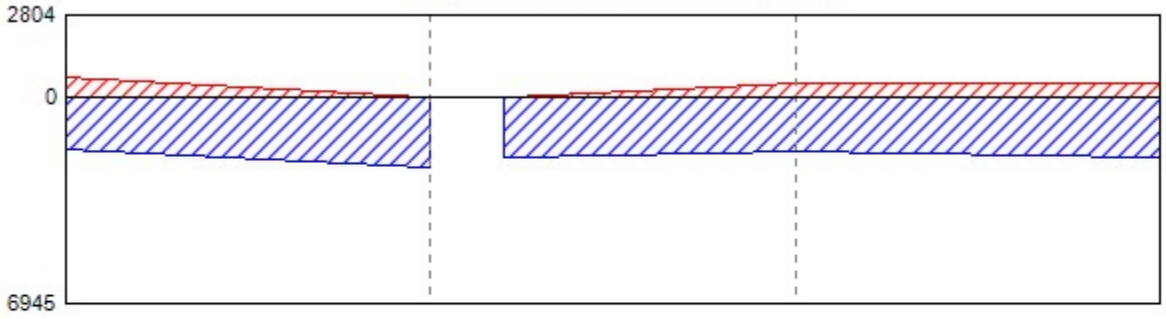
Shear	25.3141	0	46.1722	46.1722	46.1722	126.7092	126.7092	0	307.7858


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 0 0 0 0 0 0 0 1108.43


Span 37
1 m
Span 38
1 m
Span 39
1 m

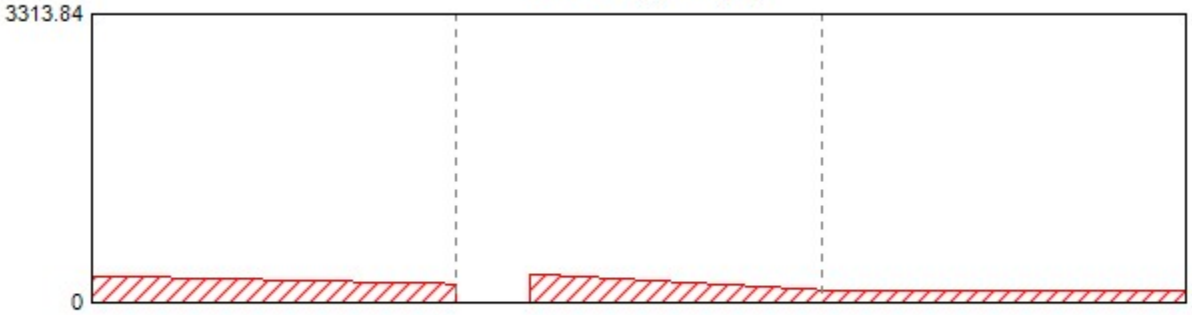

Moment Diagram (kN-m)
-798.24
0
2337
(-)Moment -111.0927 0 0 0 0 -15.3769 -15.3769 0 -1.0704
(+)Moment 519.2736 0 732.8331 732.8331 0 520.8988 520.8988 0 599.667

Longitudinal Reinforcement (mm²)



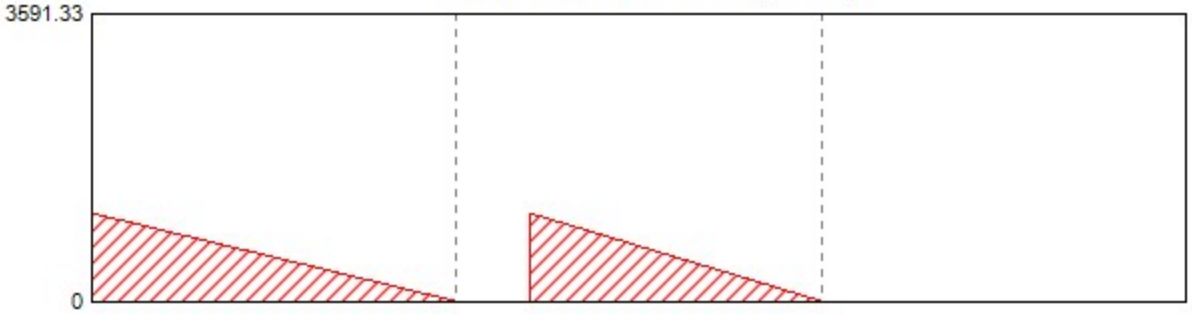
As (top)	680	0	0	0	0	444	444	0	443
As (bot)	Comb25					Comb25	Comb25		Comb25
	1764	0	2344	2344	0	1803	1803	0	2065
	Comb16		Comb16	Comb16		Comb16	Comb16		Comb16

Shear Diagram (kN)

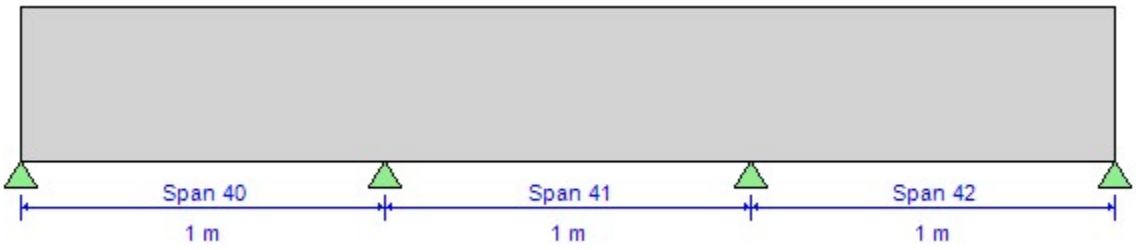


Shear	307.7858	0	204.7628	332.1436	0	137.8116	137.8116	0	146.5217

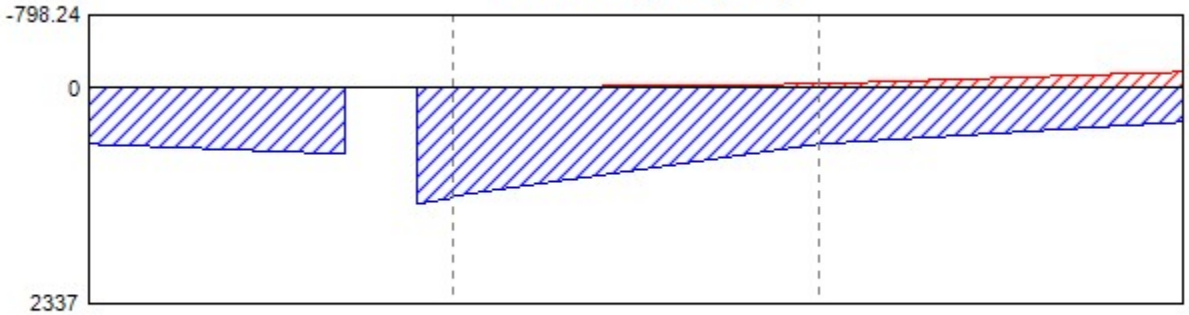
Transverse Reinforcement (mm²/m)



Asv/s reqd	1108.43	0	0	1108.43	0	0	0	0	0

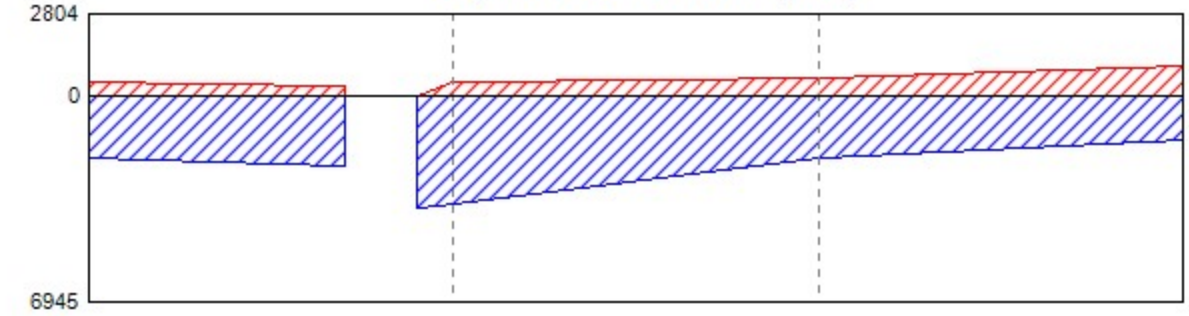


Moment Diagram (kN-m)

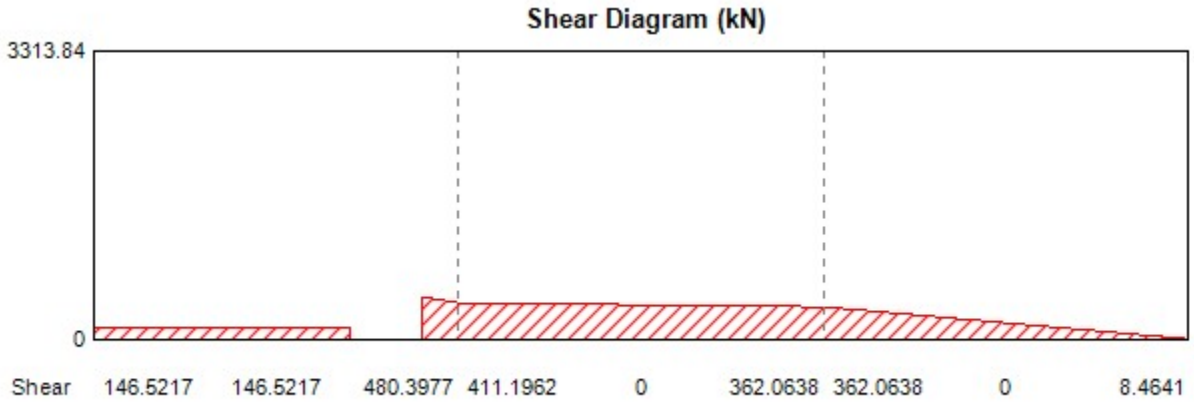


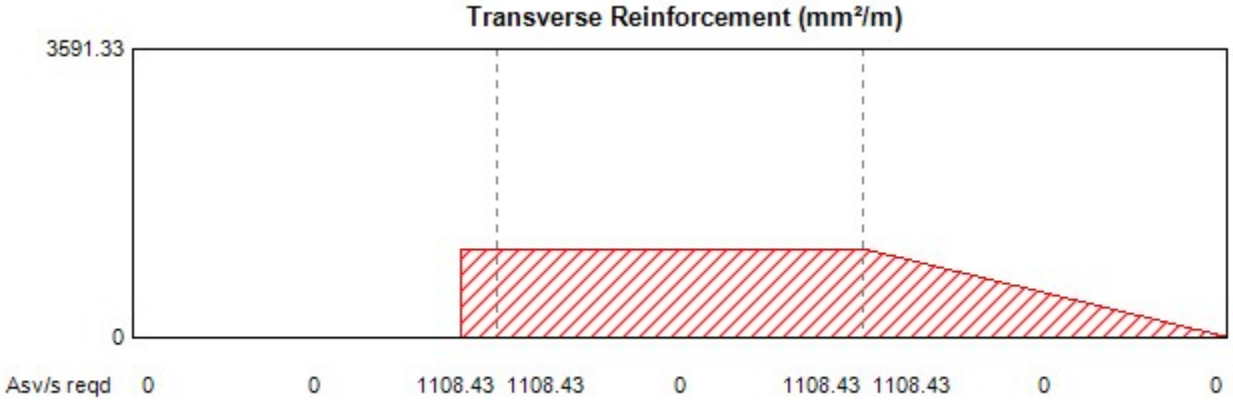
(-)Moment	-1.0704	-4.5466	-0.6363	-0.6363	0	-44.5786	-44.5786	0	-171.3218
(+)Moment	599.667	722.5624	1252.9047	1188.8539	0	610.5315	610.5315	0	372.2656

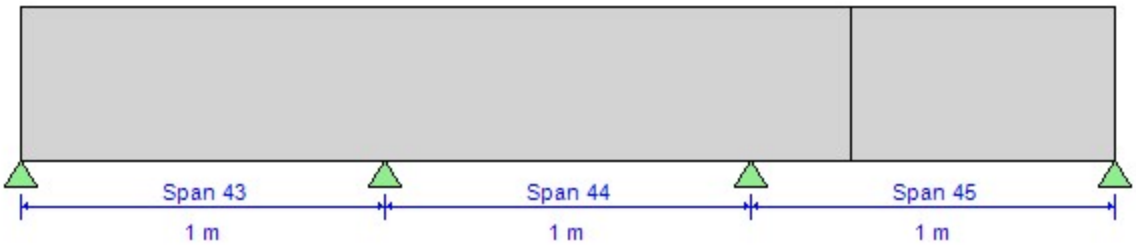
Longitudinal Reinforcement (mm²)

