Waterman Emirates
Consulting Engineers and Facility Managers

STRUCTURAL VALIDATION - SCHEME DESIGN PEER REVIEW

Validation No.:

Project No.: 22150

Project Title: PEER REVIEW OF STRUCTURAL DESIGN FOR DFC ZONE 3, LANDMARK PLACE BUILDING 03F USING LADDERBLOCK SYSTEM

Client: DUBAI FESTIVAL CITY LLC. PO BOX 49776, DUBAI, UAE

Architect: CRONE PARTNERS

Prepared by: **Waterman Emirates**
Mostafawi Building, 8th floor,
Khalid Bin Al-Waleed Road
P.O. Box 117448
DUBAI, U.A.E.

Telephone: +971 4 351 7077
Facsimile: +971 4 351 6304

Web: www.waterman-group.co.uk

Revision Record Sheet

Rev	Date	Description	Prepared by	Authorised by
B	10/12/07	Final	GK / MG / MF	TON
A	22/11/07	Preliminary	MG / MF	TON

TABLE OF CONTENTS

Item	Description	Page No.

EXECUTIVE SUMMARY

The Building 03F is part of Landmark Place Development at Dubai Festival City, Marsa Al Khor. The Building 03F consists of 17 storey office tower, five level podium housing the offices & retail lobby and underground car parking at four level basements with the total area of 47500 m2. The Building 03F is identical in design as the adjacent building 04F, currently at the final design stage.

Waterman Emirates have been engaged to carry out structural review of an alternative concept design for Building 03F utilizing the LadderBlock system. The objective of this review is to confirm the suitability of LadderBlock system as a valid alternative for construction of the building 03F, as well as to comment on the adequacy of the system for construction of other buildings within the Dubai Festival City and wider use. The review is a part of Due Diligence process undertaken by the Client and limited to structural systems only. Implications of alternate structural design to Architectural, MEP design & other trades, is not part of Waterman Emirates review. Such review will be carried out by other parties engaged directly by Client.

Waterman Emirates scope of work is to provide consulting engineering services for the following:

- Review of the basic assumptions and design parameters related to the structural design of the building;
- Review of the structural disposition and proposed LadderBlock system including the “superframe” based on the agreed assumptions and design parameters;
- Review of structural calculations transmitted by ICON;
- Review of 3D model prepared by ICON;
- Review of the structural drawings transmitted by the designer;
- Revise the existing foundation design for adjacent building 04F, to suit the proposed LadderBlock system.

Further to the original proposal and series of discussions with Client’s and ICON’s representatives, it has been agreed that ICON would provide the following.

- Project introduction, to include the narrative description of Ladder Block System and outline specifications / general notes.

- Structural Analysis for the Due Diligence process to be focused on the tower only as an isolated structure and to include a SAP2000 3D model of tower structure including the LadderBlock platform, CIS Core, and CIS “supercolumns”. Structural Analysis and Design to be carried out under the code gravity, wind and seismic loads for the critical (“worst case”) members & connections as well as drift calculated under lateral loads.

- Drawing Package to include isometric views (construction stages & completed), block reinforcing drawings for critical LadderBlock components, tower “supercolumn” reinforcement details, tower core conceptual reinforcement plans & details and critical connection details.

1 METHOD OF REVIEW

The sections 1, 2 & 6 of the submitted document "Dubai Festival City Zone 03 – LadderBlock Due Diligence Structural Narrative and Package" have been reviewed and the summary is enclosed with the report.

1.1 Structural Analysis Review

The three finite element models of office tower G+17 and four basements (car parking) have been reviewed with reference to the applicable building codes, as described in sections 3.3 and 3.4 of this document. For the purpose of static and lateral load calculation, the submitted spread sheet calculations have been checked with related code provisions. The results are commented and recommendations are noted in sections 3.1, 3.3 and 3.4.

The submitted core model which for the purpose of seismic analysis as described in the section 3.3.1 has been reviewed. Comments and recommendation are noted in section 3.3.1.

The developed tower models for wind and seismic load as described in the sections 3.3.2 and 3.4 have been reviewed and comments & recommendation are noted in sections 3.3.2 and 3.4.

The seismic tower model modified as G+17 storeys to check the seismic weight calculation and results are commented in section 3.3.1.

The generated diaphragm forces form the tower models for wind seismic loads have been compared with calculated spread sheet values. The results are commented in section 3.3.2.

The modified stiffness of the member properties and drift limitations have been verified with the relevant code requirements and results are commented in sections 3.3 and 3.4.

1.2 Ladder Block Design Review

1.2.1 Floor blocks

The light floor blocks as described in the section 3.5.1 & 3.6 has been checked for the capacity and deflection with and without structural topping using two different methods.

Method 1

It is assumed that the entire load on the floor block has carried by the Rib beams (double tee structural element).

The stiffness of “rib beam” (tee shape) and respective loading as shown in the sketch No SK3.6.1 are modelled and designed using RAPT software refer to Attached design calculation in Appendix A.

Method 2

It is assumed that the entire load on the floor block has carried by entire structural element.

The total stiffness (moment of inertia) of the floor block has been used to check deflection as described in attached spread sheet calculation no. DC 3.6.1.

The results are commented in section 3.6.

1.2.2 Ladder Blocks

The critical forces on LadderBlock members as described in the section 3.7 and including LadderBlock beam (section 3.8) and LadderBlock column (section 3.9), have been checked against the capacities as well as proposed reinforcement arrangement.

The results are commented in section 3.9.

1.2.3 Super Column

Whenever the gravity loads were exceeding LadderBlock column capacities, such columns are encased within cast-in-situ reinforced concrete envelope. These composite columns are referred to as “supercolumns”.

The “super column” design has been reviewed and calculated combined equivalent forces verified. The results are commented in section 3.10.

2 PILE FOUNDATION DESIGN

For the purpose of pile loading, the support reactions from the wind and seismic tower models have been considered.

The seismic forces from the tower model have been reduced by factor 0.7R to consider the force corresponding to the storey drift Δs since the seismic forces from the tower model are corresponding to storey drift of Δm (refer section 3.3.2 of this report). Pile loadings have been calculated for the service load combinations (refer to spread sheet calculation no DC 3.16.1 to 3.16.4) and forces are compared with 04F pile loads. The results are noted in sections 3.15 and 3.16 and revised pile / pile cap arrangement to suit to the LadderBlock platoform, is shown in sketch SK3.16.1.

The above assumption is considered adequate for the concept pile design, as a part of the due diligence process. However, for the detailed design it is recommended to create a separate model with story drift Δs for pile loading.

3 COMMENTS AND RECOMMENDATION FOR FURTHER WORK

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.1 Design Loads				
3.1.1 Gravity Loads	I	Dead & Live loads are taken as per BS648, BS6399-1 and also comply with 04F design brief. Refer to design criteria section 6.1.1 of LadderBlock Due Diligence Structural Narrative and Package.	AC	<u>The following loading should be taken correctly</u> o Additional screed load at roof level due to storm water drainage system. o Additional load due to MEP equipment and its plinths at appropriate levels.
3.1.2 Seismic Loads	I	The static lateral force procedure as per UBC 1629.8.3 has been used with the following factors o Structure type: regular o Over-strength / ductility factor R =5.5 o Seismic zone area 2A o Seismic zone factor Z = 0.15 o Importance factor I =1.0 o Soil profile = SC	AC	1. It is advisable to perform dynamic analysis for accurate results and to verify the mode shapes. 2. As per UBC clause 1629.5.3 and table 16-M, the structure should be taken as irregular structure (torsional irregularity). 3. Importance factor should be taken as 1.25 when static analysis is performed (refer attached document RF 3.1.2.0)
3.1.3 Wind Loads	I	Wind loads have been taken as per BS6399-2 with basic wind speed of 45 m/sec (3 sec gust) and effective wind speed of 23.5 m/s	AC	Wind load combinations should be as per BS code (Table 2.1 of BS 8110 Part 1: 1997) since the design parameters are taken as per BS.

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.2 Structural system	I	The LadderBlock elements have been designed to carry only the gravity loads. Wherever the gravity load exceeds the LadderBlock capacity, it is proposed to use either or combined of the following o Higher grade of concrete or reinforcing steel; o Additional reinforcing steel, doubled members or cast-in-situ elements to work compositely with block.	AC	1. Already high strength of concrete has been used (cylindrical compressive strength of 60kpa approximately equal to cube compressive strength of 75kpa). Increasing the grade of concrete may not be possible. However it is possible to increase the size of the members. 2. Reinforcement in LadderBlock column is already congested. The buildability of beam column connections should be verified with reference to the spacing of reinforcement, accommodating of sleeves, dowels etc.
	I	All the lateral load such as seismic / wind are assumed to be resisted by shear walls i.e. main core around the staircase and lift rooms.	A	
	I	The concrete floor topping has been designed as rigid diaphragm.	A	

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.3 Seismic Analysis **3.3.1 Core model**	I	For the purpose of seismic analysis two separate models have been created as core model and tower model.	A	
	I & Q	This model is simple and consists only the structural wall running up to the height of the tower. This was used for the purpose of determining the lateral seismic floor deformation to be applied in the tower analysis.	AC	1. The seismic force generated in analysis model is not complying with Calculated Storey Forces at Roof level and Level17 (refer Spreadsheet 6.1.3.3 (A) and Story Diaphragm force). 2. The seismic weight calculated in Spreadsheet 6.1.3.3 does not match with total reaction of the supports from analysis tower model (for the purpose of this check the model has been supported at ground level). 3. In some of the floors the live load has been applied incorrectly. The above (1-3) might have caused inaccurate results in the model.
	I	For the purpose of the generating the story forces the seismic mass has been assigned at each floor level.		1. Appropriate calculation should be produced to ensure the masses have been applied at centre of mass location.
	I	The deformations (Δs) are taken corresponding to ultimate seismic force (1.0EQ), with reduced wall stiffness as per UBC clause 1633.2.4	AC AC	1. As per UBC 1630.9.2 PΔ effect should also be included in Δs calculation. 2. Rational cracked section analysis to be performed and the section properties used as per UBC clause 1910.11.1 3. The drift to be checked with Load combination as per UBC clause 1612.
	I	The drift limitation has been checked as per UBC Clause 1630.10.2.	AC	<u>Additional requirements</u> 1. As per Dubai Municipality requirements, the drift at service level seismic force (UBC clause 1612.3.1) should not exceed H/500 with appropriate stiffness. 2. First two modes should be Linear.

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.3.2 Tower Model	I	The deformation taken from the core model has been amplified for inelastic response deformation (ΔM) and compared with story drift of 0.0025h and the maximum value has been applied in the model at corresponding levels.	A	
	I	Cracked section for wall, beam and column elements have been simulated using concrete with reduced modulus of elasticity as follows. o Wall = 0.5 (as per UBC clause 1633.2.4) o Column = 0.7 o Beams = 0.35	AC	Rational cracked section analysis should be performed and the section properties used as per UBC clause 1910.11.1
	I	Forces corresponding to this deformation on the elements which are not part of the later-force resisting system (ladder Block) are considered as ultimate force as per UBC clause 1633.2.4.	A	
3.4 Wind Analysis	I	A separate tower model has been created for the purpose of wind analysis.	A	
	I	The wind force has been calculated using standard pressure coefficients as per BS 6399-part2.(Refer spreadsheet 6.1.3.2 and 6.1.3.4 of due diligence structural narrative and package)	A	
	I & Q	The automatic lateral load generation option in SAP2000 has been used.	AC	The wind force generated within SAP2000 does not match with spreadsheet calculation at several floor levels.
	I	The drift has been checked against H/500 limit.	A	

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.5 Material properties **3.5.1 Floor Blocks / Slab**	I	Light weight concrete (Neopor) specified with following properties: o Unit weight = 1600 kg/m3 o Concrete compressive strength fc' = 17.2 Mpa o Yield strength of rebar fy = 460 Mpa o Short term modulus of elasticity of concrete = 6475 Mpa o Long term modulus of elasticity of concrete = 3920 Mpa	AC	The Modulus of elasticity of light weight concrete to be verified (It varies from calculated value as per section 7 of BS8110-2) Additional considerations as per section 5 of BS8110-2 shall be met for light weight aggregate concrete in particular the characteristic strength of reinforced concrete should not be less than LC20/22.
3.5.2 LadderBlock	I	Normal weight concrete specified with following properties: o Concrete compressive strength fc' = 60 Mpa o Yield strength of rebar fy = 460 Mpa o Modulus of elasticity of concrete 32563 Mpa (for beam) 36406 Mpa (for column) o Modulus of elasticity of steel = 200 Gpa	AC	Since the LadderBlock beam and column have same concrete strength the Modulus of elasticity should not differ.

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.6 Floor Blocks / Slabs	I	The 3m wide and 9m long block is a "double tee" structural element that is designed to bear on frame blocks (refer to fig 6.1.2.3 of due diligence structural narrative and package)	A	
	Q & D	The strength and deflection were checked with and without structural topping as structural component.	NA	The short term and long term deflections are exceeding the permissible limits as described in BS 8110-2 clause 3.2: the actual total long term deflections equals to 48mm (allowable 20mm) and actual incremental deflections equals to 31.8mm (allowable 18mm). Also refer to attached RAPT analysis and calculation spread sheet No DC 3.6.1)
3.7 LadderBlock	I	LadderBlock platform consist of two main components: o <u>Frame block</u> The beam and column to be cast together with or without the overhang (refer fig 1.2.1 and fig 2.1.3 of due diligence structural narrative and package)	A	
		o <u>Spacer blocks</u> The beam and column to be cast together (to be placed along the transfer direction to the main frame blocks (refer fig 1.2.2 of due diligence structural narrative and package)	A	

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.8 Ladder Block Beams	I	LadderBlock beams are of uniform thickness of 200mm and depth of 500mm near the column face & transition to 409mm towards the column. At the mid span and cantilevered end the depth is 450mm.	NA	With reference to the reinforcement detail of beam / column (fig 6.3.1 & 6.3.2 of due diligence structural narrative and package) it is not possible to place the reinforcement within beam column junction. (Refer attached sketch No. SK 3.8.1) Possibly increase the thickness of the member, or an alternative solution should be provided.
	I	The capacity of LadderBlock floor beams has been calculated (refer spreadsheet 6.3.1 of due diligence structural narrative and package).	A	
	I	The forces generated from SAP 3D model have been compared to the LadderBlock capacity.	A	
3.9 Ladder Block Columns	I	It is the part of frame block with uniform size of 800x200mm	A	
	I	PCA column software has been used to determine the column capacities.	AC	Buckling of the columns need to be checked particularly in a single frame block column. With reference to the sample calculations presented an 800 x 200 mm LadderBlock column with 16 nos of 32mm diameter bars (8% concrete to steel ratio), reinforcement for this section is congested and the spacing between the bars is not sufficient to accommodate the developed reinforcing bars from LadderBlock floor beam(Refer attached sketch No. SK 3.8.1).
	I	The forces generated from SAP 2000 model have been compared to the LB column capacity.	A	

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.10 "Super Columns"	I	When the gravity loads are exceeding LadderBlock column capacities, the columns are encased within cast-in-situ reinforced concrete envelope.	AC	The shear stress at the interface between the LadderBlock and cast in situ concrete envelope has to be checked.
	I	It has been modelled in SAP as ladder block column and cast in site column separately and connected with equal constrain / rigid link.	A	
	I	The forces are taken from these elements and combined together to get equivalent Forces.	A	
	I	PCA column software has been used to determine the column capacities as for the conventional column.	A	
	I	The capacity is compared with equivalent forces.	A	
3.11 Shear Walls / Cores	I	Shear walls / cores were not considered to be within the scope of "Ladder block due diligence structural Narrative and package".	AC	Unlike the building 04F, the core has been assumed to cater for the entire lateral load. The design of the main core should be verified.

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.12 Connections	I	LB Frame blocks are connected to each other using bolts and shear-keyed interfaces (refer figure 6.1.2.4 of "LadderBlock Due Diligence Structural Narrative And Package"). The rotational stiffness of the connection has been found and applied in the Analysis model.	AC	Local stresses in concrete around the bolts should be checked. Fire resistance of bolts for the code specified duration without losing the capacity to be addressed.
	I	Bearing pads are provided at all location where concrete-to concrete contact occurs between LB blocks to protect the blocks form chipping and cracking during erecting and to provide adequate rotation capacity, A simplified stress analysis has been provided for bearing pads.	A	
	I	Ladder block have been connected with cost in situ core wall by grouted reinforcing studs or threaded rod using preformed sleeves. The connection has been simulated in the analysis model as rigid link.	AC	The capacity reinforcing studs / threaded rod to be checked for the forces on rigid link for the critical load cases. Local stresses in core concrete around the reinforcing studs need to be checked. Fire resistance of reinforcing studs / threaded rod for the specified duration without losing its capacities should be verified.
	I	"Super columns" to Floor Blocks interface.	AC	The development of "supercolumn" reinforcement at the interface with the floor blocks should be checked.
3.13 Durability	I	Applicable to all LadderBlock platform items as well as cast in situ members.	AC	For durability consideration the cover to reinforcement, maximum free water / cement ratio and minimum cement content should satisfy "**not less than severe"** environmental conditions as per BS8110-1 or equivalent ACI Code.

Item Reviewed and Method		Description	Results	Comments and further work to be carried out by ICON
3.14 Fire Resistance	I	Applicable to all LadderBlock platform items as well as cast in situ members.	AC	The minimum dimension of members and cover to the reinforcement should satisfy not less than 2 hours of fire resistance as per section 4 of BS8110-2 or equivalent ACI Code. The bolt / studs connections should be checked for the 2 hours fire resistance.
3.15 Overall Loading On Foundation	I & Q	As above.	A	The loading on foundation has been compared with the one to the existing 04F building design and following has been noted: • Approximately 11% less in total load around the core area. • Further reduction has been noted in other tower areas. The comparison does not include the podium.
3.16 Foundation Design	I	As above.		Due to the reduced load in comparison with the 04F building, the number of piles and their size can be reduced (refer Spread sheet calculation No DC 3.16.1 to 3.16.4) and pile cap layout should be revised (refer to the attached sketch no SK 3.16.1). The above is subject to verification of the comments noted above.
3.17 Basement Design	I	As above.		Retaining wall & tanking design will not vary from the existing building 04F design.

Method of Review:	Results
I = By Inspection.	A= Acceptable.
Q = By Quick Calcs.	AC= Acceptable With Comment.
D = By Detailed Calcs.	NA = Not Acceptable.

4 CONCLUSION

Comments and recommendations for the LadderBlock platform design of Landmark Place, Building 03F are noted within the Section 3 of this report.

In short we can conclude that the LadderBlock platform design, as presented in its current form, could be used for the construction of the building 03F providing that all comments / recommendations of our report are addressed during the Detailed Design stage. However, it should be noted that addressing of the comments will likely result in increased thicknesses of LadderBlock frames, floor blocks and possibly the main core and that will affect the seismic load.

The anticipated increase of the LadderBlock frame thickness would be required due to buildabilty reasons (i.e. congested reinforcement, difficult detailing) as well as to satisfy the durability and fire rating requirements. Such increased thickness will have a knock-down effect on overall seismic load to the main core as well as to the design of floor plates & “supercolumns”. The anticipated increase of the floor blocks thickness would be required due to the deflection control, although the proposed floor block thickness may be maintained with an alternate layout of the LadderBlock frames.

The frames with increased thickness would raise other issues, not only the increase in the quantities of basic materials in comparison with anticipated within the submitted proposal, but would also require the different cranes to handle the heavier frames & floorblocks as well as other construction related issues.

The above comments are related only to the structural performance of the LadderBlock platform and does not include the review of architectural & MEP design implications that would arise as a result of retrofitting current design with a LadderBlock system (i.e. rearranging the basement car parking areas due to the different column pattern).

In summary, it is worthwhile noting that retrofitting of the existing building 04F design with LadderBlock platform has been a difficult task due to the irregular (wedge) floor plan as well as building’s height. The full potential of LadderBlock platform could be better presented on the design with more regular floor plan & lesser height (i.e. G+10) or even better on the buildings that were designed from the concept stage considering all LadderBlock platform requirements.

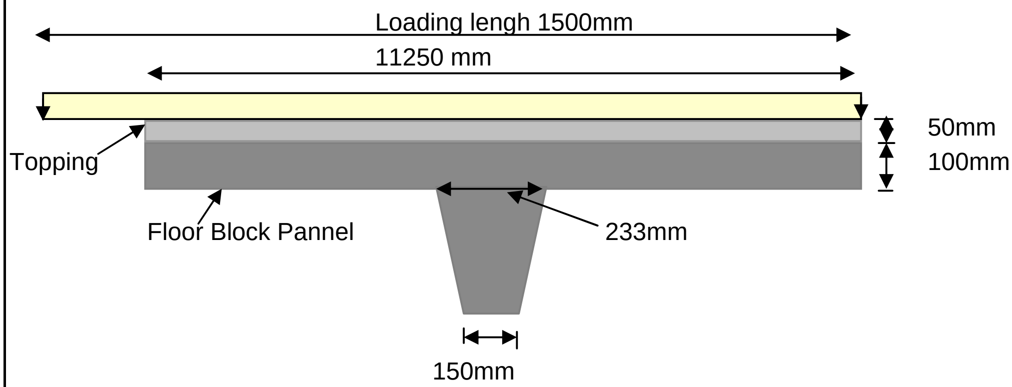
FURTHER DESIGN ACTIONS REQUIRED		RESULT
Structural Analysis	Prepare the ETABS model as per DM requirements	Increased seismic load due to weight increase
		Rearranging the LadderBlock layout will further affect the architectural & MEP design.
		Increased seismic load due to weight increase
		Increased quantity of material
		Cranage
Floor Plate	Reduce span	Increased seismic load due to weight increase

FURTHER DESIGN ACTIONS REQUIRED		RESULT
Deflection		Rearranging the LadderBlock layout will further affect the architectural & MEP design.
		Increased seismic load due to weight increase
		Increased quantity of material
		Cranage
	Increase depth	Increased seismic load due to weight increase
		Rearranging the LadderBlock layout will further affect the architectural & MEP design.
		Increased seismic load due to weight increase
		Increased quantity of material
		Cranage
	Increase topping thickness	Increased seismic load due to weight increase
		Rearranging the LadderBlock layout will further affect the architectural & MEP design.
		Increased seismic load due to weight increase
		Increased quantity of material
		Cranage
	Change Design to Post/tensioned solution	Increased seismic load due to weight increase
		Rearranging the LadderBlock layout will further affect the architectural & MEP design.
		Increased seismic load due to weight increase
		Increased quantity of material
		Cranage
Durability / Fire	Increase the sections sizes to comply with BS8110	Increased seismic load due to weight increase
		Possibly reduced concrete strength.
		Increased overall height
	The bolt connection to be checked for the 2 hours fire resistance.	Apply fire protective coating and grout the bolt holes.
Reinforcement Quantities	Reduce Reinforcement Strength	Increase in section size due reduction in reinforcement strength
		Increased quantity of material and therefore cost but saving in concrete strength cost and buildability of sections
		Increased seismic load due to weight increase
		Cranage possible increase depending on Ladderblock arrangement

APPENDIX A

Waterman Emirates Consulting Engineers and Facility Managers			Mostafawi Building, 8th Floor, Khalid Bin Al-Waleed Road, P.O.Box 117448 Dubai, United Arab		
PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	Sketch No SK 3.6.1		DATE 9/12/2007
TITLE:	Calculation of Loading on Floor Block	DESIGNED MG	CHECKED GK	SHEET

Reference	Calculation	Remarks



Loading with structural Topping		For 1.5m Wide
Self weight of Pannel	2.60 KN/m^2	3.9 KN/m
Dead Load	4.00 KN/m^2	6.0 KN/m
Live Load	3.00 KN/m^2	4.5 KN/m

Loading without structural Topping		For 1.5m Wide
Self weight of Pannel	2.60 KN/m^2	3.9 KN/m
Dead Load	2.80 KN/m^2	4.2 KN/m
Live Load	3.00 KN/m^2	4.5 KN/m

SK 3.6.1

S:\Projects\22150 - DFC Ladderblock\Engineering\Structural\Floor pannel\rev1\Rib beamwithtopping.rpf

RAPT - Version: 6.2.0.7
Reinforced And Post-Tensioned Concrete Analysis & Design Package

Licensee
Waterman Emirates
Mostafawi Building Office 803
Khalid Bin Al-Waleed Road
Bur Dubai, Dubai UAE
59456281107UPP

Input

General

Design Code	List	United Kingdom - BS 8110*SAVED*
Material	List	United Kingdom - United Kingdom Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Beam
Panel Type	List	Internal
Strip Type	List	One way - Nominal Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	17.5MPa
Concrete - Columns	List	17.5MPa
Top Reinforcement Depth from top	mm	30
Bottom Reinforcement from bottom	mm	30
Self Weight Definition	List	User Defined
Pattern Live Load	Y/N	
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	9000	150	1125	1125
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse v'c
	A	List	mm	MPa
1	1	Knife-Edge	1125	
2	2	Knife-Edge	1125	

Beams

Beam Number	Beam Depth	Beam Width at Slab	Beam Width	Effective Flange Width
	mm	mm	mm	mm
1	650	233	150	1125

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Initial Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Line

Load	Left End Reference Column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m		mm	kN/m	A
1	1	0	3.9	2	0	3.9	

2. Initial Dead Load - Line

Load	Left End Reference Column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m		mm	kN/m	A
1	1	0	6	2	0	6	

3. Live Load - Line

Load	Left End Reference Column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Live Load reduction	Description
		mm	kN/m		mm	kN/m	#.#	A
1	1	0	4.5	2	0	4.5	1	

Load Combinations : Ultimate

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1.4	1.4	1.6
2	Live Load	1	1	1.6
3	Dead Load	1.5	1.5	0

Load Combinations : Short Term Service

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	1

Load Combinations : Permanent Service

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.25

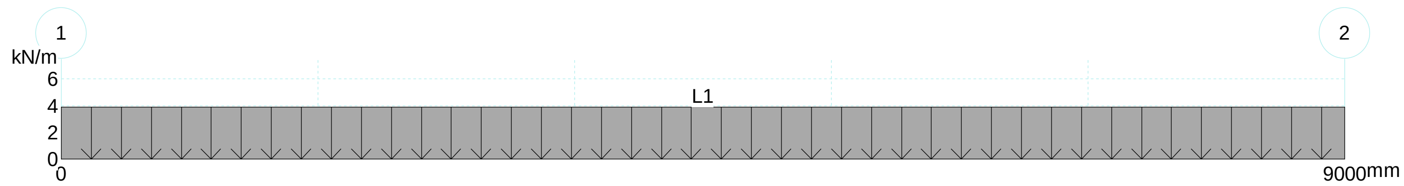
Load Combinations : Deflection

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Short Term - Deflection	1	1	1
2	Permanent - Deflection	1	1	0.25
3	Initial - Deflection	1	1	0

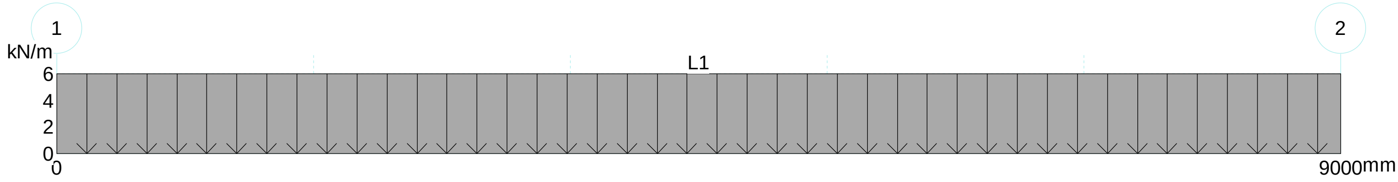
Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

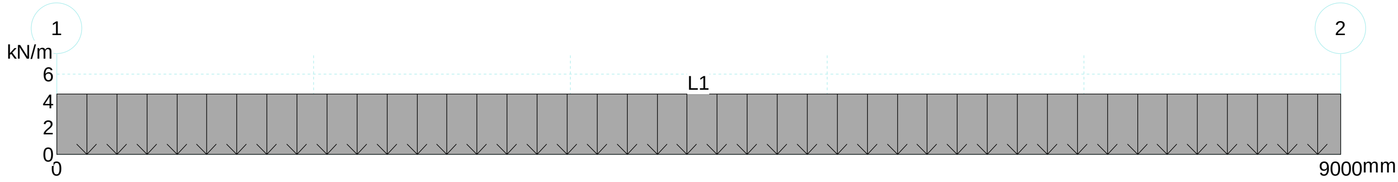
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Initial Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type	Preferred Bar Size	Number of Legs
	List	List	#
Flexural Bar	T 460MPa		
Flexural Mesh	A 460MPa		
Shear Option 1	T 460MPa	8	2
Shear Option 2	T 460MPa	10	2
Shear Option 3	T 460MPa	12	2
Punching Shear	T 460MPa	10	2