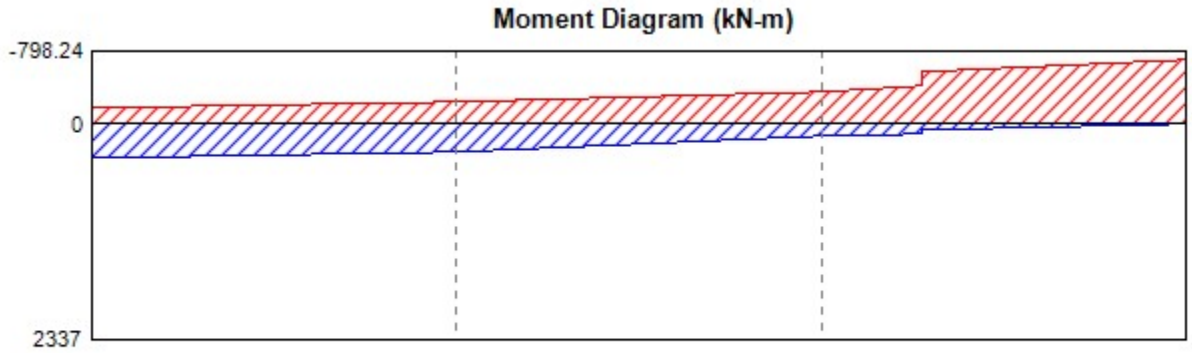


As (top)	443	355	474	474	0	619	619	0	999
As (bot)	Comb25	Comb27	Comb18	Comb18		Comb16	Comb16		Comb16
	2065	2393	3816	3636	0	2085	2085	0	1510
	Comb16	Comb16	Comb16	Comb16		Comb16	Comb16		Comb16

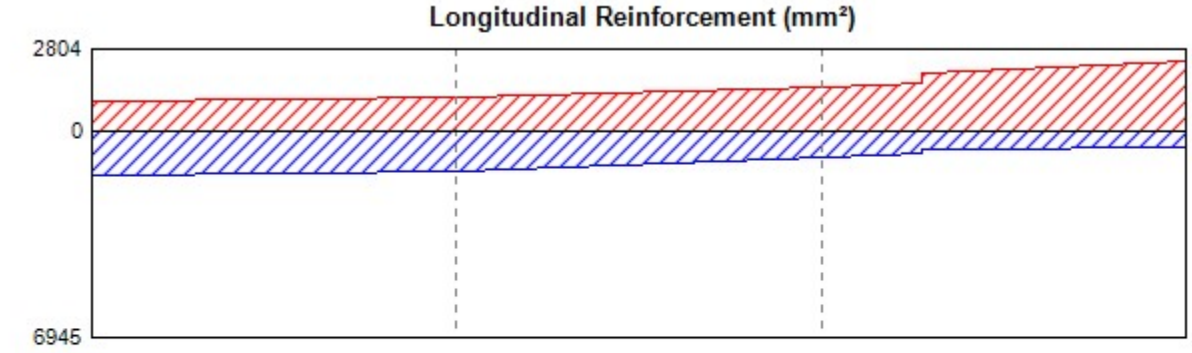

Shear Diagram (kN)
3313.84
0
Shear 146.5217 146.5217 480.3977 411.1962 0 362.0638 362.0638 0 8.4641


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 1108.43 1108.43 0 1108.43 1108.43 0 0

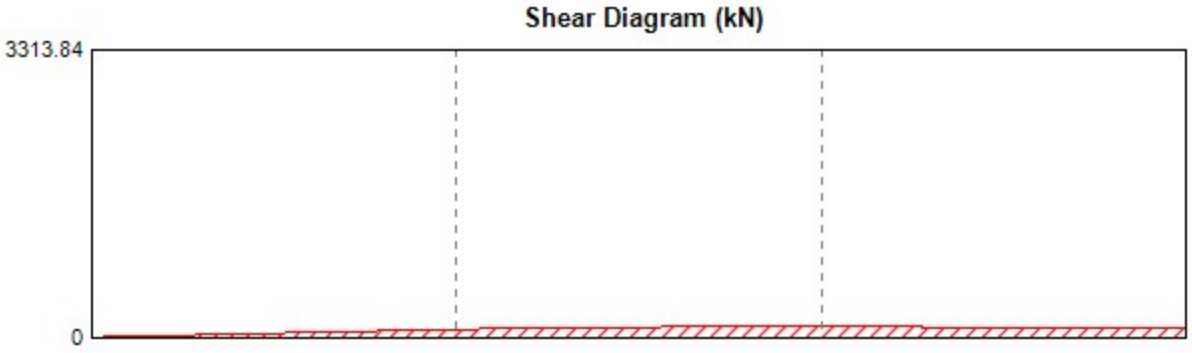

Span 43
1 m
Span 44
1 m
Span 45
1 m



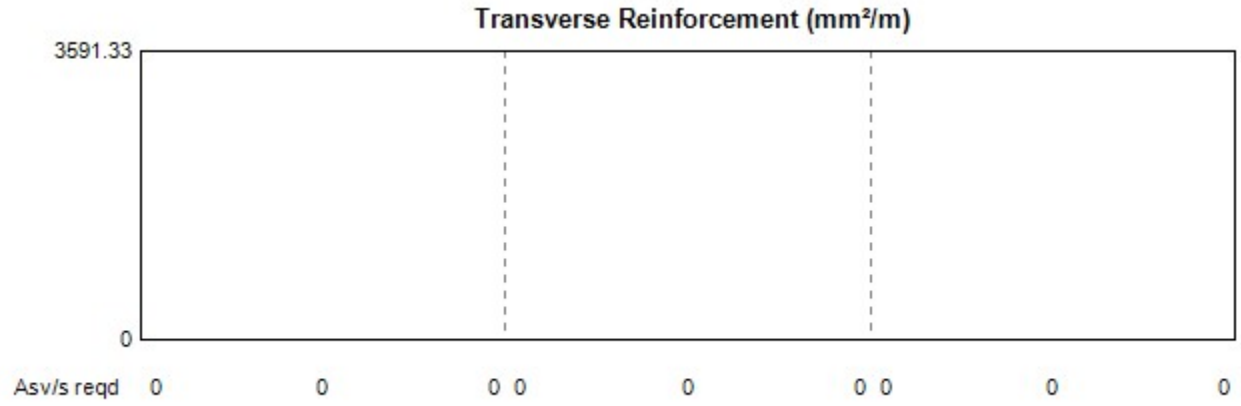
(-)Moment	-171.3218	0	-237.6344	-237.6344	0	-352.9855	-352.9855	-558.034	-693.6871
(+)Moment	372.2656	0	305.2348	305.2348	0	136.6662	136.6662	110.7124	6.2607

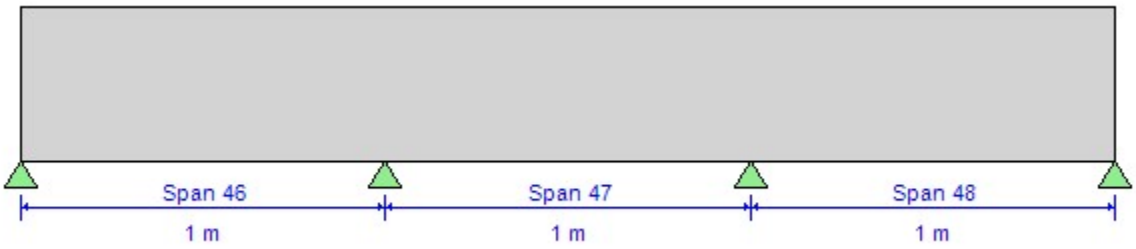


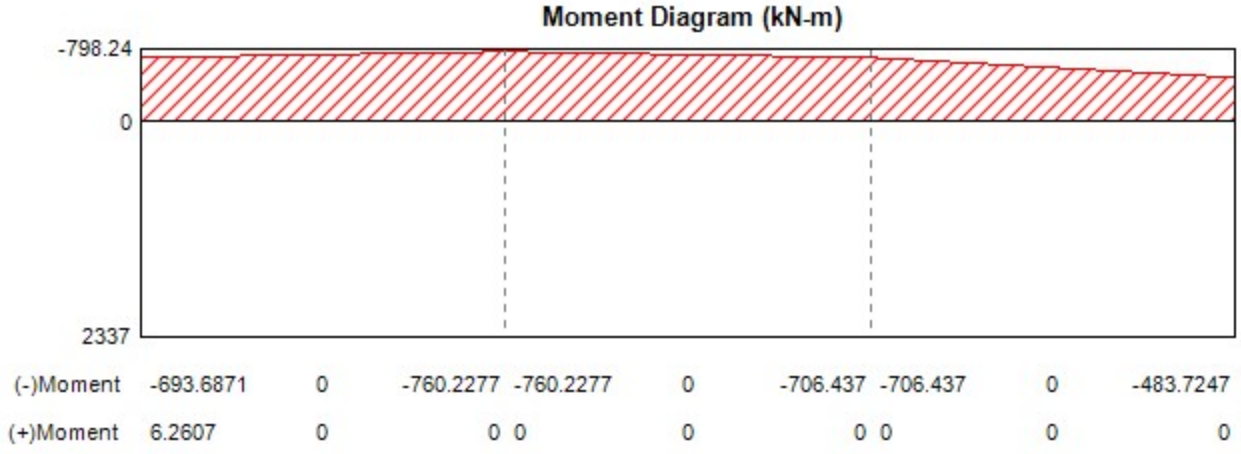
As (top)	999	0	1178	1178	0	1493	1493	1940	2358
As (bot)	Comb16		Comb16	Comb16		Comb16	Comb16	Comb16	Comb16
	1510	0	1348	1348	0	861	861	766	568
	Comb16		Comb16	Comb16		Comb25	Comb25	Comb25	Comb16

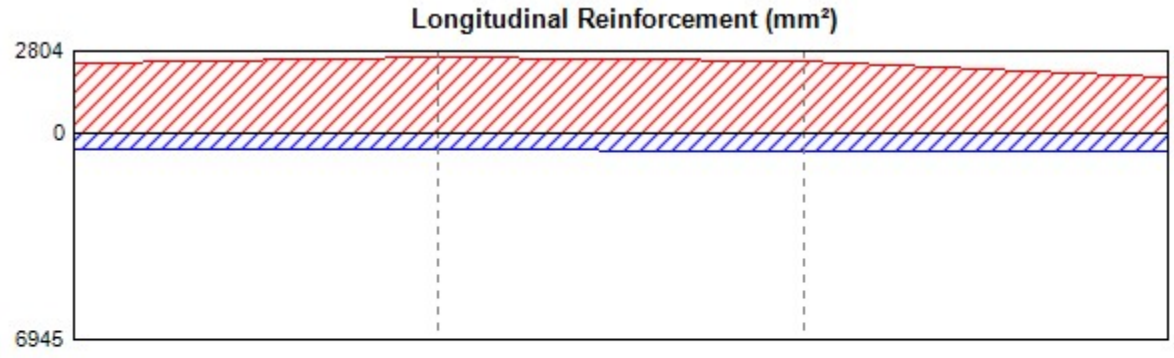


Shear	8.4641	0	92.2663	92.2663	0	134.7002	134.7002	134.7002	126.0661

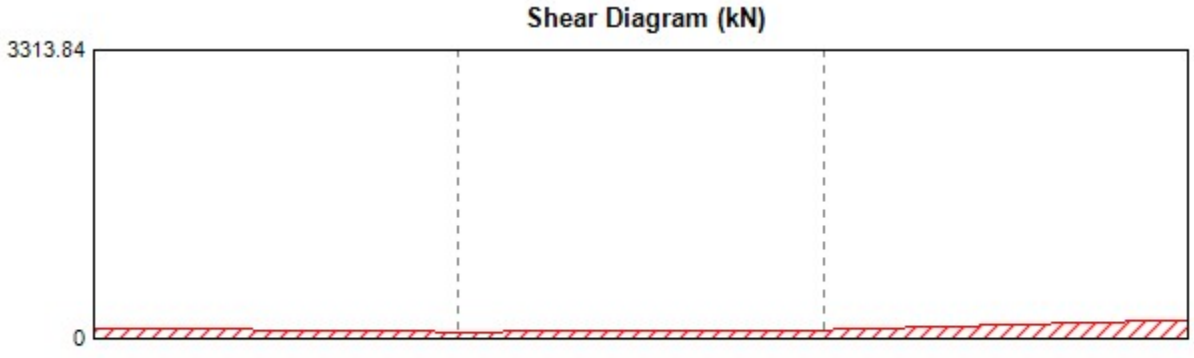

Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 0 0 0 0 0 0 0 0 0 0 0 0


Span 46
1 m
Span 47
1 m
Span 48
1 m

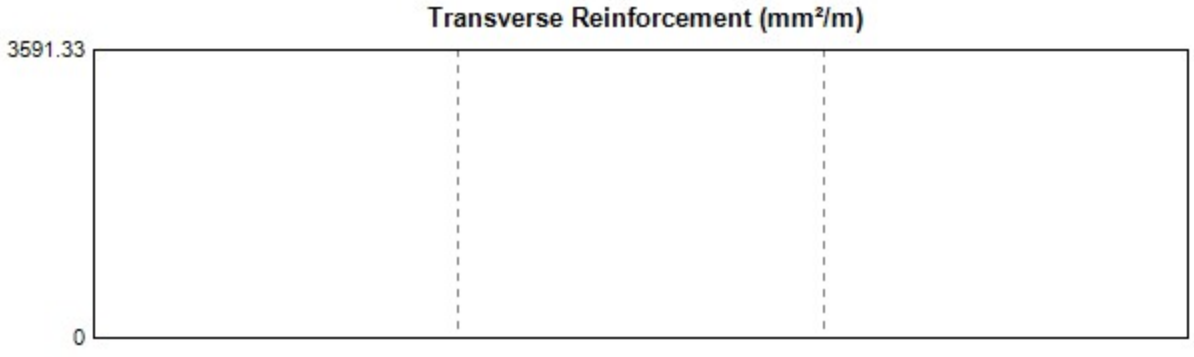

Moment Diagram (kN-m)
-798.24
0
2337
(-)Moment -693.6871 0 -760.2277 -760.2277 0 -706.437 -706.437 0 -483.7247
(+)Moment 6.2607 0 0 0 0 0 0 0 0 0 0 0 0 0