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	60	0			N	N
Span Reinforcement	300	60		0	0	N	N

Design Zones : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Depth From Top at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Depth From Top at right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size
	List		mm	mm	mm		mm	mm	mm	List	List	List
1	Bar	1	0	0	30	2	0	0	30	16	16	16

Layer Number	Minimum Number of Bars	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	#	mm	%	%
1	0	0	0	0

Design Zones : Bottom

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Depth From Bottom at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Depth From Bottom at right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size
	List		mm	mm	mm		mm	mm	mm	List	List	List
1	Bar	1	0	0	30	2	0	0	30	16	16	16

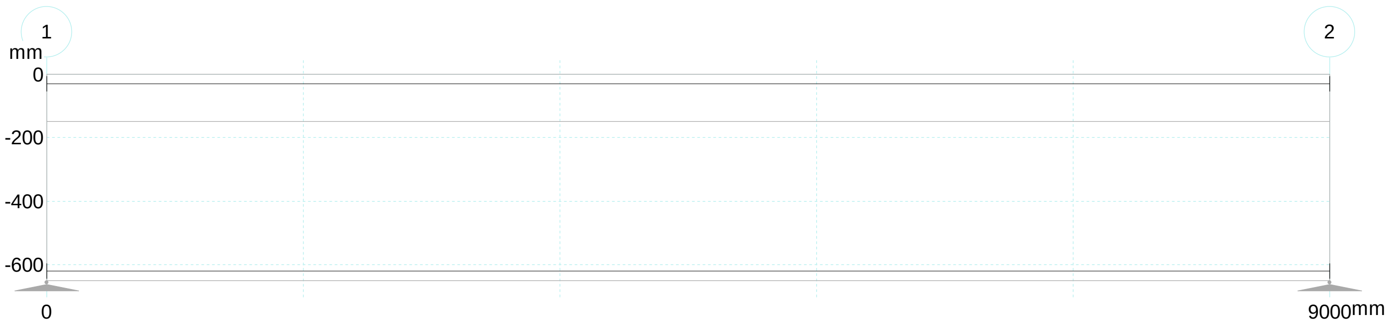
Layer Number	Minimum Number of Bars	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	#	mm	%	%
1	0	0	0	0

User Defined : Bottom

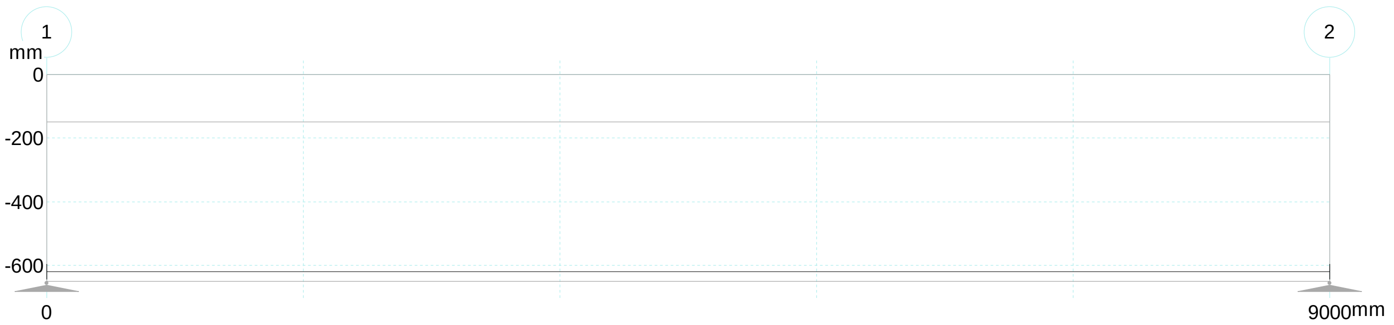
Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Depth From Datum at left end	% Development of Left End of Bar in Tension	% Development of Left End of Bar in Compression	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Depth From Datum at right end	% Development of Right End of Bar in Tension
	List		mm	mm	mm	%	%		mm	mm	mm	%
1	T 460MPa	1	0	0	620	81.3	0	1	9000	0	620	100

Layer Number	% Development of Right End of Bar in Compression	Bar Size	Number of Bars	Spacing of Bars	% in Flange
	%	List	#	mm	%
1	0	16	5	0	0

Reinforcement Design Zones



Reinforcement Design Zones User Defined



Design Data

Capacity Reduction factor (phi) for Flexure	#.#	1
Capacity Reduction factor (phi) for Shear	#.#	1
Material Factor for Concrete in Flexure	#.#	1.5
Material Factor for Concrete in Shear	#.#	1.25
Material Factor for Reinforcement	#.#	1.05
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.5
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	Y
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default

Maximum Service Stress Change - Prestressed Sections	MPa	200
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C.	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	S

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	20
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	500
Incremental Deflection Warning Limit - Maximum Deflection	mm	20
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	19.18
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#
Pattern Live Load for Ultimate Strength	Y/N
Pattern Live Load for Crack Control	Y/N
Pattern Live Load For Deflections	Y/N
Pattern Live Load for Deflection Permanent Load Combination	Y/N

Material Properties

Concrete

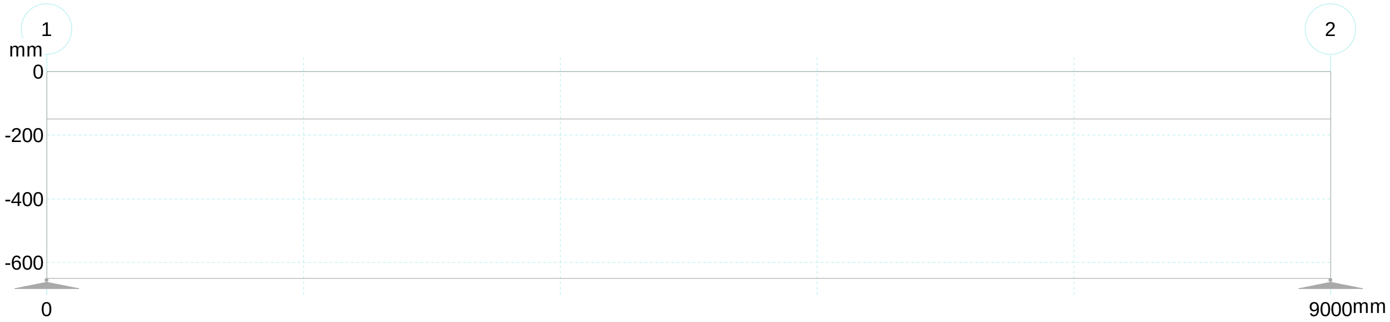
Description	17.5MPa
Characteristic Compressive Strength	19.2
Mean Compressive Strength	23.96
Lower Characteristic Tensile Strength	2.19
Upper Characteristic Tensile Strength	3.51
Concrete Weight	1600
Design Concrete Modulus	6472
Mean Concrete Modulus	6472
Ultimate Concrete Modulus	3920
Basic Shrinkage Strain	600
Basic Creep Factor	3.4
Concrete Strain Limit	0.004

Reinforcement Bar

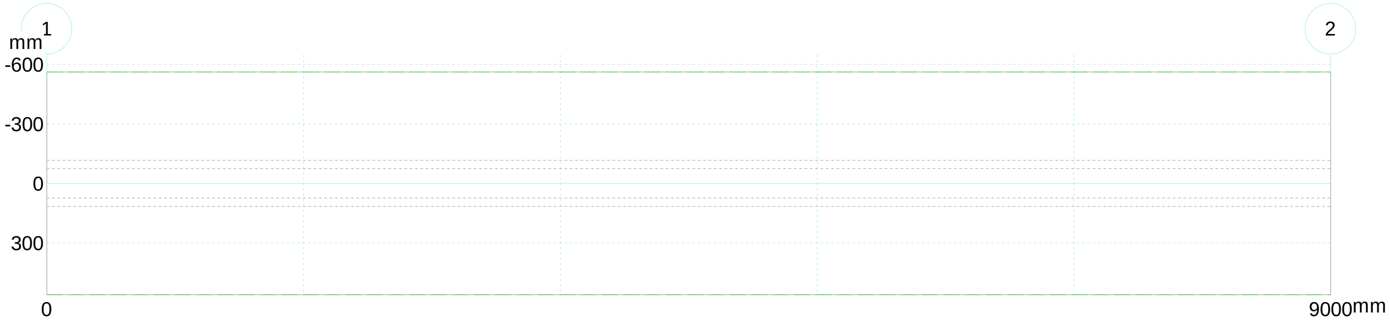
Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Description
T	Deformed	460	2e5	Normal	0.05	496.8	

Nominal Bar Size	Bar Diameter	Bar Area	Bar Inertia	Bar Weight	Stock Length
A	mm	mm2	mm4	kg/m	mm
8	8	50.3	201.14	0.4	12000
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
25	25	491	19182.5	3.85	12000
32	32	804	51492.6	6.31	12000
40	40	1260	1.257e5	9.86	12000

Elevation view



Plan view



Warnings

Input

No errors or warnings were found.

Output

Warning:Incremental Deflection span/deflection ratio in at least one span is less than defined limit.
Warning:Total Deflection span/deflection ratio in at least one span is less than defined limit.
Warning:Incremental deflection in at least one span is greater than defined limit.
Warning:Total deflection in at least one span is greater than defined limit.

Frame Properties

Span 1

Length	mm	9000
Inertia	mm4	8.04e9
Area	mm2	2.65e5

Column Members

Col No.	Area Above	Inertia Above	Area Below	Inertia Below
#	mm2	mm4	mm2	mm4
1	0	0	0	0
2	0	0	0	0

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Initial Dead Load	Live Load
Moment Above	kNm	0	0	0
Moment Below	kNm	0	0	0
Reaction	kN	17.55	27	20.25
Elastic Rotation	#.#	2.28e-3	3.5e-3	2.63e-3
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Initial Dead Load	Live Load
Moment Above	kNm	0	0	0
Moment Below	kNm	0	0	0
Reaction	kN	17.55	27	20.25
Elastic Rotation	#.#	-2.28e-3	-3.5e-3	-2.63e-3
Elastic Axial Shortening	mm	0	0	0

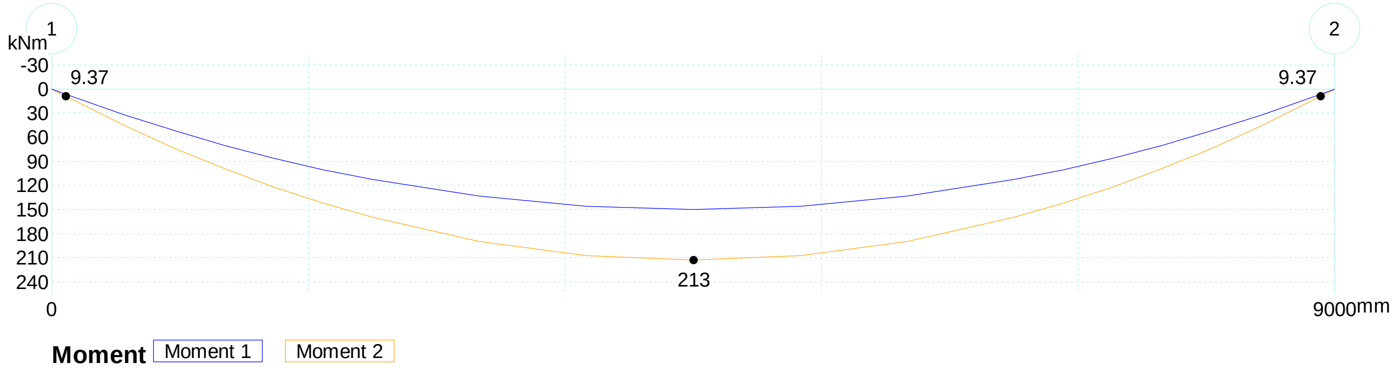
Load Combinations

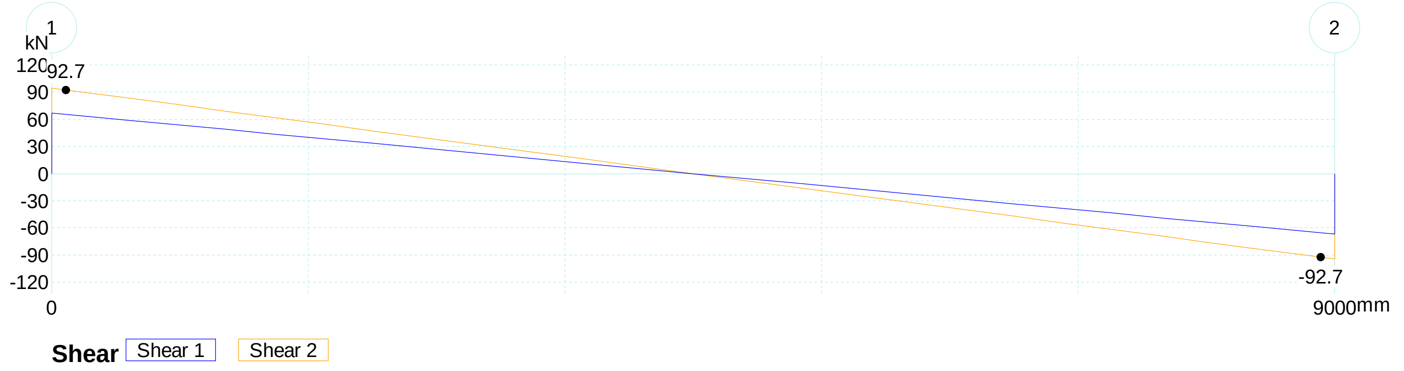
Column Actions

Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	64.8	64.8	94.77	94.77	66.82	94.77
Elastic Rotation	#.#	8.41e-3	8.41e-3	0.01	0.01	8.67e-3	0.01
Elastic Axial Shortening	mm	0	0	0	0	0	0

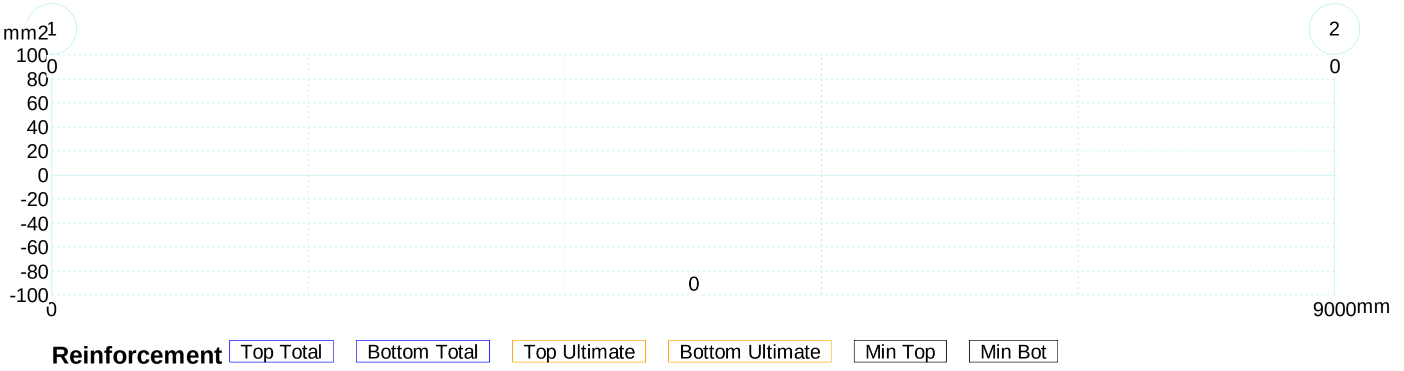
Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	64.8	64.8	94.77	94.77	66.82	94.77
Elastic Rotation	#.#	-8.41e-3	-8.41e-3	-0.01	-0.01	-8.67e-3	-0.01
Elastic Axial Shortening	mm	0	0	0	0	0	0

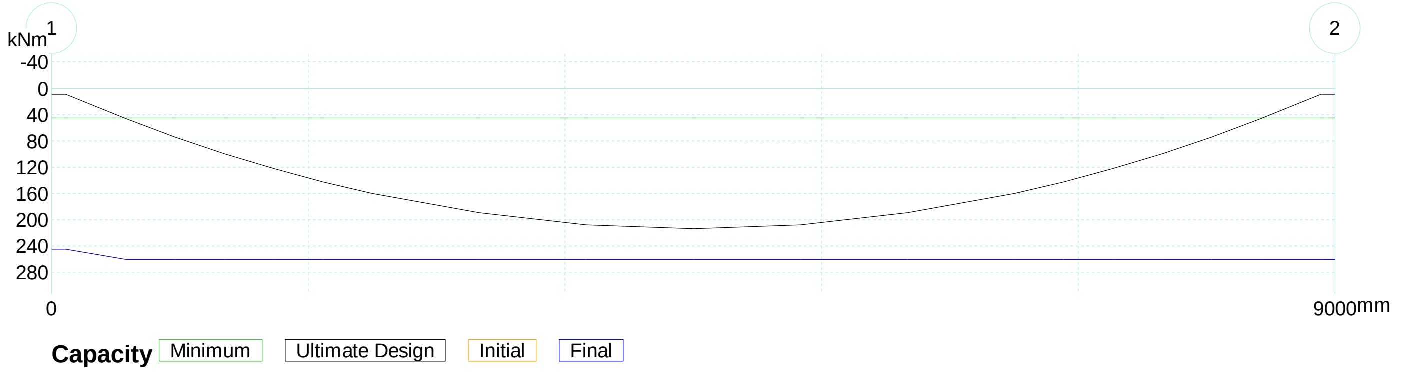
Ultimate Flexure

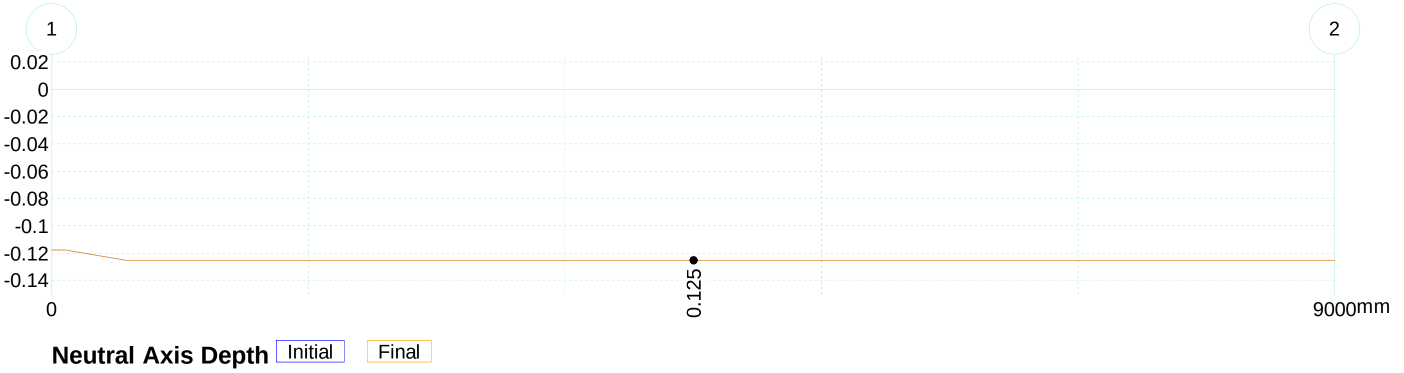




Flexural Design
Ultimate

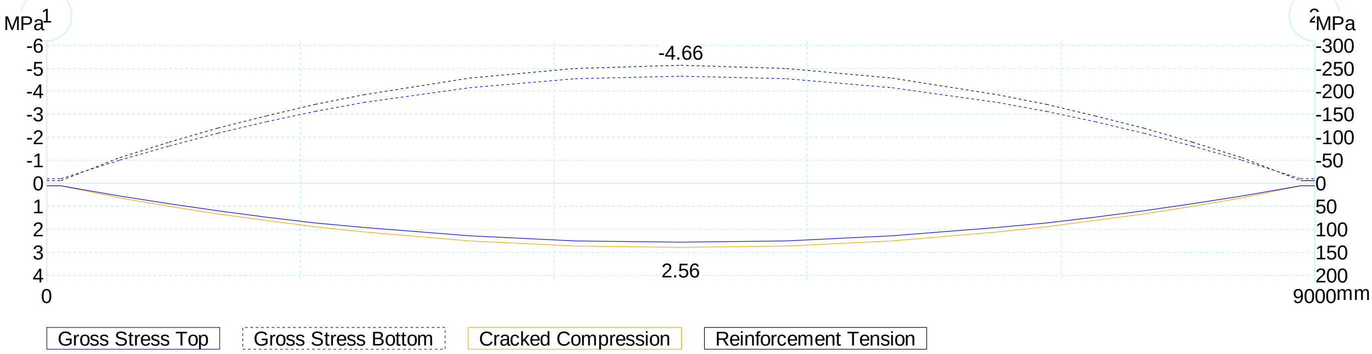




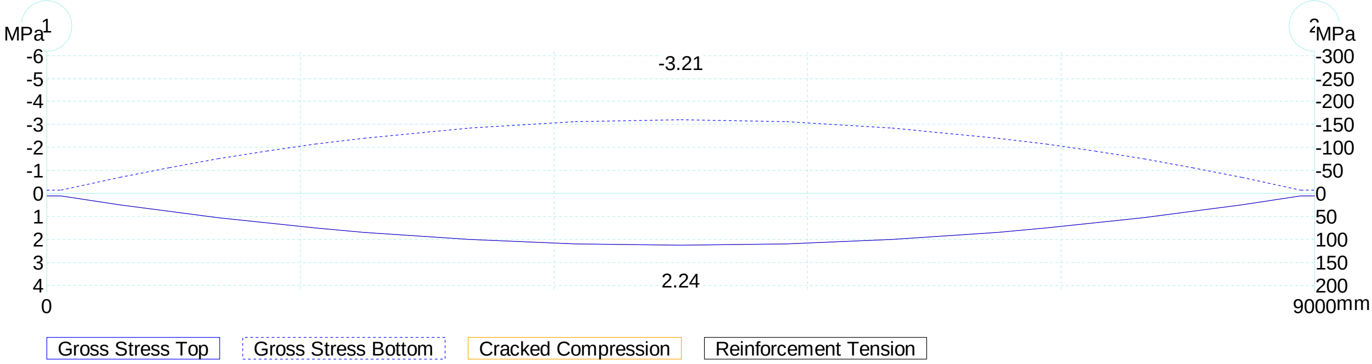


Service

Maximum Moment Condition



Reversal Moment Condition



Shear Design

Beam

Span 1

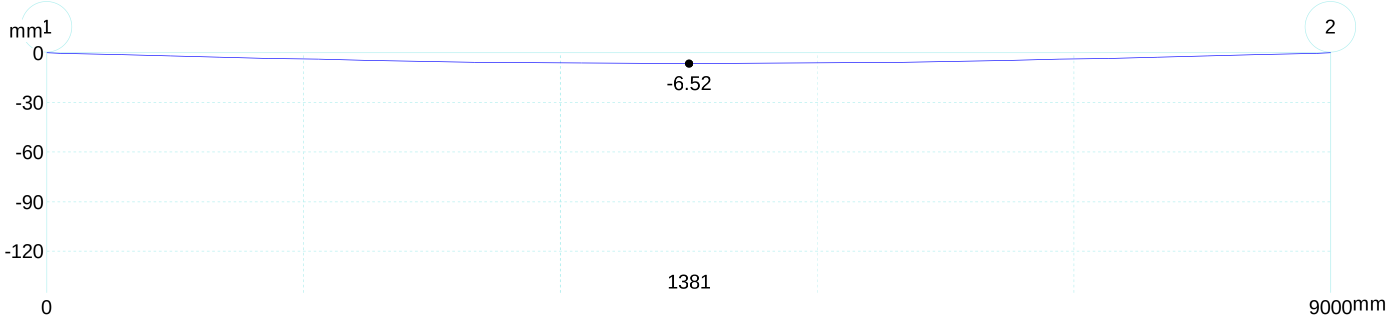
Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Asv/s	Spacing of Sets			Shear Comments
											2 legs T8	2 legs T10	2 legs T12	
mm	kN	kN/m	kN/m	mm	mm2	mm	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	92.66	9.37	0	620	0	150	732.04	99999	732.04	0.14	465	465	465	Minimum Steel
520	83.82	46.43	0	620	0	150	143.83	99999	143.83	0.14	465	465	465	Minimum Steel
866	76.53	74.17	0	620	0	150	86.36	99999	86.36	0.14	465	465	465	Minimum Steel
1212	69.75	95.45	0	620	0	150	61.71	99999	61.71	0.14	465	465	465	Minimum Steel
1558	62.46	118.32	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
1904	55.18	138.68	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
2250	49.41	146.26	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
3000	33.62	177.39	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
3750	20.35	183.39	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
4500	8.1	176.78	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
5250	-20.35	183.39	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
6000	-33.61	177.39	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
6750	-49.41	146.26	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
7096	-55.18	138.68	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
7442	-62.46	118.32	0	620	0	150	60.32	99999	60.32	0.14	465	465	465	Minimum Steel
7788	-69.75	95.45	0	620	0	150	61.71	99999	61.71	0.14	465	465	465	Minimum Steel
8134	-76.53	74.17	0	620	0	150	86.36	99999	86.36	0.14	465	465	465	Minimum Steel
8480	-83.82	46.43	0	620	0	150	143.83	99999	143.83	0.14	465	465	465	Minimum Steel
8900	-92.66	9.37	0	620	0	150	747.91	99999	747.91	0.14	465	465	465	Minimum Steel

Punching

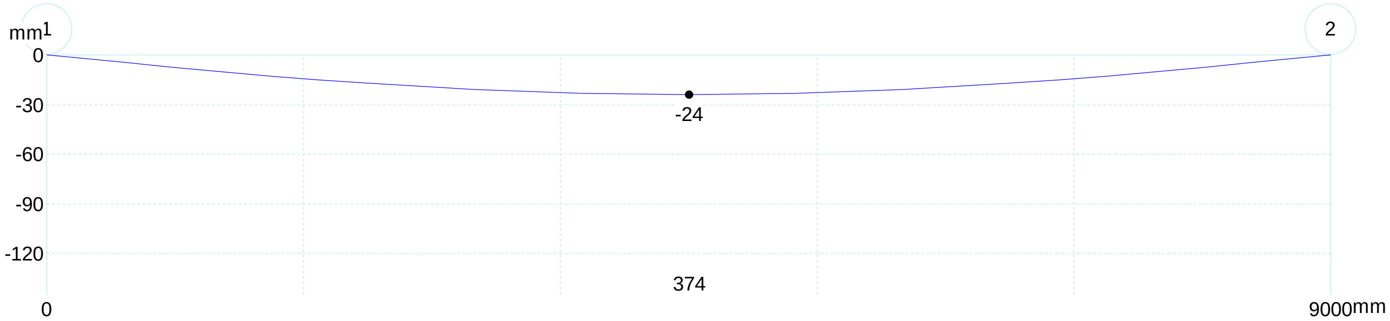
Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	V*eff	Vu	Vumax	Asv	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	mm2	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Check Not Carried Out!