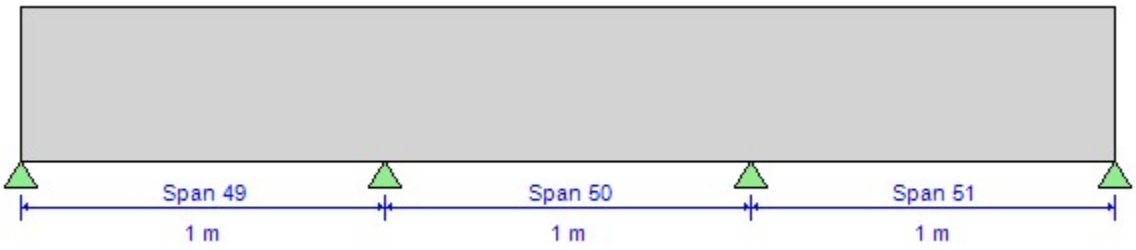
As (top)	2358	0	2545	2545	0	2452	2452	0	1915
As (bot)	Comb16		Comb18	Comb18		Comb18	Comb18		Comb18
	568	0	564	564	0	609	609	0	643
	Comb16		Comb18	Comb18		Comb18	Comb18		Comb18



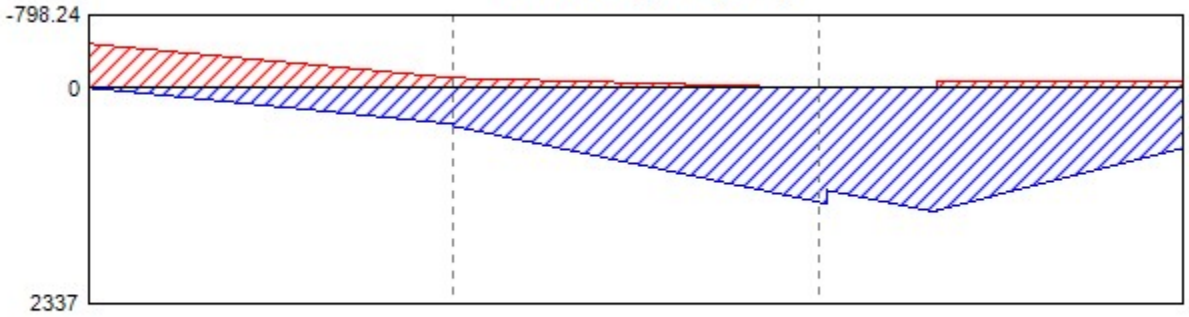
Shear	126.0661	0	68.1322	68.1322	0	87.7423	87.7423	0	200.2796



Asv/s reqd	0	0	0	0	0	0	0	0	0

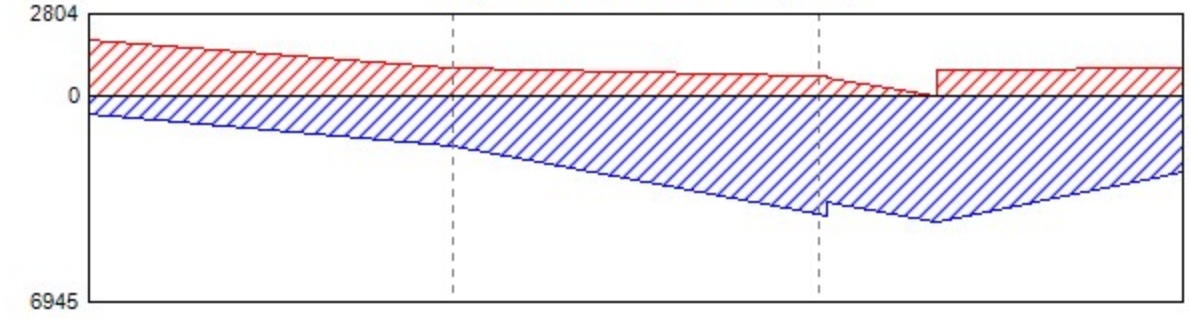


Moment Diagram (kN-m)

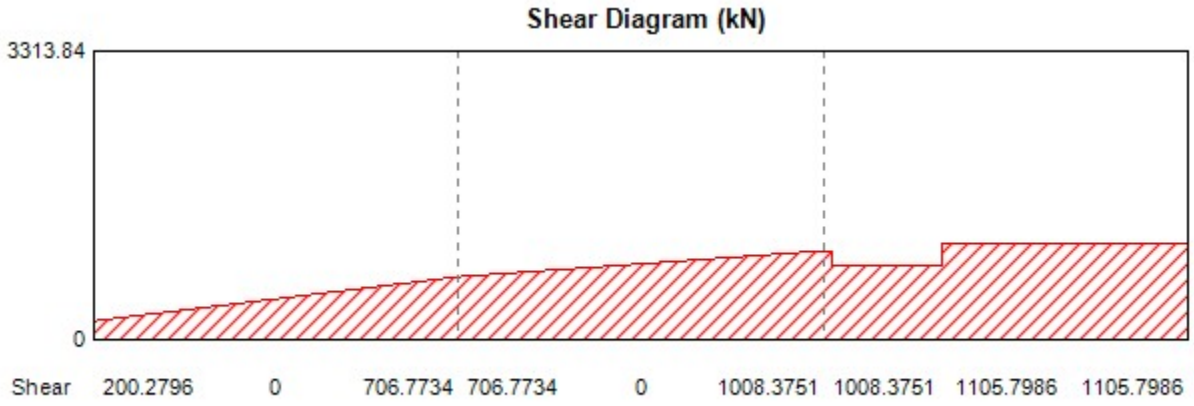


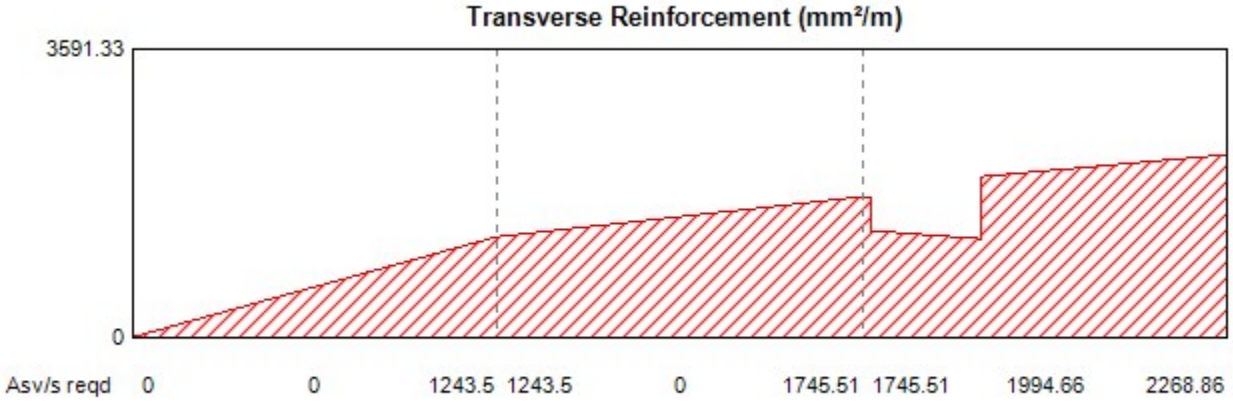
(-)Moment	-483.7247	0	-100.229	-100.229	0	-8.9316	-8.9316	-62.4035	-67.9841
(+)Moment	0	0	403.3448	403.3448	0	1251.498	1270.6295	1331.8975	660.9327

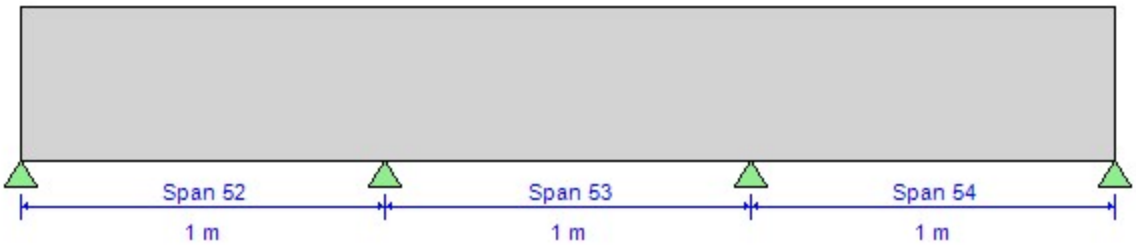
Longitudinal Reinforcement (mm²)

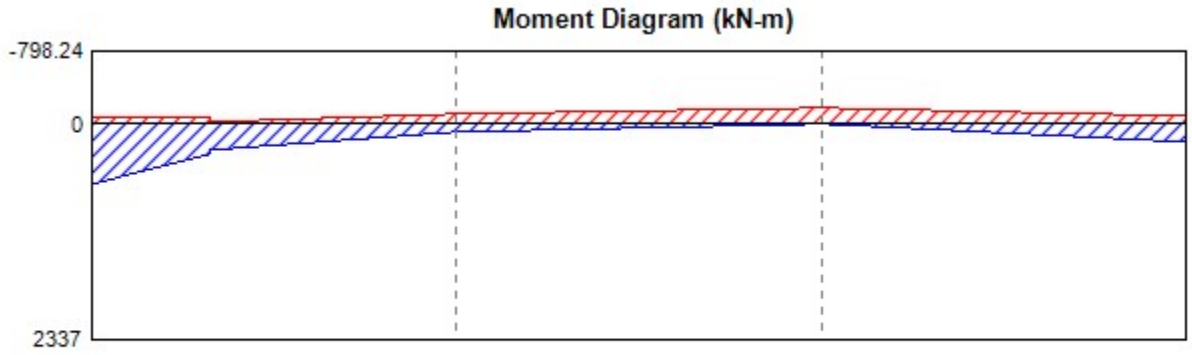


As (top)	1915	0	930	930	0	665	665	873	915
As (bot)	Comb18		Comb18	Comb18		Comb27	Comb27	Comb27	Comb27
	643	0	1724	1724	0	4011	4063	4284	2543
	Comb18		Comb18	Comb18		Comb18	Comb18	Comb18	Comb18

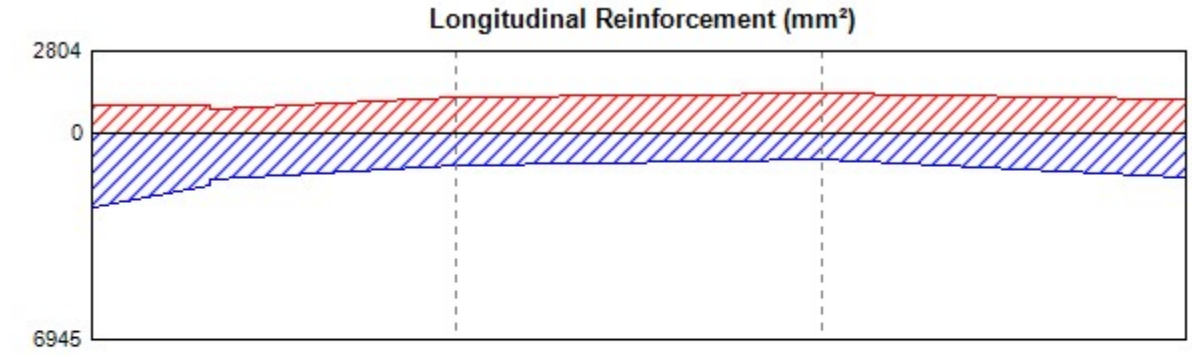

Shear Diagram (kN)
3313.84
0
Shear 200.2796 0 706.7734 706.7734 0 1008.3751 1008.3751 1105.7986 1105.7986