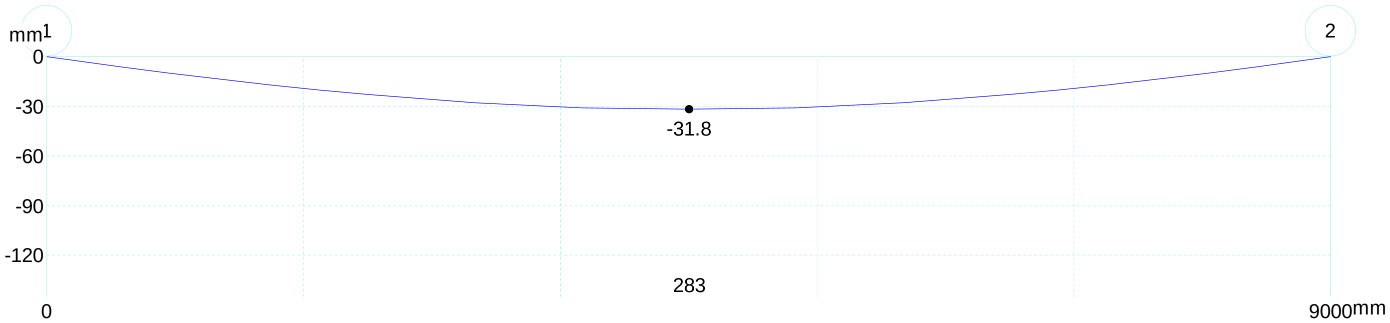
Deflections
Full live load
Transfer



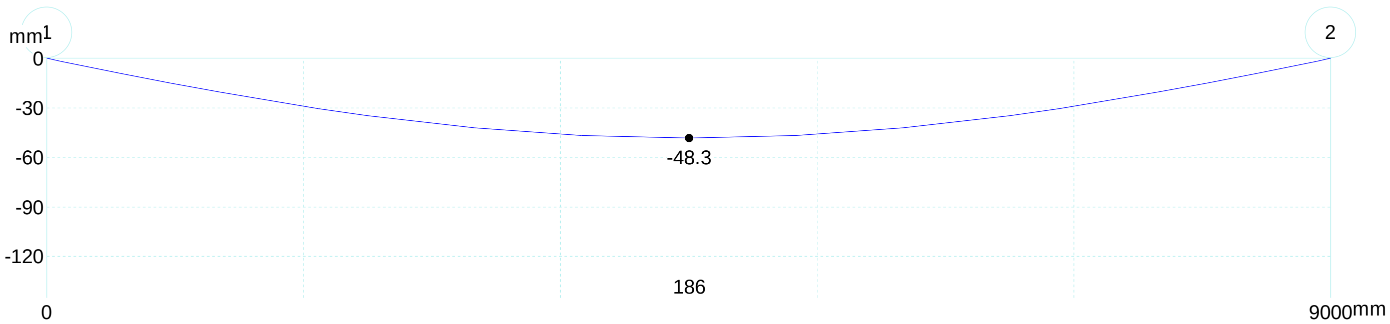
Short Term



Incremental



Total Long Term



Span 1

Design Comments:-

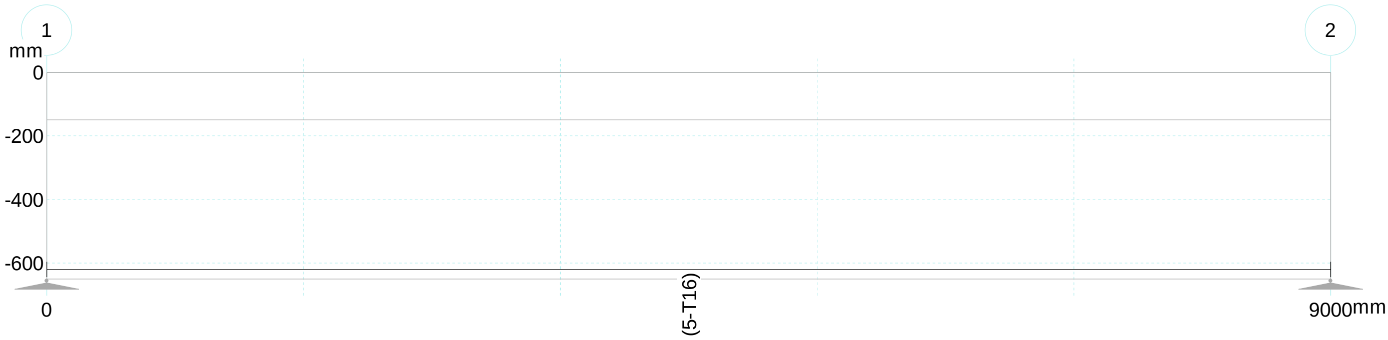
- Incremental Span/Deflection ratio less than user defined limit = 283
- Total Span/Deflection ratio less than user defined limit = 186
- Incremental Deflection greater than user defined limit = -31.8mm
- Total Deflection greater than user defined limit = -48.3mm

Detailed Reinforcement
Span 1

	Top Reinforcement					Bottom Reinforcement					Shear Reinforcement				
												Spacing of Sets			
Locat	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Space	Area	Depth	Section Width	Rebar Reqd	Area	2 legs T8	2 legs T10	2 legs T12	Shear Comments
mm	mm	mm2	mm	mm	A	mm	mm2	mm	mm	A	mm2/mm	mm	mm	mm	A
100	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
520	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
866	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
1212	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel

	Top Reinforcement					Bottom Reinforcement					Shear Reinforcement				
												Spacing of Sets			
Locat	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Space	Area	Depth	Section Width	Rebar Reqd	Area	2 legs T8	2 legs T10	2 legs T12	Shear Comments
mm	mm	mm2	mm	mm	A	mm	mm2	mm	mm	A	mm2/mm	mm	mm	mm	A
1558	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
1904	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
2250	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
3000	0	0	30	1125	No Steel Added	283.8	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
3750	0	0	30	1125	No Steel Added	237.3	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
4500	0	0	30	1125	No Steel Added	224.9	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
5250	0	0	30	1125	No Steel Added	237.3	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
6000	0	0	30	1125	No Steel Added	283.8	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
6750	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
7096	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
7442	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
7788	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
8134	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
8480	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel
8900	0	0	30	1125	No Steel Added	300	0	620	155	No Steel Added	0.14	465	465	465	Minimum Steel

Reinforcement Layout



S:\Projects\22150 - DFC Ladderblock\Engineering\Structural\Floor pannel\rev1\Rib beamwithouttopping.rpf

RAPT - Version: 6.2.0.7
Reinforced And Post-Tensioned Concrete Analysis & Design Package

Licensee
Waterman Emirates
Mostafawi Building Office 803
Khalid Bin Al-Waleed Road
Bur Dubai, Dubai UAE
59456281107UPP

Input

General

Design Code	List	United Kingdom - BS 8110*SAVED*
Material	List	United Kingdom - United Kingdom Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Beam
Panel Type	List	Internal
Strip Type	List	One way - Nominal Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	17.5MPa
Concrete - Columns	List	17.5MPa
Top Reinforcement Depth from top	mm	30
Bottom Reinforcement from bottom	mm	30
Self Weight Definition	List	User Defined
Pattern Live Load	Y/N	
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	9000	100	1125	1125
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse v'c
	A	List	mm	MPa
1	1	Knife-Edge	1125	
2	2	Knife-Edge	1125	

Beams

Beam Number	Beam Depth	Beam Width at Slab	Beam Width	Effective Flange Width
	mm	mm	mm	mm
1	600	233	150	1125

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Initial Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Line

Load	Left End Reference Column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m		mm	kN/m	A
1	1	0	3.91	2	0	3.91	

2. Initial Dead Load - Line

Load	Left End Reference Column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m		mm	kN/m	A
1	1	0	4.2	2	0	4.2	

3. Live Load - Line

Load	Left End Reference Column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Live Load reduction	Description
		mm	kN/m		mm	kN/m	#.#	A
1	1	0	4.5	2	0	4.5	1	

Load Combinations : Ultimate

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1.4	1.4	1.6
2	Live Load	1	1	1.6
3	Dead Load	1.5	1.5	0

Load Combinations : Short Term Service

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	1

Load Combinations : Permanent Service

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.25

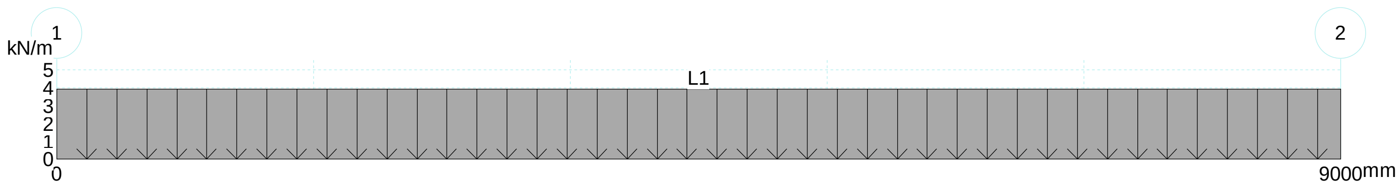
Load Combinations : Deflection

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Short Term - Deflection	1	1	1
2	Permanent - Deflection	1	1	0.25
3	Initial - Deflection	1	1	0

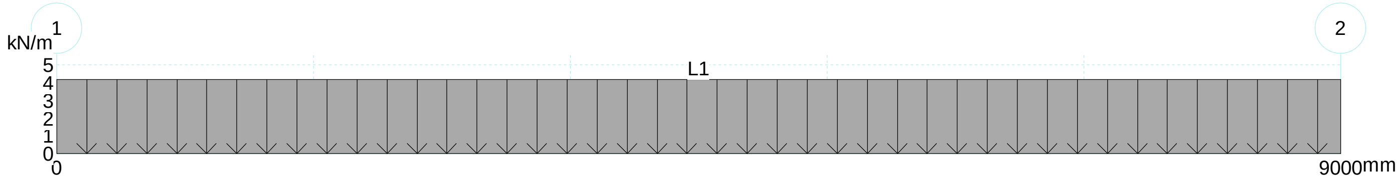
Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Initial Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

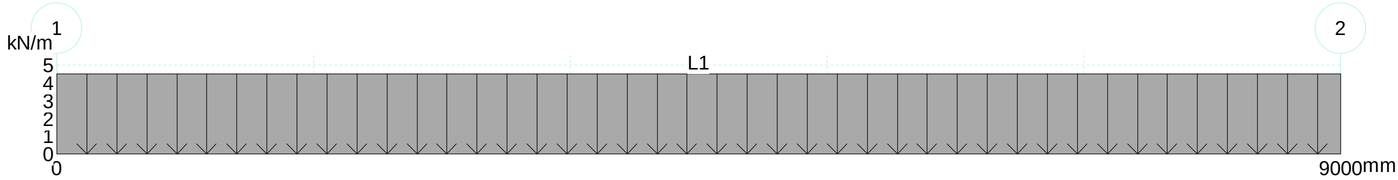
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Initial Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type	Preferred Bar Size	Number of Legs
	List	List	#
Flexural Bar	T 460MPa		
Flexural Mesh	A 460MPa		
Shear Option 1	T 460MPa	8	2
Shear Option 2	T 460MPa	10	2
Shear Option 3	T 460MPa	12	2
Punching Shear	T 460MPa	10	2

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	60	0			N	N
Span Reinforcement	300	60		0	0	N	N

Design Zones : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Depth From Top at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Depth From Top at right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size
	List		mm	mm	mm		mm	mm	mm	List	List	List
1	Bar	1	0	0	30	2	0	0	30	32	16	25

Layer Number	Minimum Number of Bars	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	#	mm	%	%
1	0	0	0	0

Design Zones : Bottom

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Depth From Bottom at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Depth From Bottom at right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size
	List		mm	mm	mm		mm	mm	mm	List	List	List
1	Bar	1	0	0	30	2	0	0	30	32	16	25

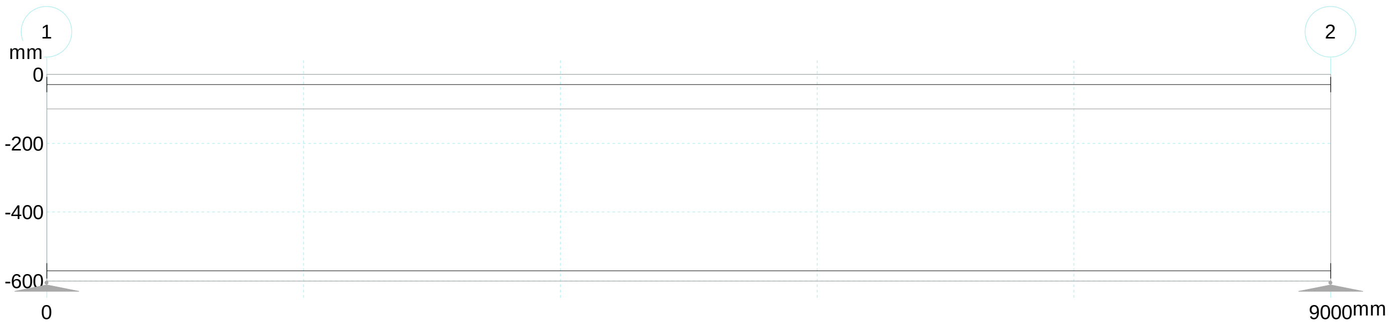
Layer Number	Minimum Number of Bars	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	#	mm	%	%
1	0	0	0	0

User Defined : Bottom

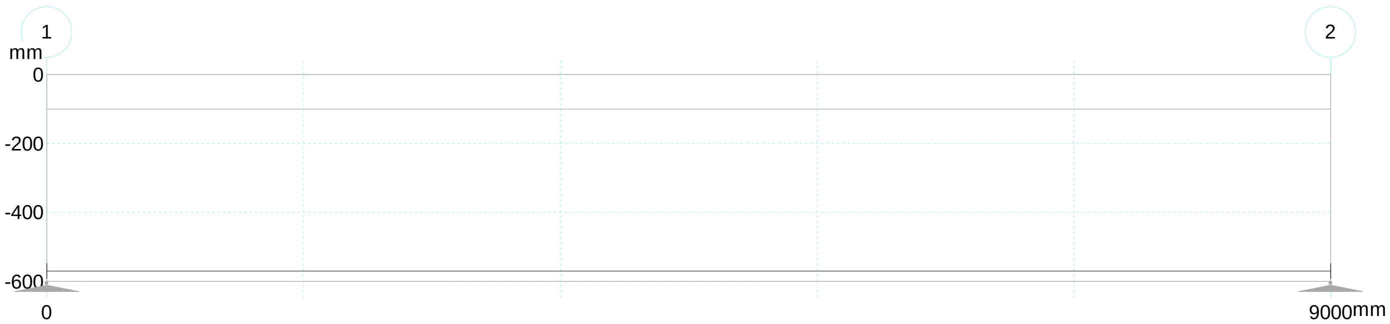
Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Depth From Datum at left end	% Development of Left End of Bar in Tension	% Development of Left End of Bar in Compression	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Depth From Datum at right end	% Development of Right End of Bar in Tension
	List		mm	mm	mm	%	%		mm	mm	mm	%
1	T 460MPa	1	0	0	570	81.3	0	1	9000	0	570	100

Layer Number	% Development of Right End of Bar in Compression	Bar Size	Number of Bars	Spacing of Bars	% in Flange
	%	List	#	mm	%
1	0	16	4	0	0

Reinforcement Design Zones



Reinforcement Design Zones User Defined



Design Data

Capacity Reduction factor (phi) for Flexure	#.#	1
Capacity Reduction factor (phi) for Shear	#.#	1
Material Factor for Concrete in Flexure	#.#	1.5
Material Factor for Concrete in Shear	#.#	1.25
Material Factor for Reinforcement	#.#	1.05
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.5
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	Y
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default

Maximum Service Stress Change - Prestressed Sections	MPa	200
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C.	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	S

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	20
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	500
Incremental Deflection Warning Limit - Maximum Deflection	mm	20
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	19.18
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#
Pattern Live Load for Ultimate Strength	Y/N
Pattern Live Load for Crack Control	Y/N
Pattern Live Load For Deflections	Y/N
Pattern Live Load for Deflection Permanent Load Combination	Y/N

Material Properties

Concrete

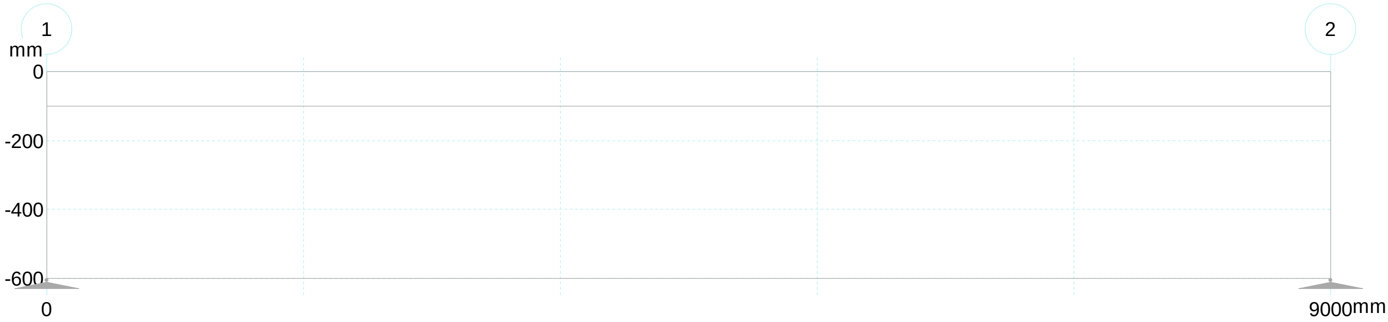
Description	17.5MPa
Characteristic Compressive Strength	19.2
Mean Compressive Strength	23.96
Lower Characteristic Tensile Strength	2.19
Upper Characteristic Tensile Strength	3.51
Concrete Weight	1600
Design Concrete Modulus	6472
Mean Concrete Modulus	6472
Ultimate Concrete Modulus	3920
Basic Shrinkage Strain	600
Basic Creep Factor	3.4
Concrete Strain Limit	0.004

Reinforcement Bar

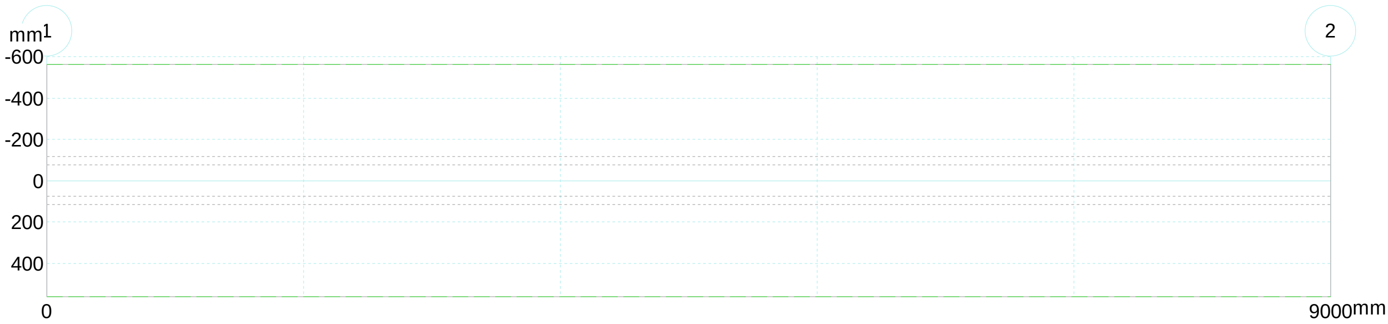
Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Description
T	Deformed	460	2e5	Normal	0.05	496.8	

Nominal Bar Size	Bar Diameter	Bar Area	Bar Inertia	Bar Weight	Stock Length
A	mm	mm2	mm4	kg/m	mm
8	8	50.3	201.14	0.4	12000
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
25	25	491	19182.5	3.85	12000
32	32	804	51492.6	6.31	12000
40	40	1260	1.257e5	9.86	12000

Elevation view



Plan view



Warnings

Input

No errors or warnings were found.

Output

Warning:Incremental Deflection span/deflection ratio in at least one span is less than defined limit.
Warning:Total Deflection span/deflection ratio in at least one span is less than defined limit.
Warning:Incremental deflection in at least one span is greater than defined limit.
Warning:Total deflection in at least one span is greater than defined limit.

Frame Properties

Span 1

Length	mm	9000
Inertia	mm4	6.17e9
Area	mm2	2.08e5

Column Members

Col No.	Area Above	Inertia Above	Area Below	Inertia Below
#	mm2	mm4	mm2	mm4
1	0	0	0	0
2	0	0	0	0

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Initial Dead Load	Live Load
Moment Above	kNm	0	0	0
Moment Below	kNm	0	0	0
Reaction	kN	17.62	18.9	20.25
Elastic Rotation	#.#	2.98e-3	3.2e-3	3.42e-3
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Initial Dead Load	Live Load
Moment Above	kNm	0	0	0
Moment Below	kNm	0	0	0
Reaction	kN	17.62	18.9	20.25
Elastic Rotation	#.#	-2.98e-3	-3.2e-3	-3.42e-3
Elastic Axial Shortening	mm	0	0	0

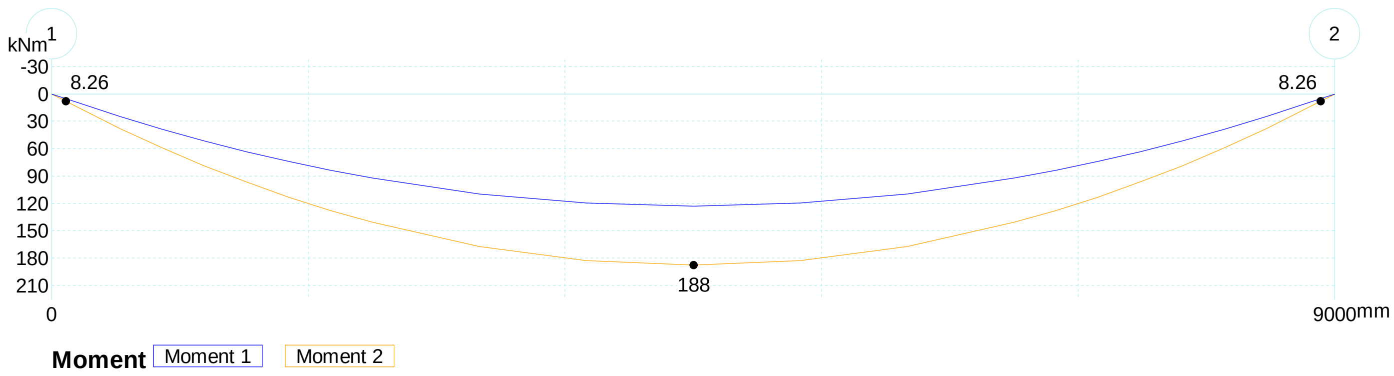
Load Combinations

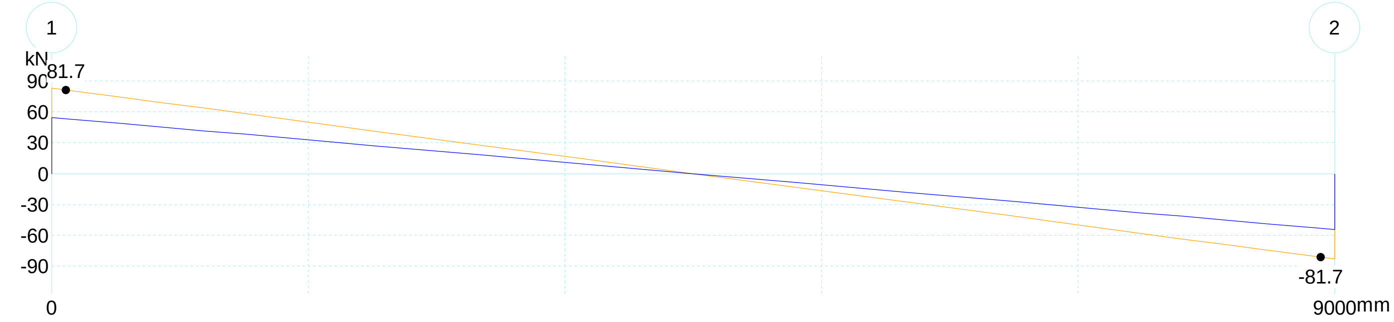
Column Actions

Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	56.77	56.77	83.52	83.52	54.78	83.52
Elastic Rotation	#.#	9.6e-3	9.6e-3	0.01	0.01	9.26e-3	0.01
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	56.77	56.77	83.52	83.52	54.78	83.52
Elastic Rotation	#.#	-9.6e-3	-9.6e-3	-0.01	-0.01	-9.26e-3	-0.01
Elastic Axial Shortening	mm	0	0	0	0	0	0

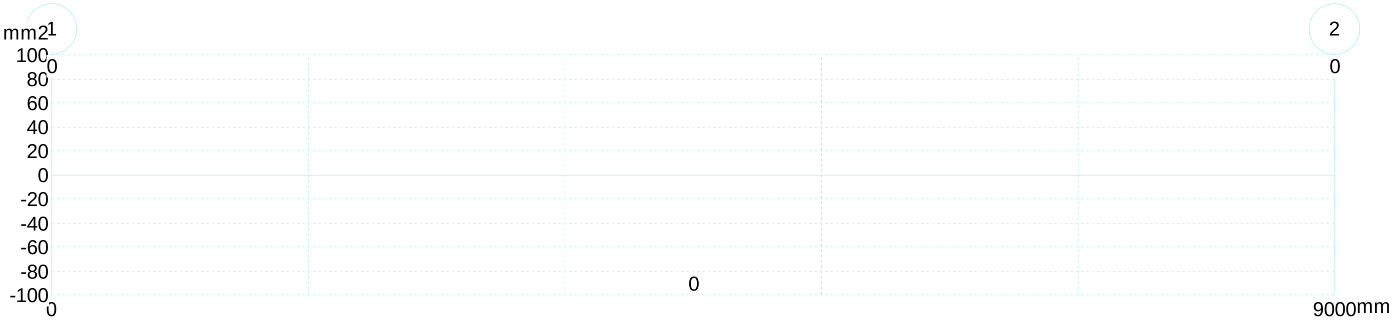
Ultimate Flexure



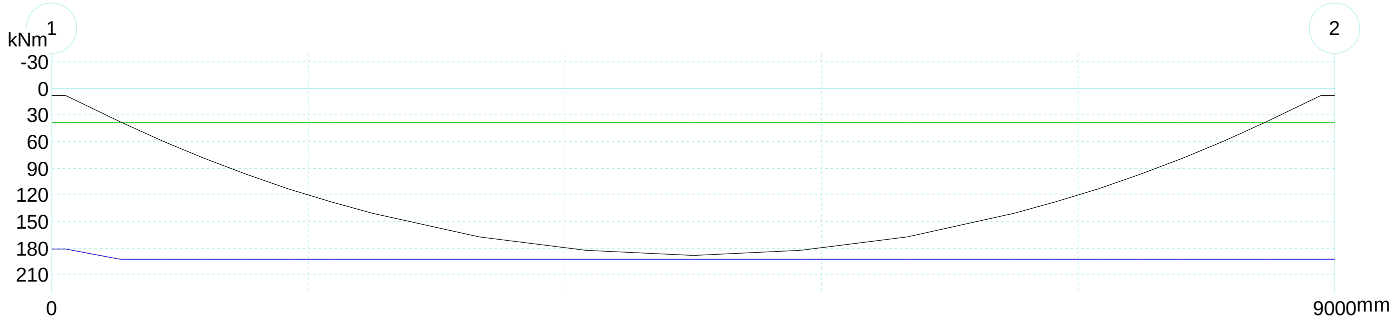


Shear Shear 1 Shear 2

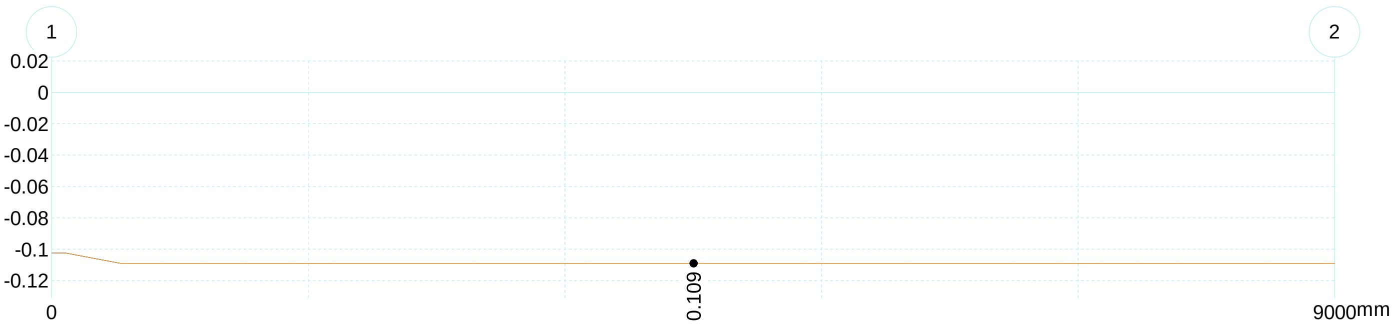
Flexural Design
Ultimate



Reinforcement Top Total Bottom Total Top Ultimate Bottom Ultimate Min Top Min Bot



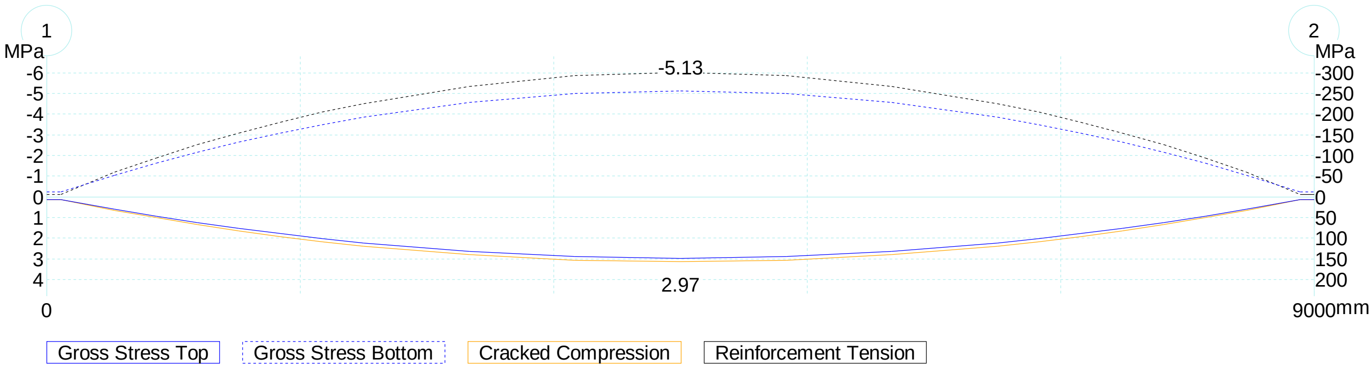
Capacity Minimum Ultimate Design Initial Final