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 1243.5 1243.5 0 1745.51 1745.51 1994.66 2268.86

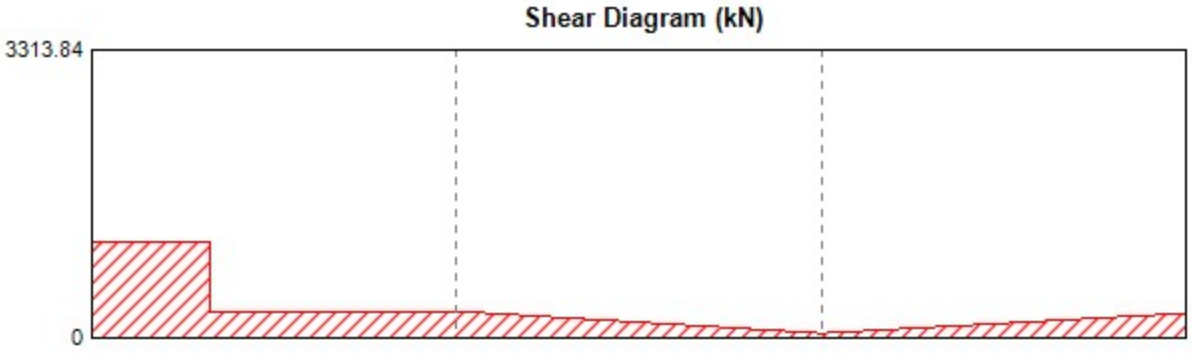

Span 52
1 m
Span 53
1 m
Span 54
1 m



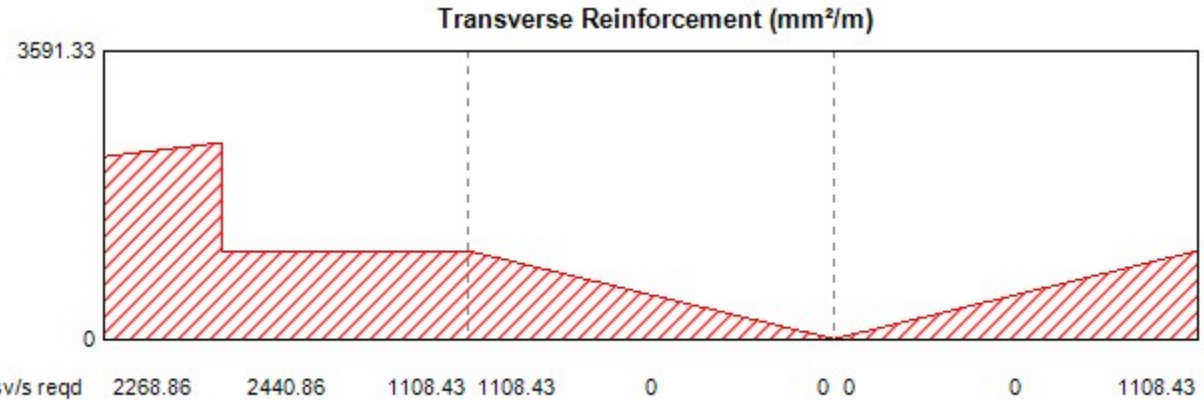
(-)Moment	-67.9841	-70.638	-104.1437	-104.1437	0	-181.9911	-181.9911	0	-82.1487
(+)Moment	660.9327	335.9499	94.8763	94.8763	0	2.7685	2.7685	0	195.6273



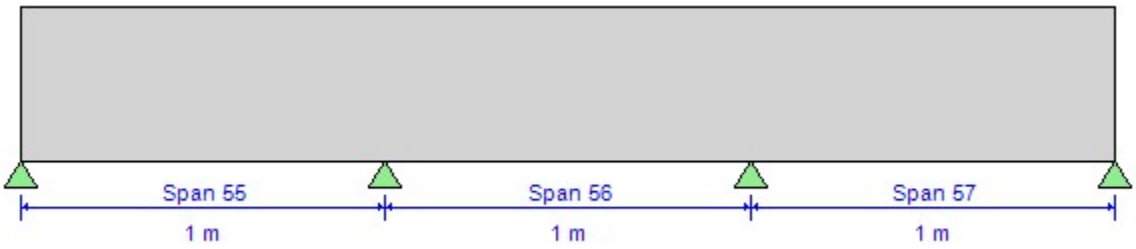
As (top)	915	935	1084	1084	0	1379	1379	0	1154
As (bot)	Comb27	Comb27	Comb18	Comb18		Comb18	Comb18		Comb18
	2543	1738	1059	1059	0	888	888	0	1465
	Comb18	Comb18	Comb18	Comb18		Comb18	Comb18		Comb18

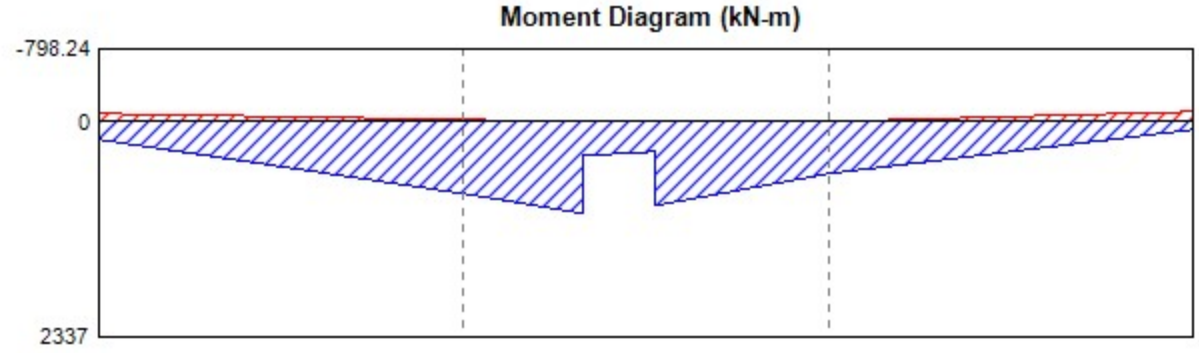


Shear	1105.7986	1105.7986	292.9621	292.9621	0	51.7891	51.7891	0	280.3939

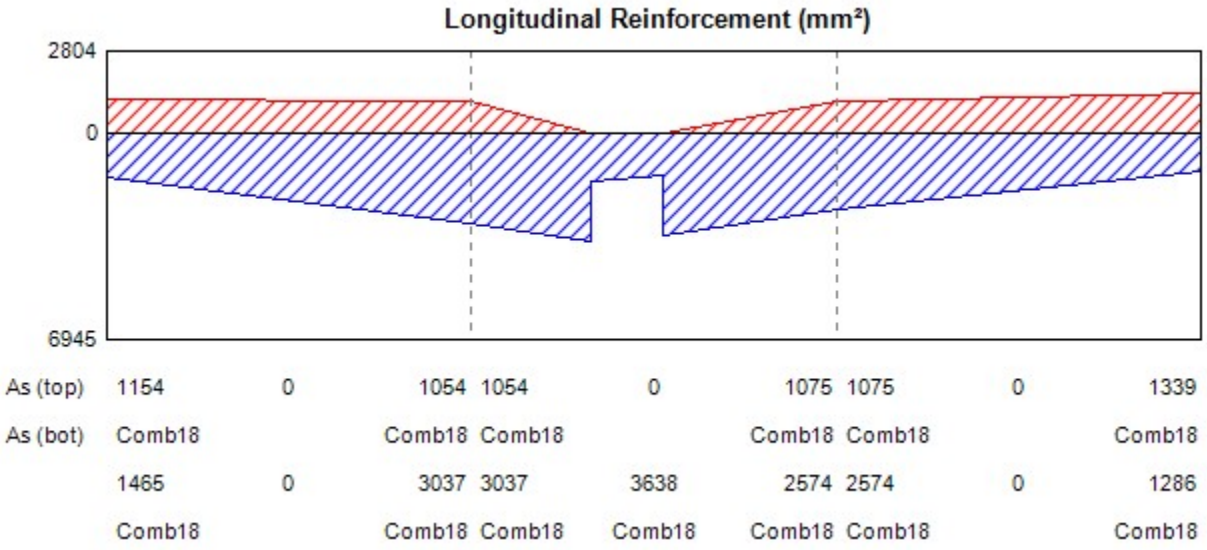


Asv/s reqd	2268.86	2440.86	1108.43	1108.43	0	0	0	0	1108.43

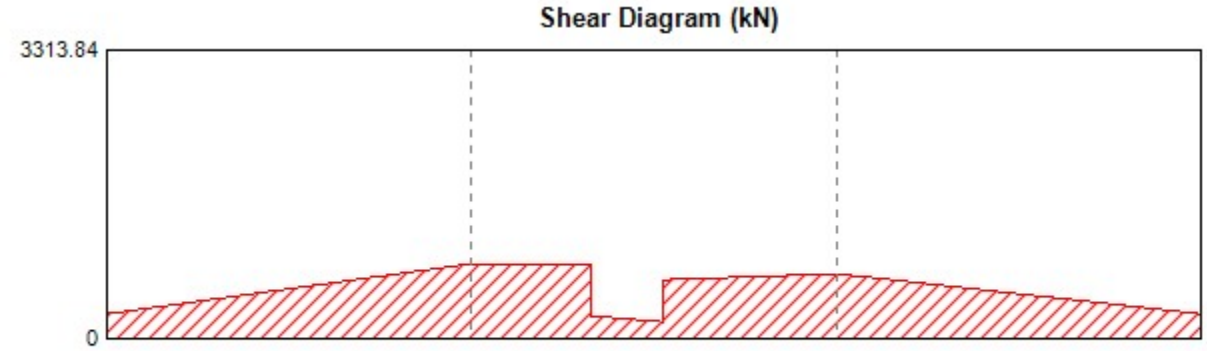




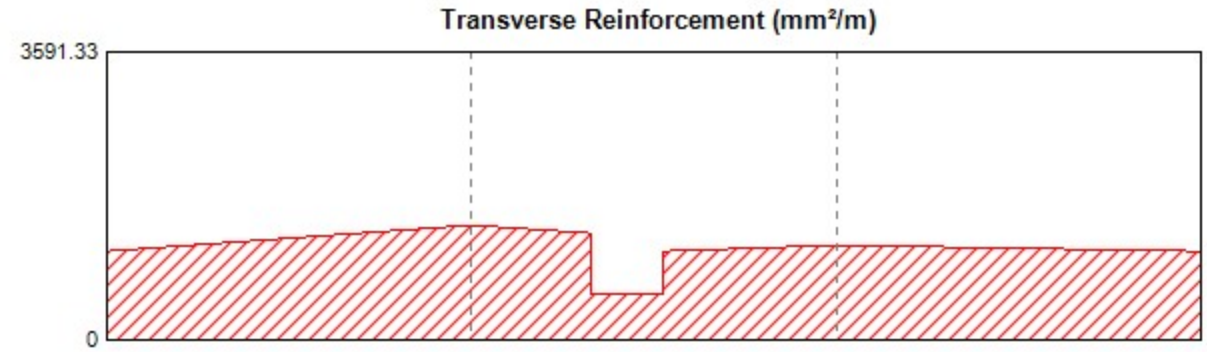
(-)Moment	-82.1487	0	-29.5182	-29.5182	0	-7.9865	-7.9865	0	-115.7382
(+)Moment	195.6273	0	784.2223	784.2223	1009.6858	570.3116	570.3116	0	96.3419



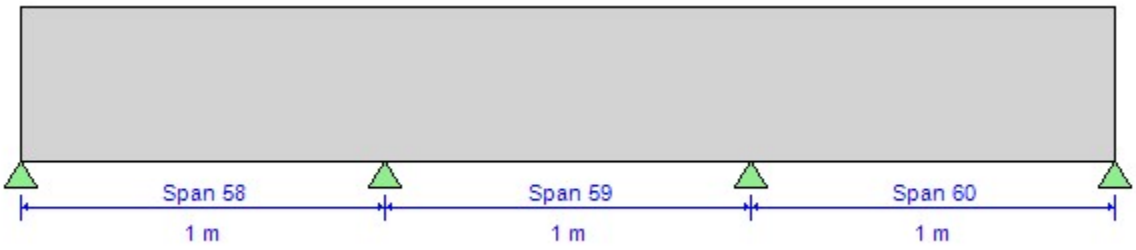
As (top)	1154	0	1054	1054	0	1075	1075	0	1339
As (bot)	Comb18		Comb18	Comb18		Comb18	Comb18		Comb18
	1465	0	3037	3037	3638	2574	2574	0	1286
	Comb18		Comb18	Comb18	Comb18	Comb18	Comb18		Comb18



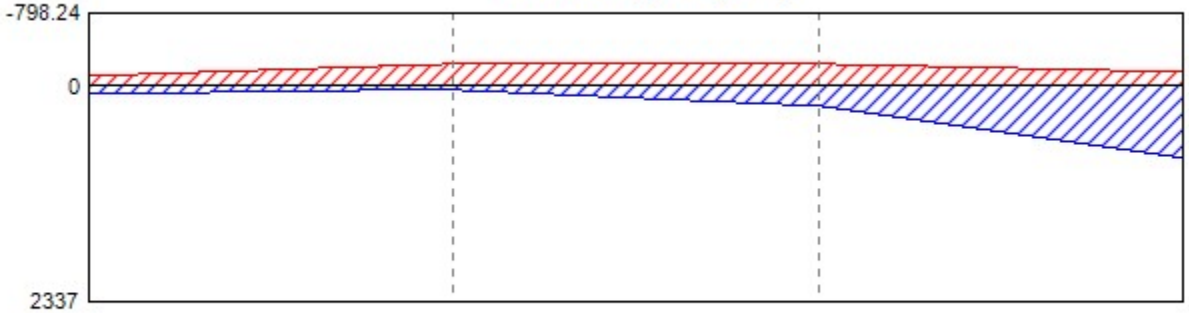
Shear	280.3939	0	851.3797	851.3797	851.3797	743.9173	743.9173	0	287.5756



Asv/s reqd	1108.43	0	1424.86	1424.86	1329.61	1173.7	1173.7	0	1108.43

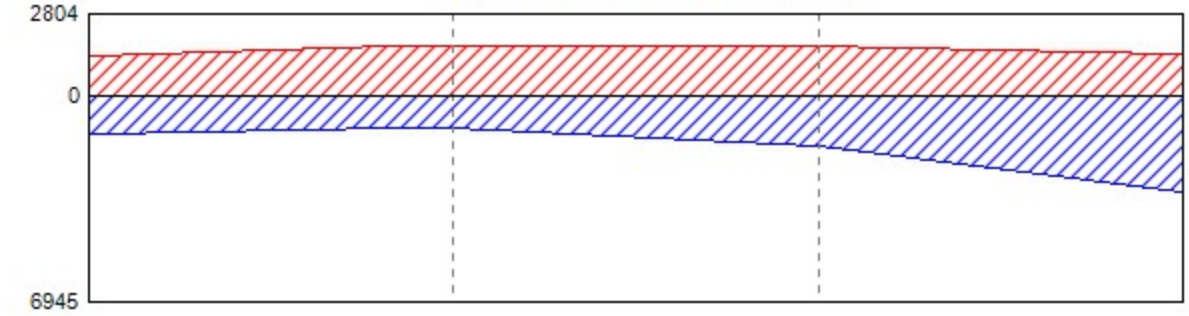


Moment Diagram (kN-m)

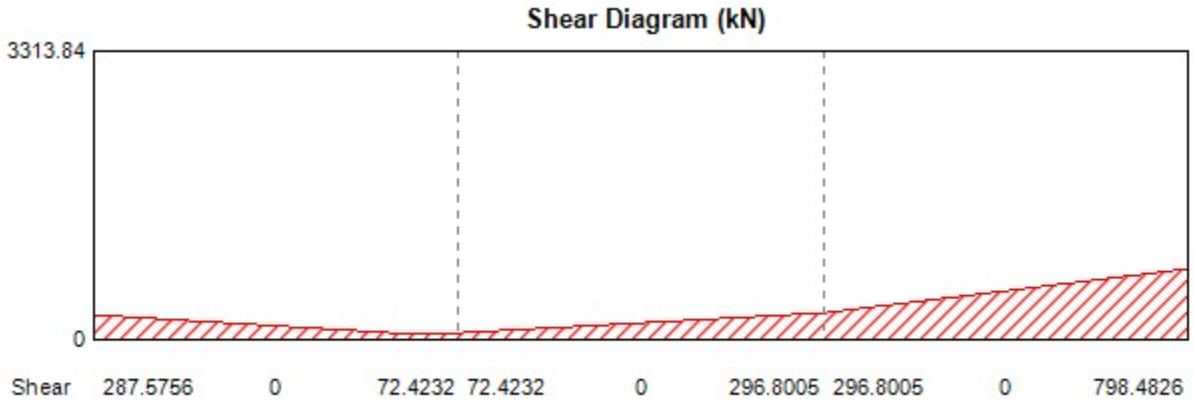


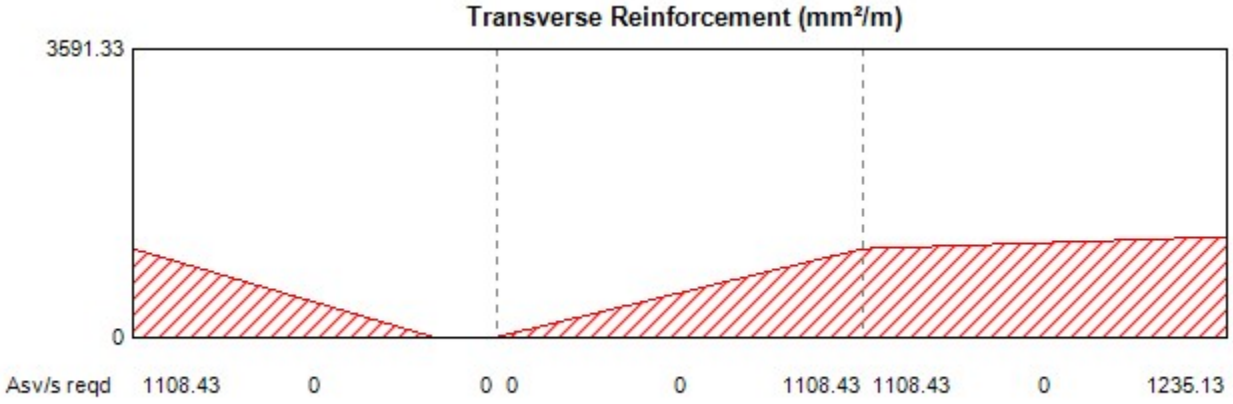
(-)Moment	-115.7382	0	-238.5244	-238.5244	0	-243.6204	-243.6204	0	-148.6085
(+)Moment	96.3419	0	42.6876	42.6876	0	219.0759	219.0759	0	796.2596

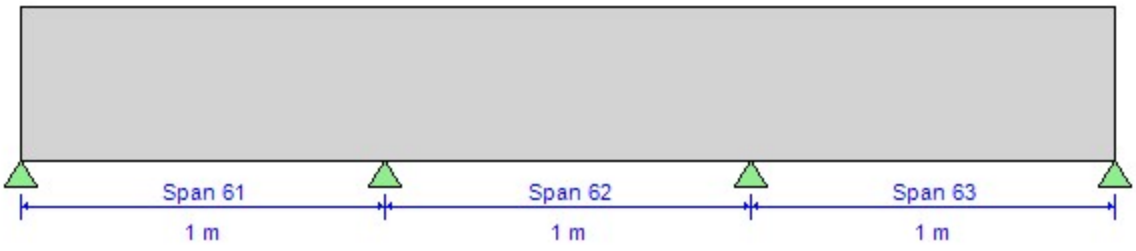
Longitudinal Reinforcement (mm²)



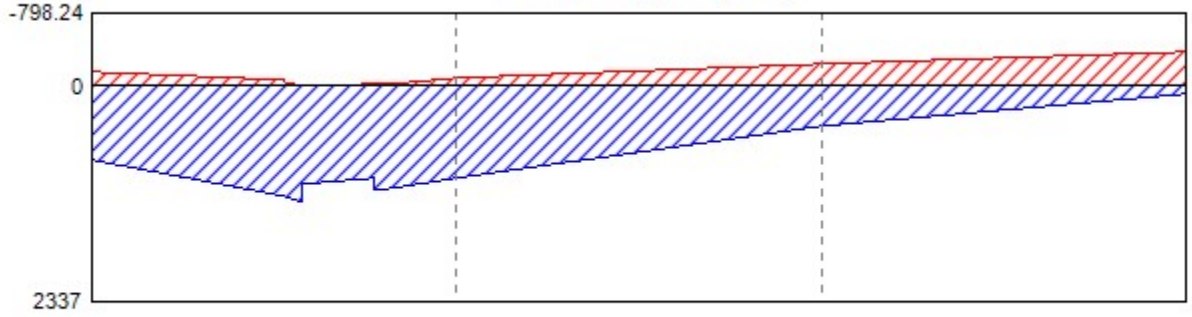
As (top)	1339	0	1720	1720	0	1665	1665	0	1425
As (bot)	Comb18		Comb18	Comb18		Comb27	Comb27		Comb27
	1286	0	1098	1098	0	1690	1690	0	3231
	Comb18		Comb27	Comb27		Comb18	Comb18		Comb18


Shear Diagram (kN)
3313.84
0
Shear 287.5756 0 72.4232 72.4232 0 296.8005 296.8005 0 798.4826


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 1108.43 0 0 0 0 1108.43 1108.43 0 1235.13

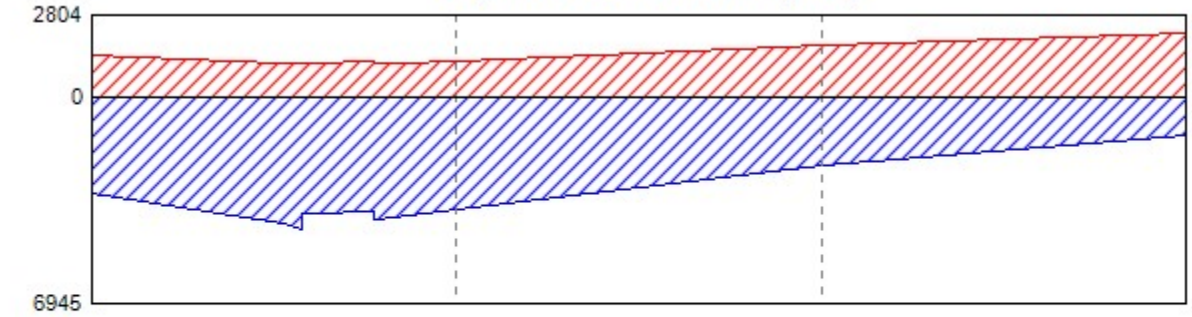

Span 61
1 m
Span 62
1 m
Span 63
1 m

Moment Diagram (kN-m)



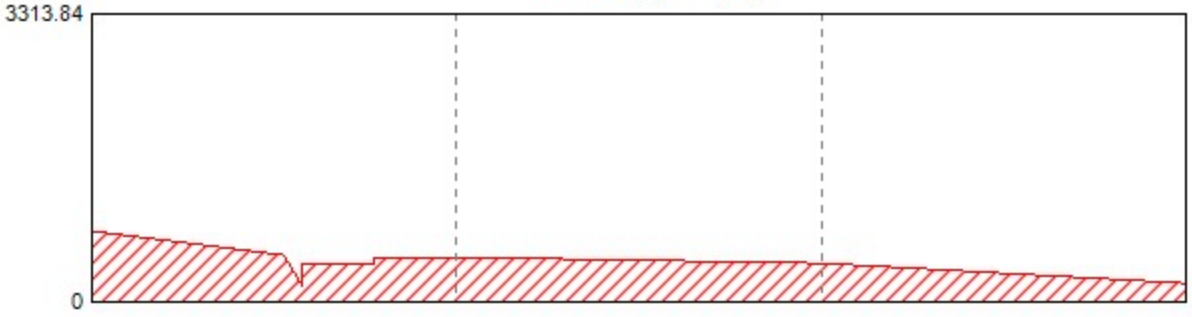
(-)Moment	-148.6085	-54.6877	-83.6856	-83.6856	0	-247.0952	-247.0952	0	-377.5842
(+)Moment	796.2596	1253.0092	1142.0404	1011.0929	0	431.1395	431.1395	0	79.8794

Longitudinal Reinforcement (mm²)