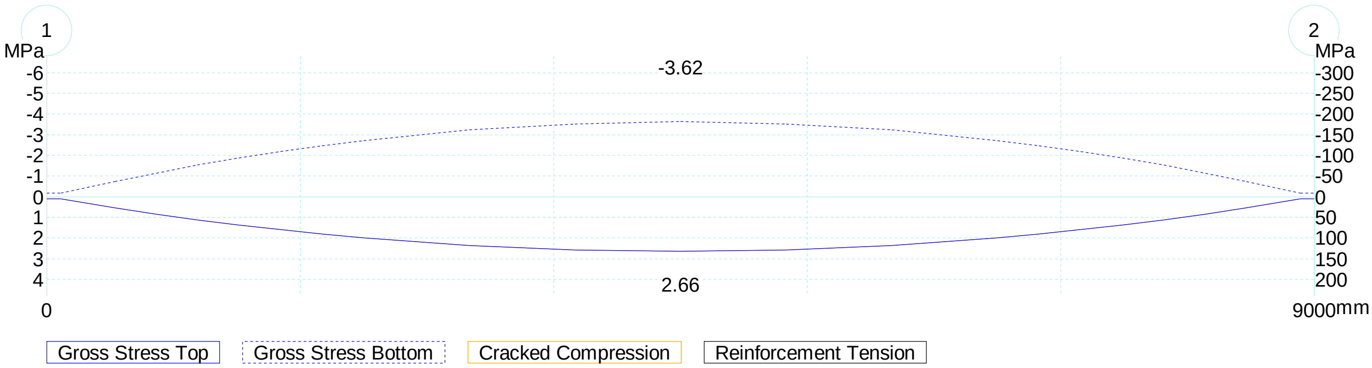
Neutral Axis Depth Initial Final

Service

Maximum Moment Condition



Reversal Moment Condition



Shear Design

Beam

Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Asv/s	Spacing of Sets			Shear Comments
											2 legs T8	2 legs T10	2 legs T12	
mm	kN	kN/m	kN/m	mm	mm2	mm	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	81.67	8.26	0	570	0	150	590.7	99999	590.7	0.14	427.5	427.5	427.5	Minimum Steel
480	74.62	37.95	0	570	0	150	125.73	99999	125.73	0.14	427.5	427.5	427.5	Minimum Steel
775	69.14	59.16	0	570	0	150	77.87	99999	77.87	0.14	427.5	427.5	427.5	Minimum Steel
1070	63.77	74.74	0	570	0	150	56.4	99999	56.4	0.14	427.5	427.5	427.5	Minimum Steel
1365	58.69	92.85	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
1660	53.22	109.36	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
1955	47.74	124.25	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
2250	43.79	127.28	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
3000	29.87	154.9	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
3750	18.48	158.79	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
4500	8.1	151.48	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
5250	-18.48	158.79	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
6000	-29.87	154.9	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
6750	-43.79	127.28	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
7045	-47.74	124.25	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
7340	-53.22	109.36	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
7635	-58.69	92.85	0	570	0	150	52.94	99999	52.94	0.14	427.5	427.5	427.5	Minimum Steel
7930	-63.77	74.74	0	570	0	150	56.4	99999	56.4	0.14	427.5	427.5	427.5	Minimum Steel
8225	-69.14	59.16	0	570	0	150	77.87	99999	77.87	0.14	427.5	427.5	427.5	Minimum Steel
8520	-74.62	37.95	0	570	0	150	125.73	99999	125.73	0.14	427.5	427.5	427.5	Minimum Steel
8900	-81.67	8.26	0	570	0	150	603.51	99999	603.51	0.14	427.5	427.5	427.5	Minimum Steel

Punching

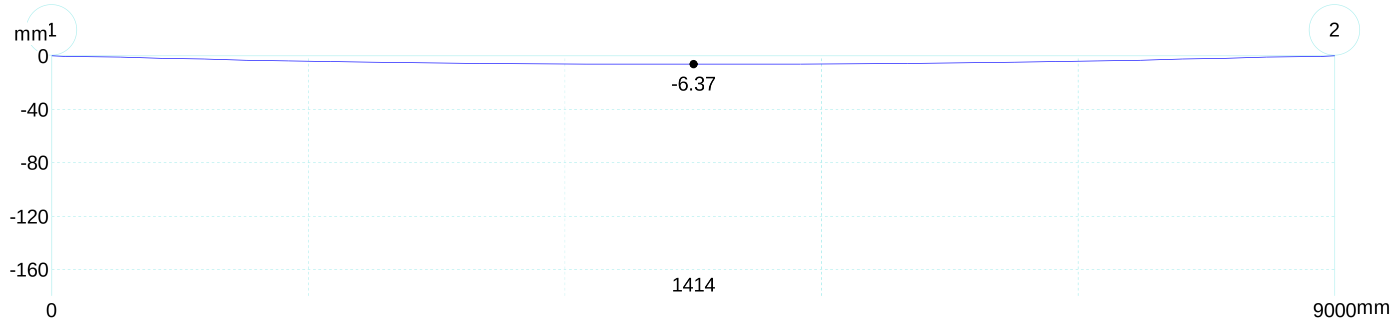
Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	V*eff	Vu	Vumax	Asv	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	mm2	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Check Not Carried Out!

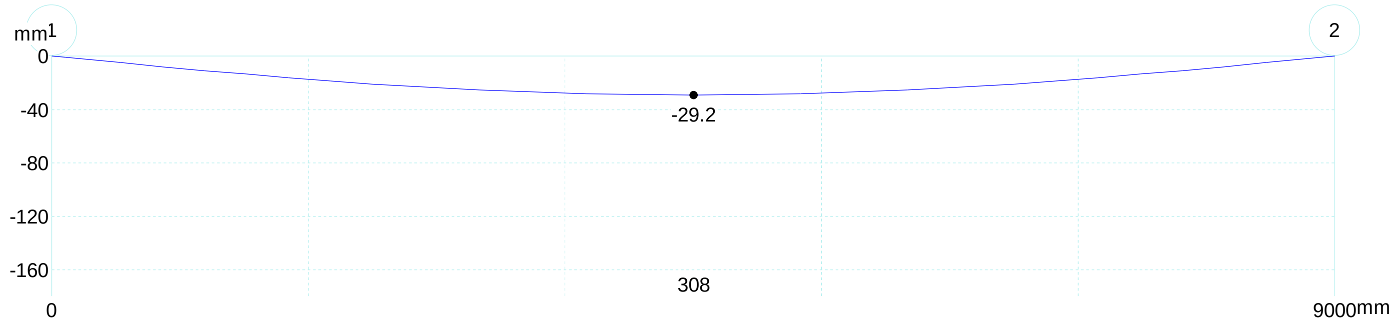
Deflections

Full live load

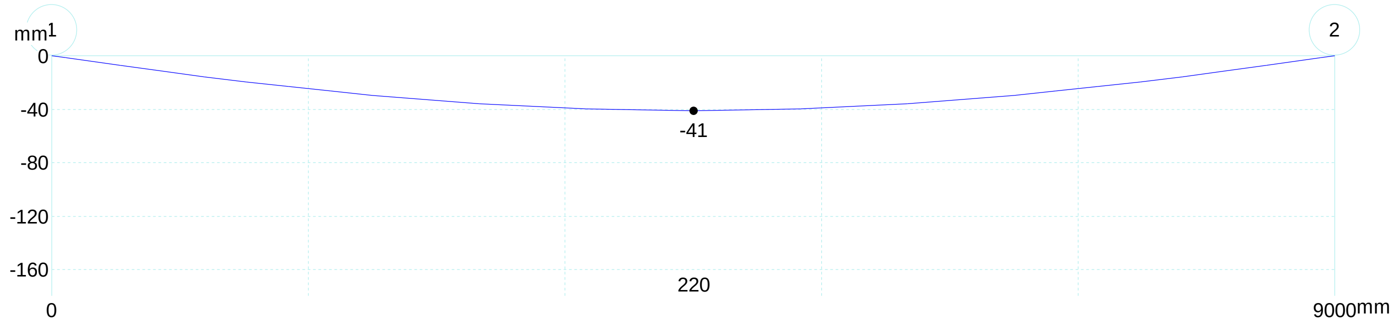
Transfer



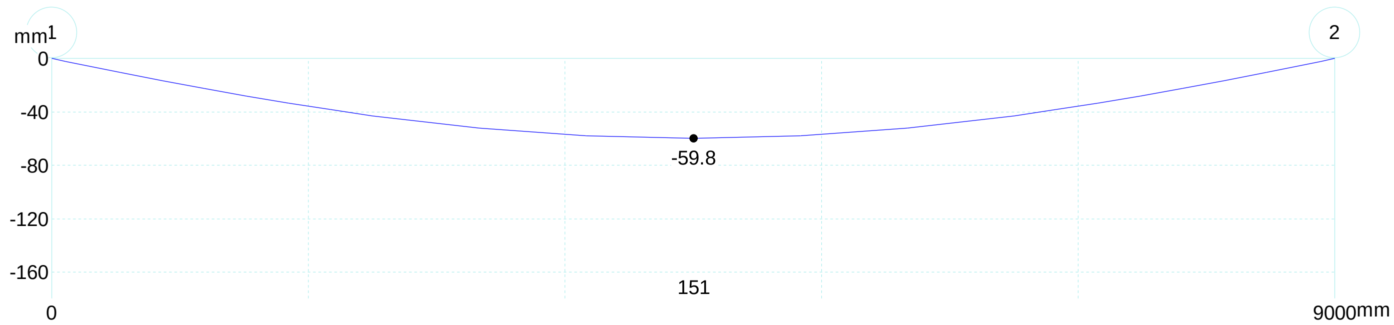
Short Term



Incremental



Total Long Term



Span 1

Design Comments:-

- Incremental Span/Deflection ratio less than user defined limit = 220
- Total Span/Deflection ratio less than user defined limit = 151
- Incremental Deflection greater than user defined limit = -41mm
- Total Deflection greater than user defined limit = -59.8mm

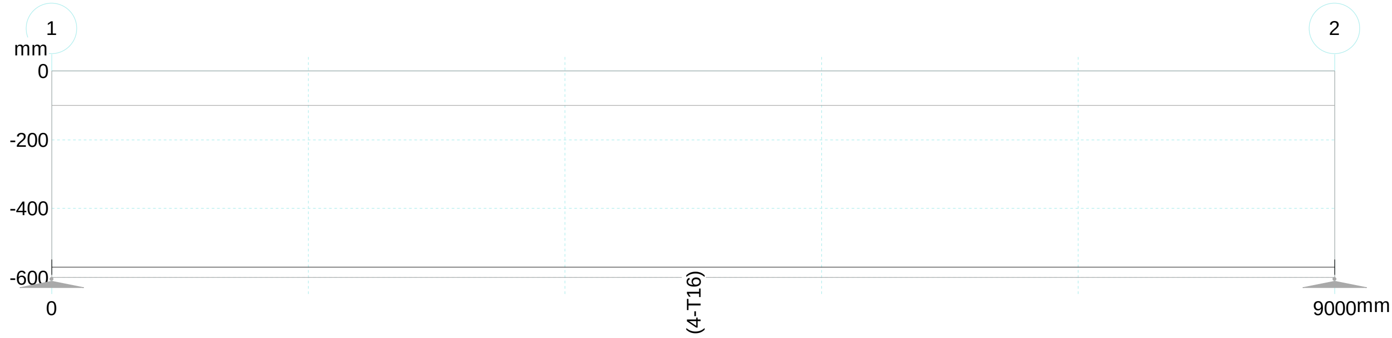
Detailed Reinforcement

Span 1

	Top Reinforcement					Bottom Reinforcement					Shear Reinforcement				
												Spacing of Sets			
Locat	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Space	Area	Depth	Section Width	Rebar Reqd	Area	2 legs T8	2 legs T10	2 legs T12	Shear Comments
mm	mm	mm2	mm	mm	A	mm	mm2	mm	mm	A	mm2/mm	mm	mm	mm	A
100	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
480	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
775	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
1070	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel

	Top Reinforcement					Bottom Reinforcement					Shear Reinforcement				
												Spacing of Sets			
Locat	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Space	Area	Depth	Section Width	Rebar Reqd	Area	2 legs T8	2 legs T10	2 legs T12	Shear Comments
mm	mm	mm2	mm	mm	A	mm	mm2	mm	mm	A	mm2/mm	mm	mm	mm	A
1365	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
1660	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
1955	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
2250	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
3000	0	0	30	1125	No Steel Added	236.5	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
3750	0	0	30	1125	No Steel Added	199.2	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
4500	0	0	30	1125	No Steel Added	189.8	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
5250	0	0	30	1125	No Steel Added	199.2	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
6000	0	0	30	1125	No Steel Added	236.5	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
6750	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
7045	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
7340	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
7635	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
7930	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
8225	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
8520	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel
8900	0	0	30	1125	No Steel Added	300	0	570	155	No Steel Added	0.14	427.5	427.5	427.5	Minimum Steel

Reinforcement Layout

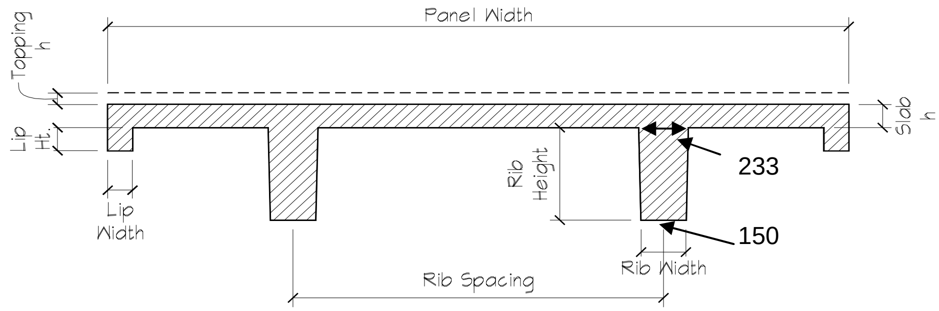


Waterman Emirates
Consulting Engineers and Facility Managers

Mostafawi Building, 8th Floor,
Khalid Bin Al-Waleed Road,
P.O.Box 117448
Dubai, United Arab

PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	DOCUMENT NO DC 3.6.1		DATE 9/12/2007
TITLE:	Calculation of deflection in floor block	DESIGNED MG	CHECKED GK	SHEET