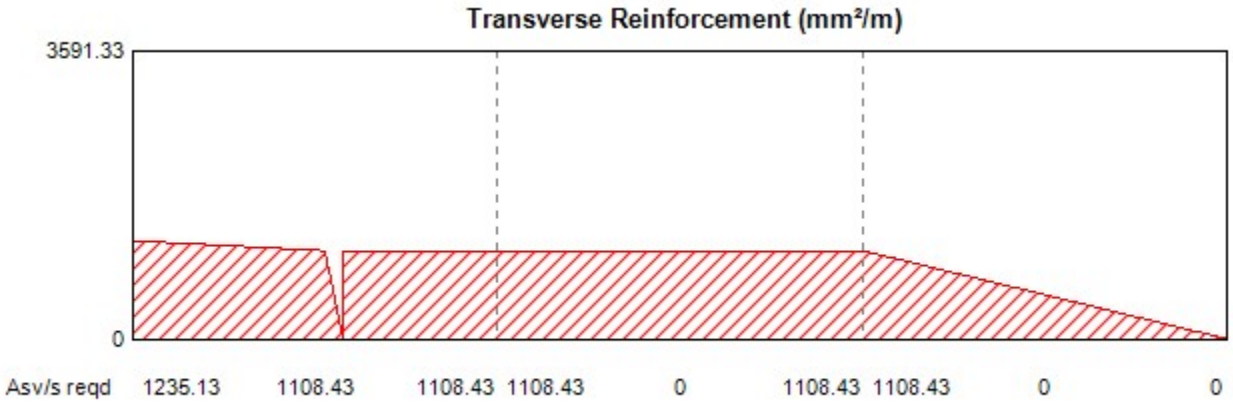


As (top)	1425	1184	1223	1223	0	1732	1732	0	2196
As (bot)	Comb27	Comb27	Comb27	Comb27		Comb27	Comb27		Comb18
	3231	4441	4116	3765	0	2325	2325	0	1278
	Comb18	Comb18	Comb18	Comb18		Comb18	Comb18		Comb27

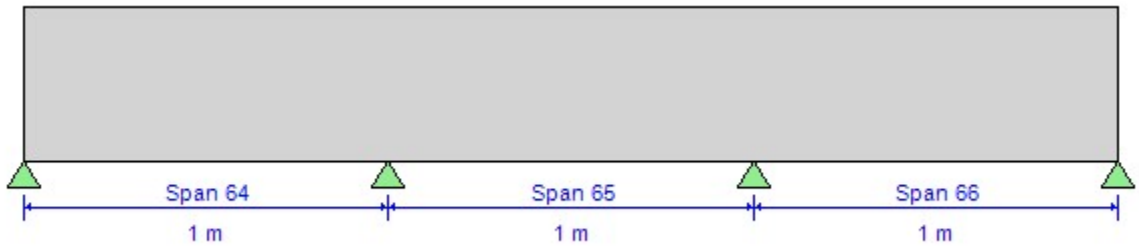
Shear Diagram (kN)

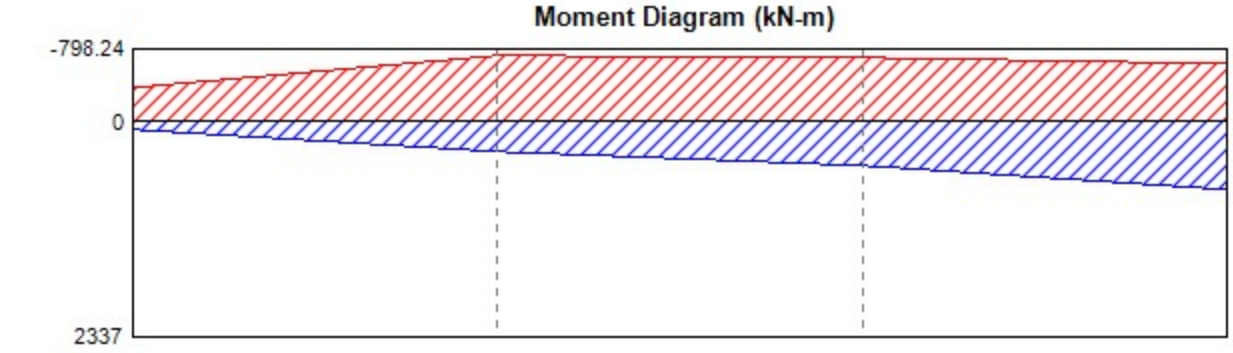


Shear	798.4826	537.1748	447.2228	509.3408	0	440.684	440.684	0	208.5065



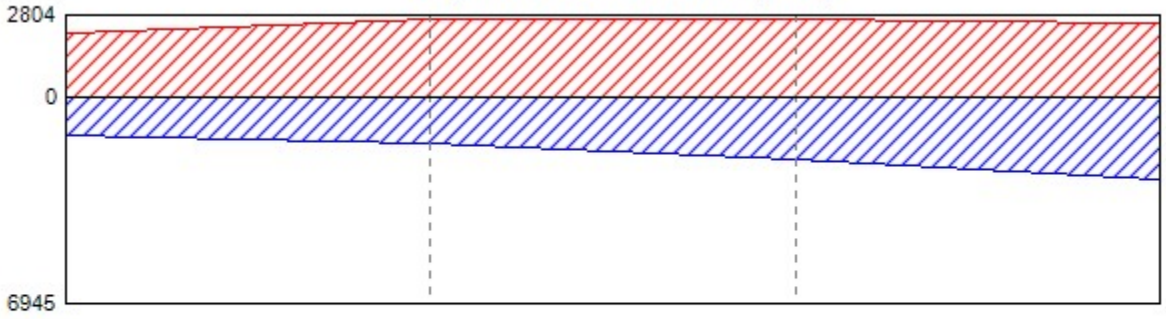
Asv/s reqd	1235.13	1108.43	1108.43	1108.43	0	1108.43	1108.43	0	0





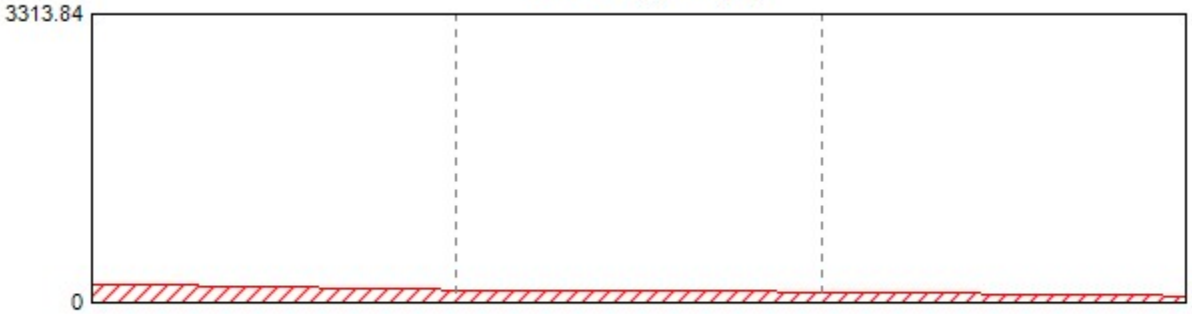
(-)Moment	-377.5842	0	-720.4618	-720.4618	0	-686.9277	-686.9277	0	-638.2276
(+)Moment	79.8794	0	324.2045	324.2045	0	489.2707	489.2707	0	736.1428

Longitudinal Reinforcement (mm²)



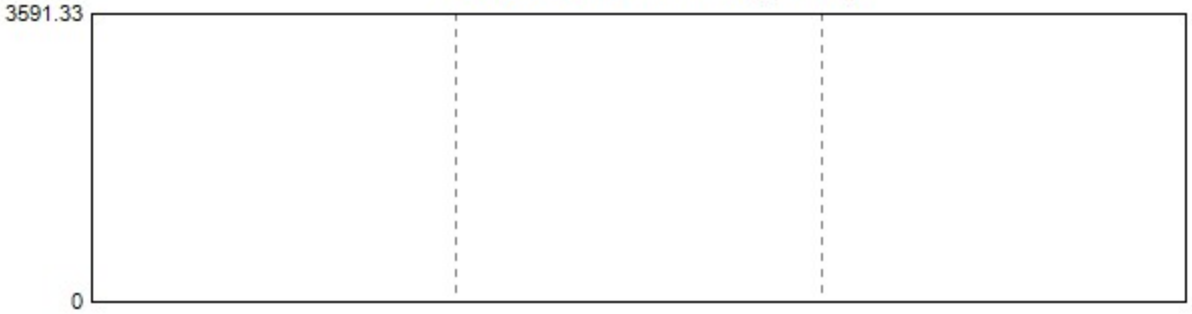
As (top)	2196	0	2670	2670	0	2620	2620	0	2529
As (bot)	Comb18		Comb16	Comb16		Comb16	Comb16		Comb16
	1278	0	1536	1536	0	2115	2115	0	2782
	Comb27		Comb25	Comb25		Comb16	Comb16		Comb16

Shear Diagram (kN)

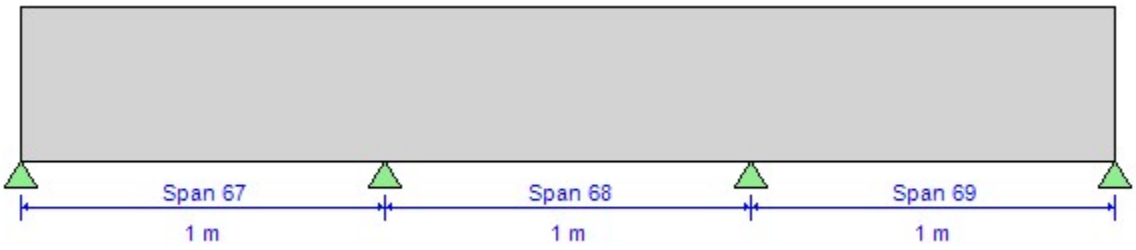


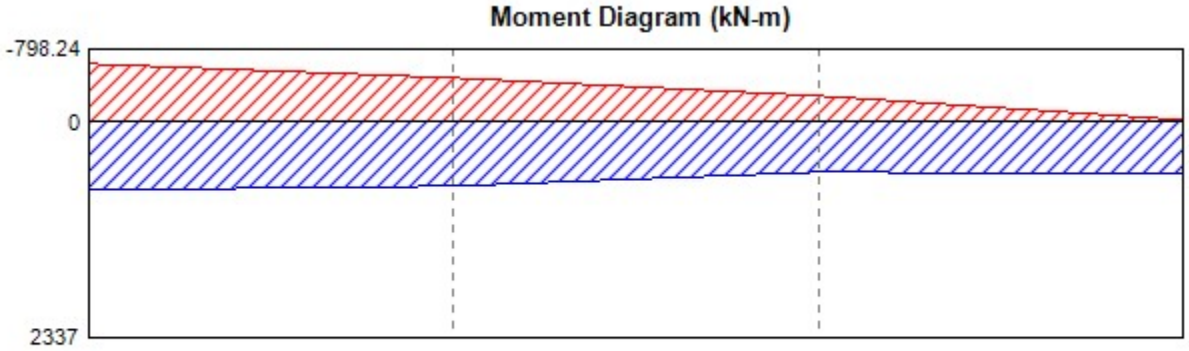
Shear	208.5065	0	139.9094	139.9094	0	112.2179	112.2179	0	67.4959

Transverse Reinforcement (mm²/m)

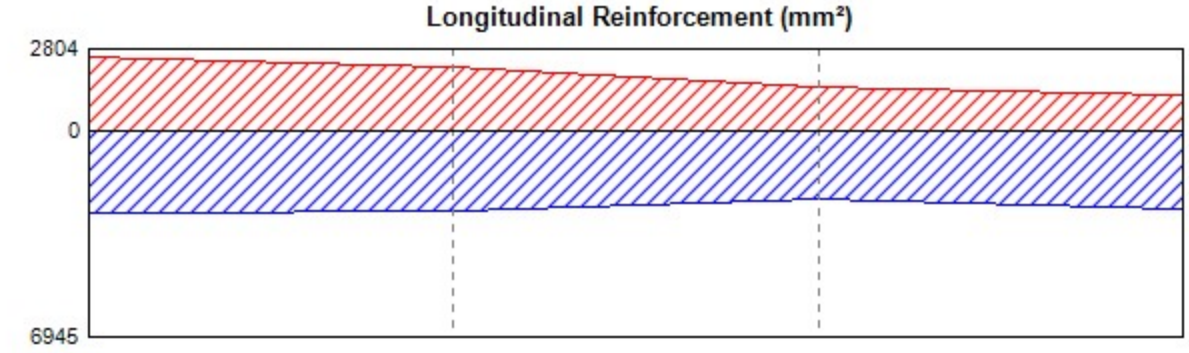


Asv/s reqd	0	0	0	0	0	0	0	0	0

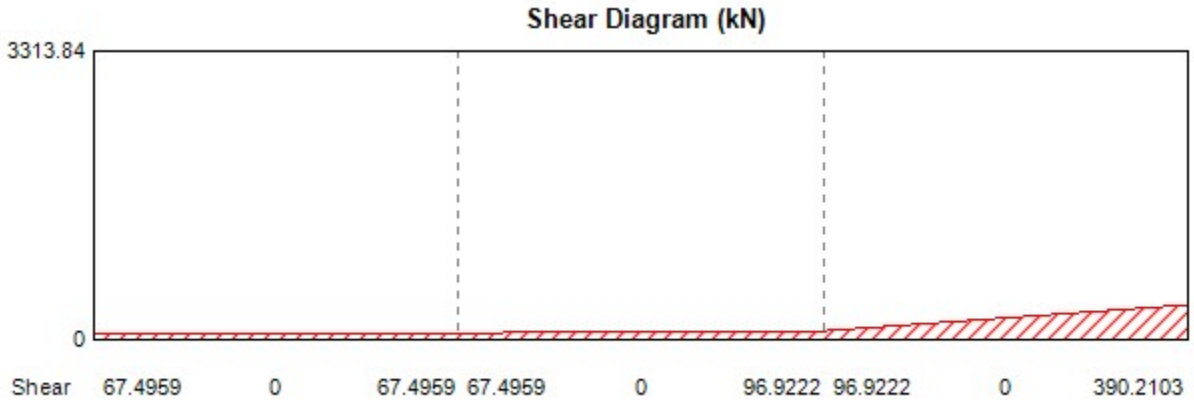


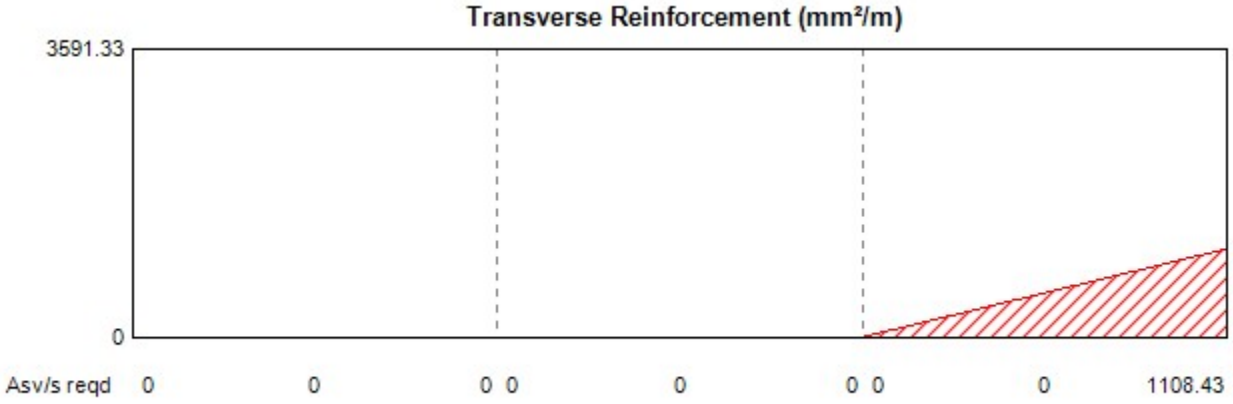


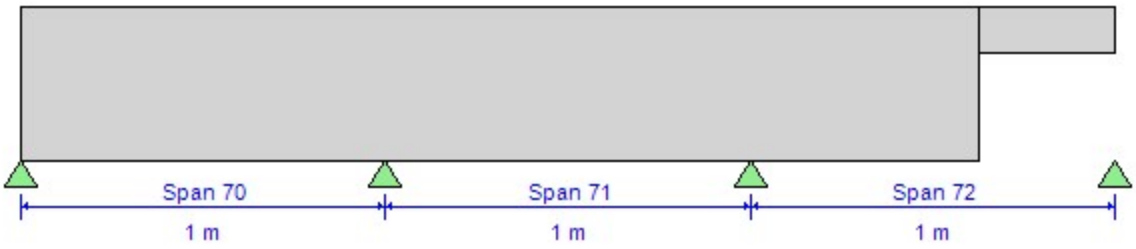
(-)Moment	-638.2276	0	-485.6213	-485.6213	0	-281.0542	-281.0542	0	-20.8203
(+)Moment	736.1428	0	700.9924	700.9924	0	544.5857	544.5857	0	559.8253

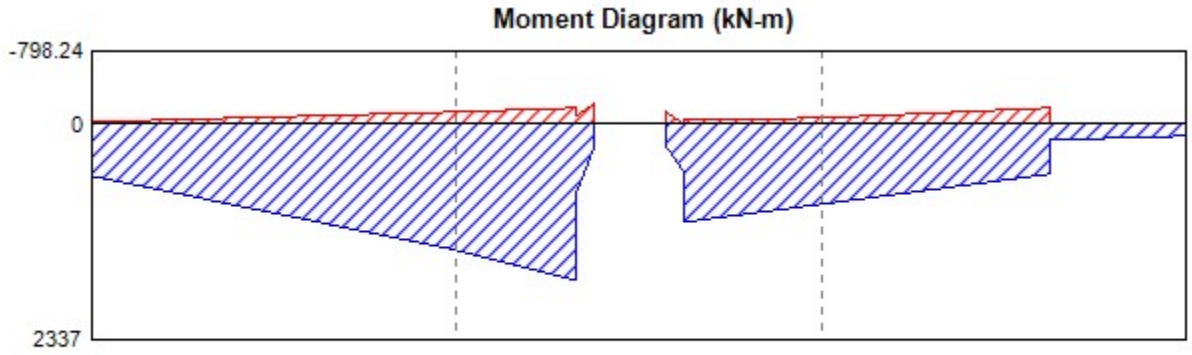


As (top)	2529	0	2148	2148	0	1504	1504	0	1212
As (bot)	Comb16		Comb16	Comb16		Comb25	Comb25		Comb18
	2782	0	2698	2698	0	2307	2307	0	2657
	Comb16		Comb16	Comb16		Comb16	Comb16		Comb18

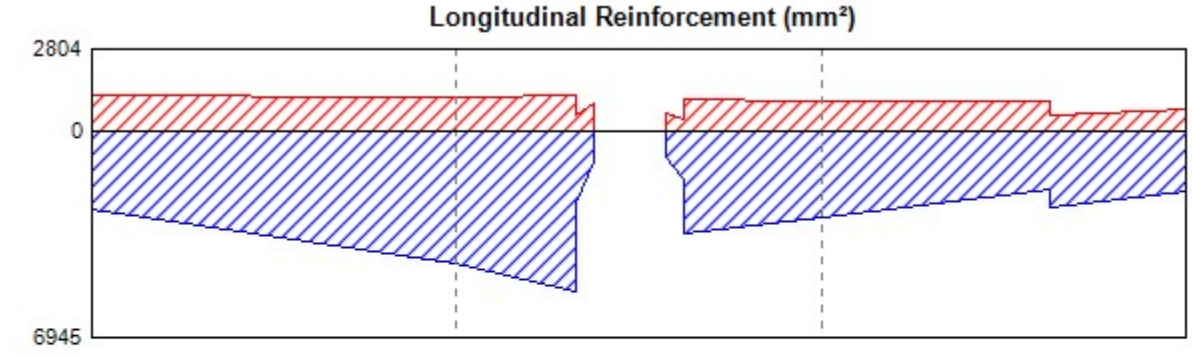

Shear Diagram (kN)
3313.84
0
Shear 67.4959 0 67.4959 67.4959 0 96.9222 96.9222 0 390.2103


Transverse Reinforcement (mm²/m)
3591.33
0
Asv/s reqd 0 0 0 0 0 0 0 0 1108.43

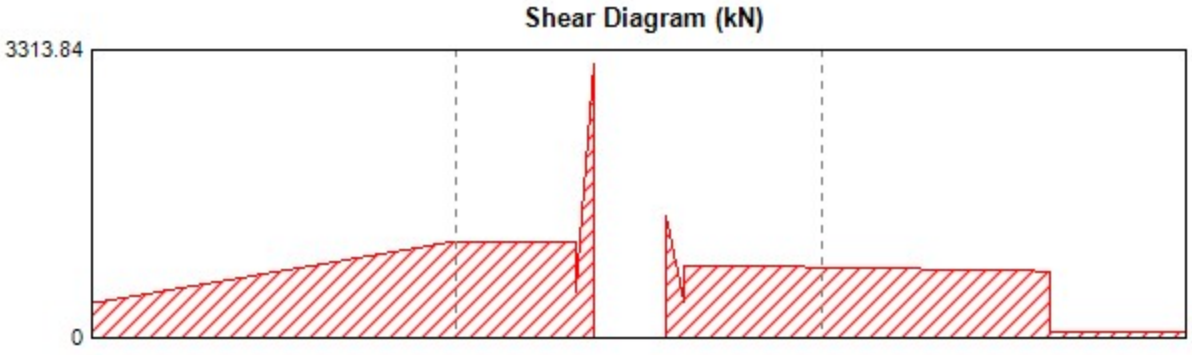

Span 70
1 m
Span 71
1 m
Span 72
1 m



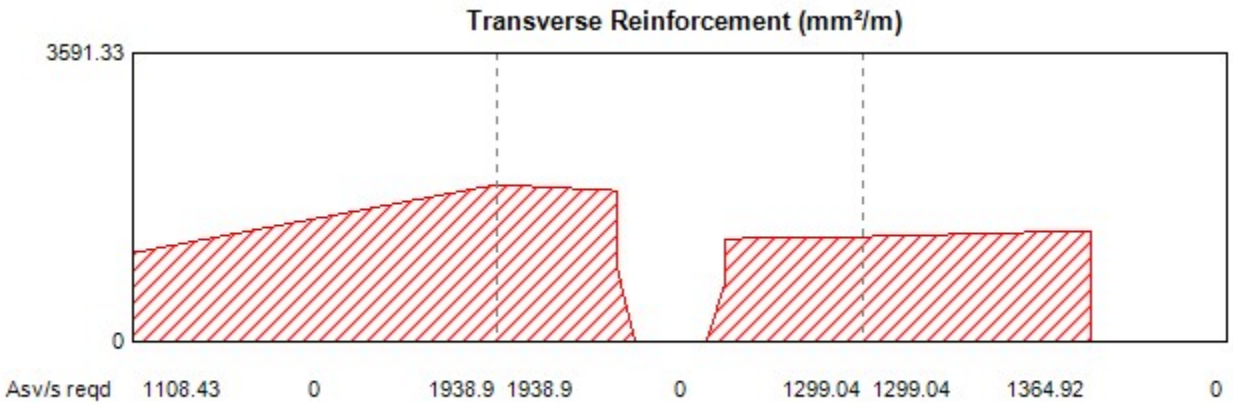
(-)Moment	-20.8203	0	-139.2543	-139.2543	-170.2215	-60.6297	-60.6297	-163.7905	-9.6615
(+)Moment	559.8253	0	1371.0915	1371.0915	1695.8243	874.1014	874.1014	167.4377	123.2835



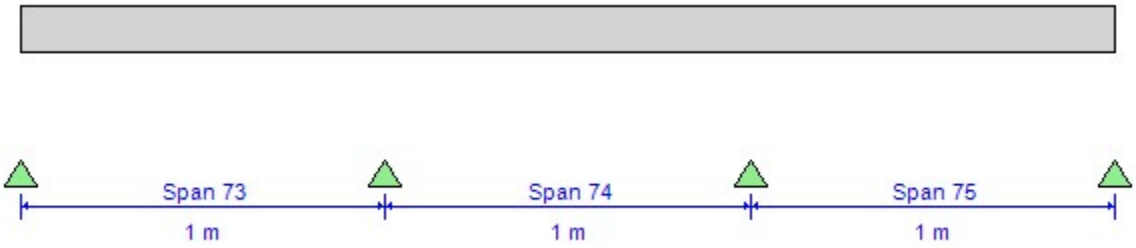
As (top)	1212	0	1157	1157	1239	992	992	1020	768
As (bot)	Comb18		Comb25	Comb25	Comb25	Comb18	Comb18	Comb16	Comb18
	2657	0	4499	4499	5398	2918	2918	2591	2057
	Comb18		Comb16	Comb16	Comb16	Comb16	Comb16	Comb16	Comb16

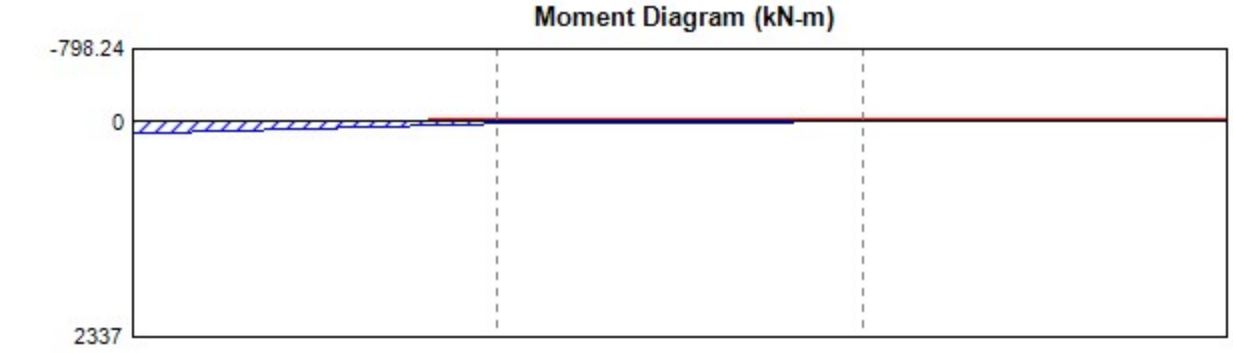


Shear	390.2103	0	1097.9044	1097.9044	3156.039	803.5174	803.5174	768.8649	77.7066

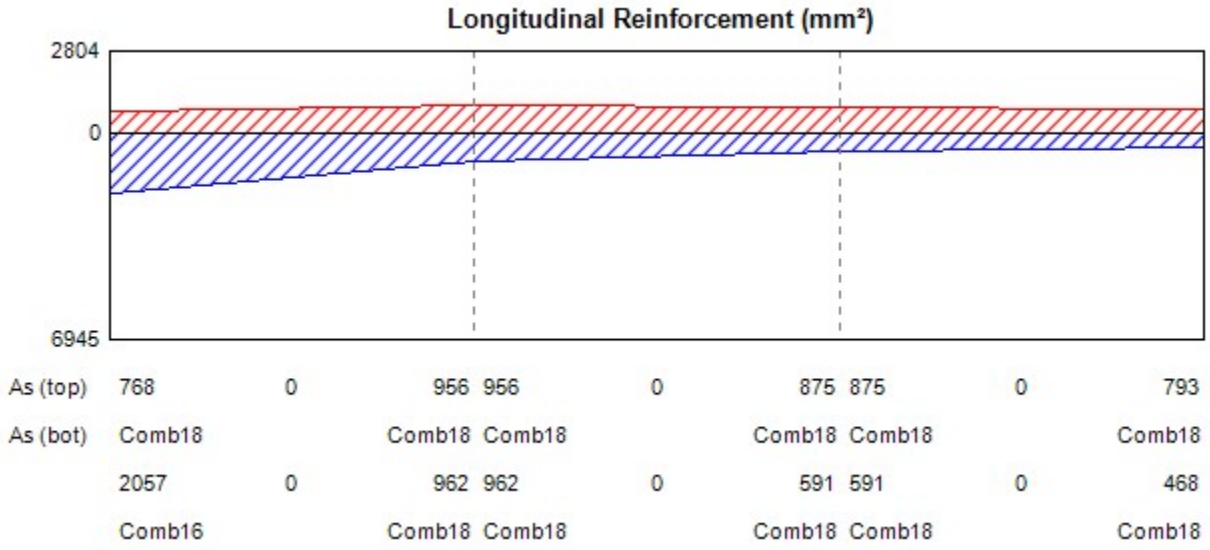


Asv/s reqd	1108.43	0	1938.9	1938.9	0	1299.04	1299.04	1364.92	0

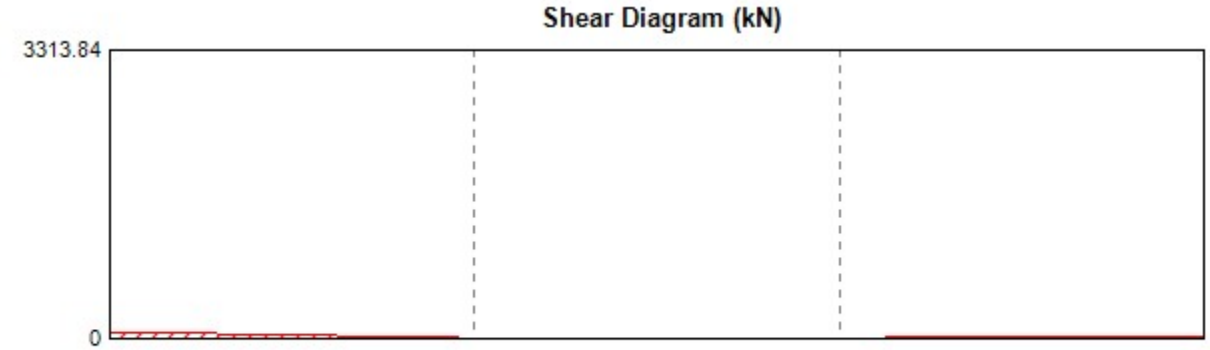




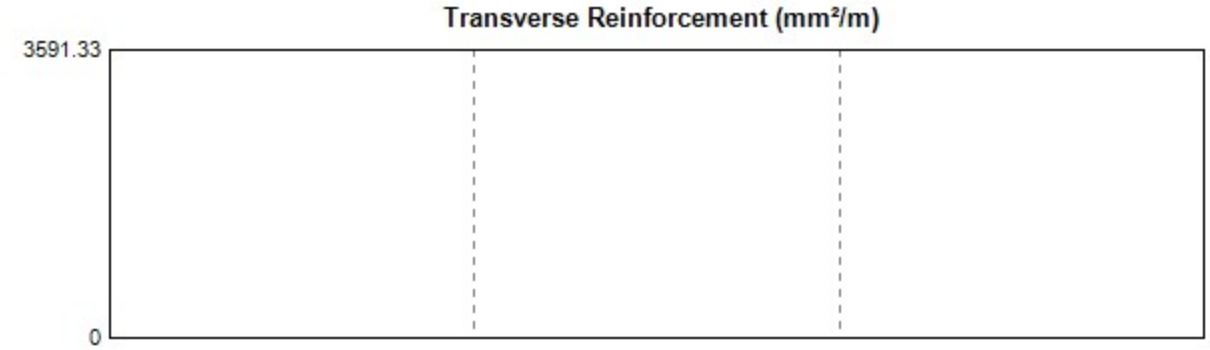
(-)Moment	-9.6615	0	-24.8084	-24.8084	0	-24.0308	-24.0308	0	-24.3214
(+)Moment	123.2835	0	25.1347	25.1347	0	6.6991	6.6991	0	4.4824



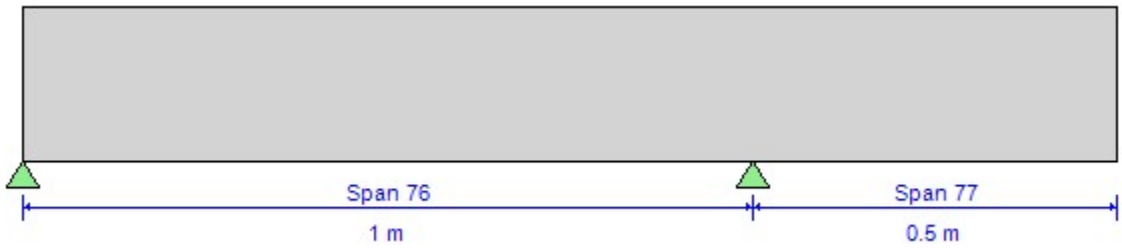
As (top)	768	0	956	956	0	875	875	0	793
As (bot)	Comb18		Comb18	Comb18		Comb18	Comb18		Comb18
	2057	0	962	962	0	591	591	0	468
	Comb16		Comb18	Comb18		Comb18	Comb18		Comb18



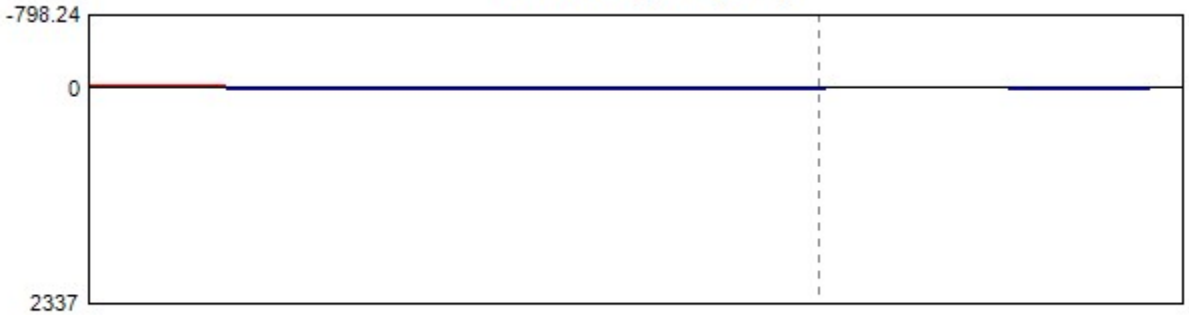
Shear	77.7066	0	9.4323	9.4323	0	1.2476	1.2476	0	20.5339



Asv/s reqd	0	0	0	0	0	0	0	0	0

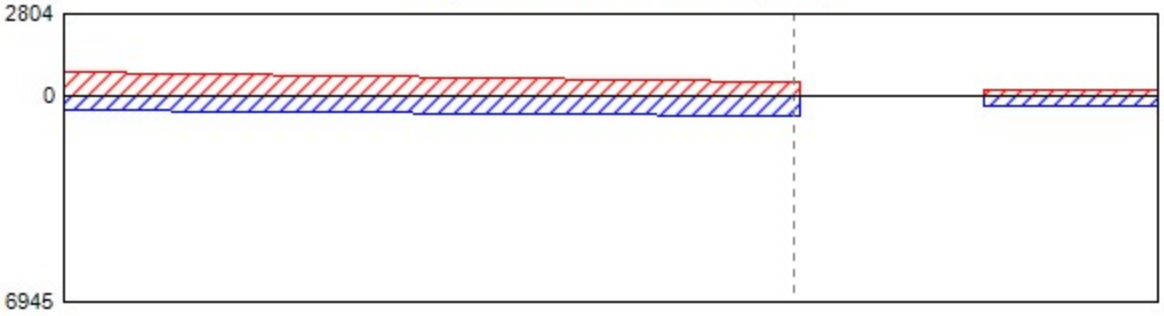


Moment Diagram (kN-m)

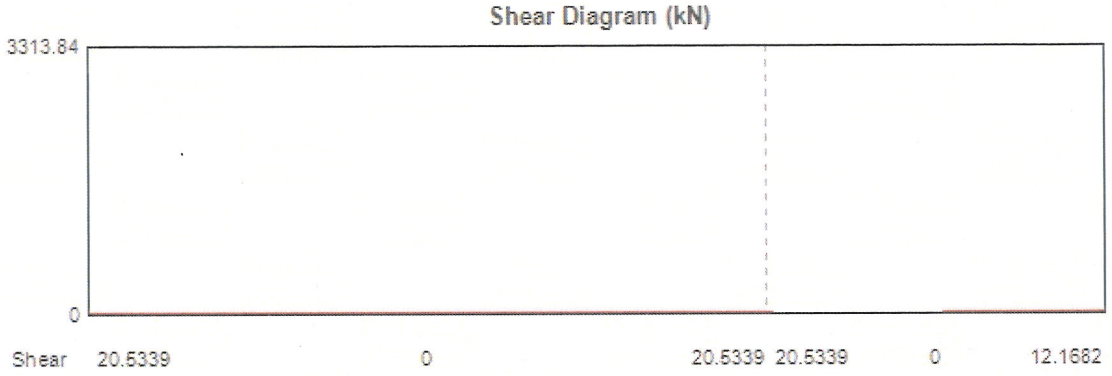


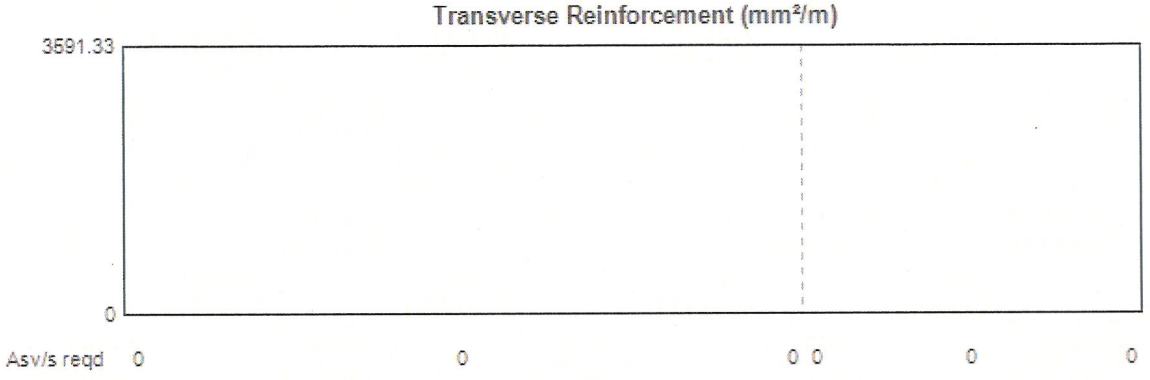
(-)Moment	-24.3214	0	-4.4096	-4.4096	-9.6328	-6.7495
(+)Moment	4.4824	0	18.5105	18.5946	15.6378	8.6928

Longitudinal Reinforcement (mm²)



As (top)	793	0	464	464	185	177
As (bot)	Comb18		Comb27	Comb27	Comb16	Comb18
	468	0	709	710	248	197
	Comb18		Comb18	Comb18	Comb16	Comb18





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