Reference	Calculation	Remarks



Method 1 It is assumed that the entire load on the floor block has carried by the Rib beams (double tee structural element)

Item	Nos	Wide	Height	CG from Bottom of Rb (y) in m	Area	A y	Ixx (ind)	A $(Y-y)^2$	A $(Y-y)^2$ (Without topping)
Topping	1	3.00	0.05	0.63	0.15	0.09	3.13E-05	5.08E-03	
Slab	1	3.00	0.10	0.55	0.30	0.17	2.50E-04	1.41E-03	3.57E-03
Lib at edge	2	0.20	0.10	0.45	0.04	0.02	3.33E-05	3.95E-05	3.32E-06
Rb Triangle portion	2	0.08	0.50	0.33	0.042	0.01	5.76E-04	9.10E-04	4.80E-04
Rb rectangular portion	2	0.15	0.50	0.25	0.15	0.04	3.13E-03	8.03E-03	5.47E-03
					0.68	**0.33**	**4.02E-03**	**1.55E-02**	**9.52E-03**

<u>Section Properties including Topping</u>

Y	0.481	m	from Base
Area	681500	mm^2	
I_{xx} from CG	1.95E+10	mm^4	

<u>Section Properties excluding Topping</u>

Y	0.441	m	from Base
Area	531500	mm^2	
I_{xx} from CG	1.35E+10	mm^4	

<u>Loading</u>

<u>Dead</u>

Partition	=	1.00	kpa
Structural concrete floor topping	=	1.20	kpa
Concrete Floor panel	=	2.61	kpa
Typical floor finishes	=	1.30	kpa
Services & ceiling	=	0.50	kpa
		6.61	**kpa**
For 3m wide		19.83	KN/m

Mostafawi Building, 8th Floor,
Khalid Bin Al-Waleed Road,
P.O.Box 117448
Dubai, United Arab

PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	DOCUMENT NO DC 3.6.1		DATE 9/12/2007
TITLE:	Calculation of deflection in floor block	DESIGNED MG	CHECKED GK	SHEET

Reference	Calculation					Remarks
	<u>Live</u>		3.00	kpa		
	For 3m wide		9	KN/m		
	Span		9.00	m		
6.3.3 of Ladder block due diligence package document	Short term elastic modules of EC		6475	Mpa		
Spread sheet 6.3.3(A)	long term elastic modules of EC		3920	Mpa		
	<u>Deflection calculation</u>					
	δ		$5wl^4/384EI$			
	<u>Considering topping as structural component</u>					
	Deflection per unit load per m		0.68	mm/unit Load		
	<u>Without Considering topping as structural component</u>					
	Deflection per unit load per m		0.98	mm/unit Load		
	<u>Considering topping as structural component</u>					
	1.Service Loadings	1DL+1LL	28.83	KN/m		
BS8110-2	δ		19.51	mm		
Clause	<u>Without Considering topping as structural component</u>					
3.2.1.2	1.Service Loadings	1DL+1LL	27.63	KN/m		No Topping Load considered
	δ		26.99	mm	exceeding the limit	
	2.Long term deflection					
	Factor which is taken for Creep and cracked moment of inertia				2.75	
	<u>Considering topping as structural component</u>					
	Lodings	1DL+0.25LL	22.08	KN/m		
	δ		41.10	mm	exceeding the limit	
	<u>Without Considering topping as structural component</u>					
	Lodings	1DL+0.25LL	20.88	KN/m		No Topping Load considered
	δ		56.09	mm	exceeding the limit	

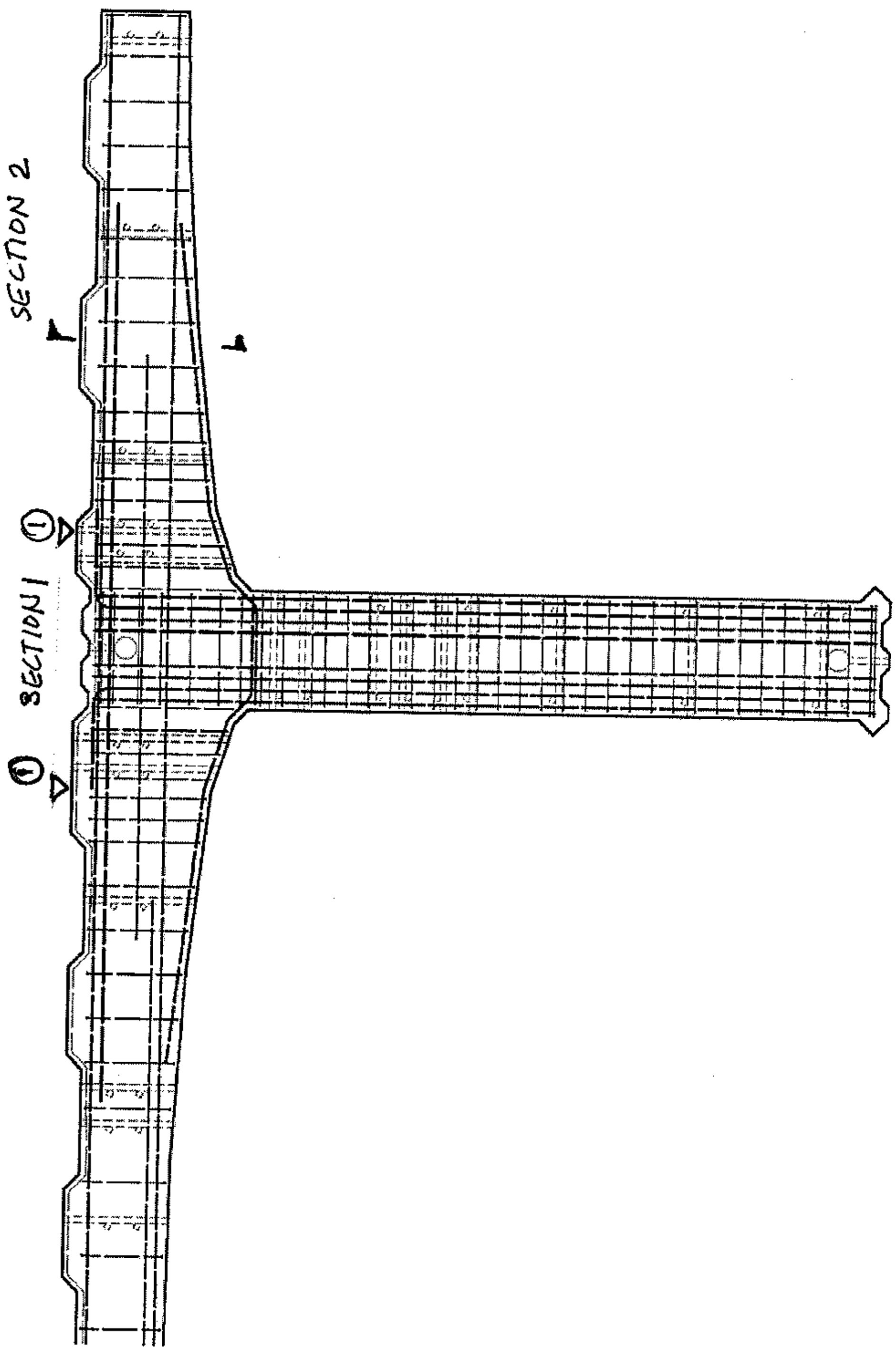
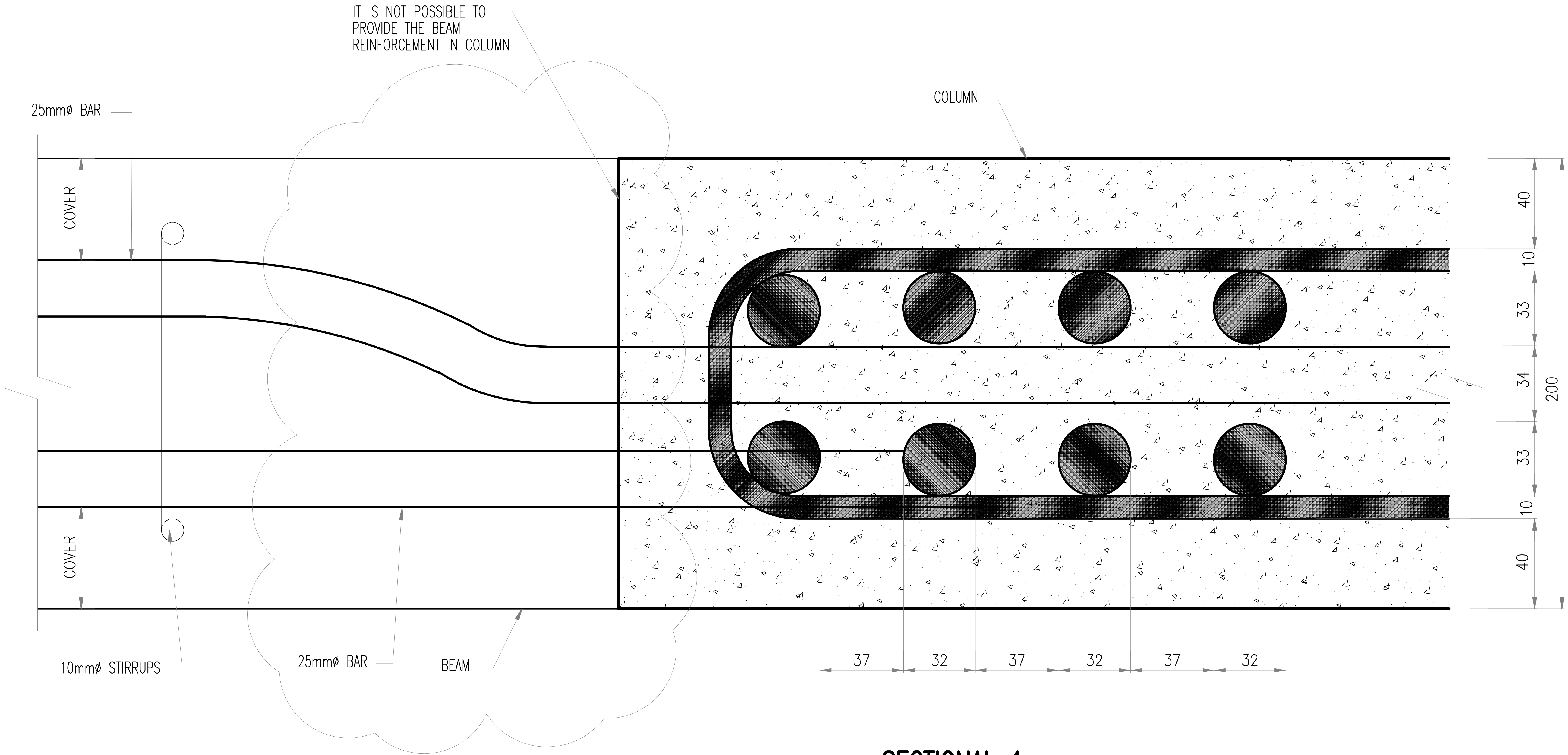


FIG. 6.3.2 (A)
ELEVATION OF OFFICE LEVEL LB FRAME REINFORCING



SECTIONAL 1

SK-3.8.1

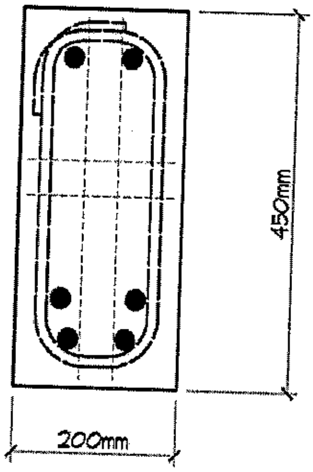


FIG. 6.3.1 (A)
200X450 BEAM SECTION AT MIDSPAN

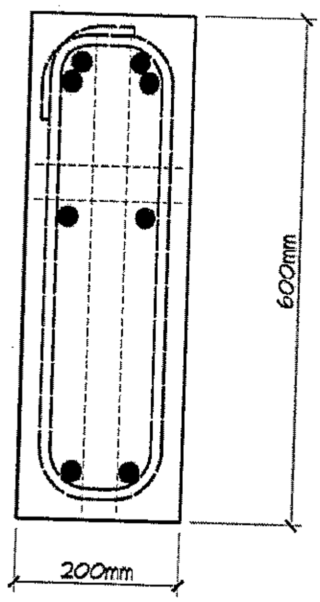


FIG. 6.3.1 (B)
200X600 BEAM SECTION AT FACE OF COLUMN

SECTION 2

Waterman Emirates
Consulting Engineers and Facility Managers

Mostafawi Building, 8th Floor,
Khalid Bin Al-Waleed Road,
P.O.Box 117448
Dubai, United Arab Emirates

PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	DOCUMENT NO		DATE
		D C 3.16.1		9/12/2007
TITLE:	CALCULATION OF PILE LOADING FOR PILE CAP 1	DESIGNED	CHECKED	SHEET
		MG	GK	

Load Cas	1SDL	1SDL	2SDWx	3SDWx	4SDWx	5SDWx	6SDWy	7SDWy	8SDWy	9SDWy	10SDE1	10SDE-1	11SDE1
DEAD	1	1	1	1	1	1	1	1	1	1	1	1	0.9
Reduced live	1	1	1	1			1	1					
LIVE	1	1	1	1			1	1					
WINDX			1	-1	1	-1	1	-1	1	-1			
WINDY													
SEISMIC-X											0.19	-0.186	0.139
SEISMIC-Y													

Load Cas	11SDE-1	12SDE1	12SDE-1	13SDE1	13SDE-1
DEAD	0.9	1	1	0.9	0.9
Reduced live					
LIVE					
WINDX					
WINDY					
SEISMIC-X	-0.186				
SEISMIC-Y		0.186	-0.186	0.139	-0.186

No of pile 6

fck 40

Centre of pile group:

X_{pg} 3.775 m

Y_{pg} 2.000 m

ΣIyy^2 40.04

ΣIxx^2 28.52

Total Area of pi 6.786 m^2

PILE INFORMATION

Pile No.	X (m)	Y (m)	Dia (m)	Area of pile (m2)	rx = (X-X$_{pg}$) (m)	ry = (Y-Y$_{p}$) (m)	Iyy= Ap*rx^2	IXX= Ap*ry^2	Capacity KN
1	0.8	-0.05	1.2	1.13	-2.975	-2.05	10.01	4.75	9490
2	6.75	-0.05	1.2	1.13	2.975	-2.05	10.01	4.75	9490
3	0.800	4.05	1.2	1.131	-2.98	2.05	10.01	4.75	9490
4	6.750	4.05	1.2	1.131	2.98	2.05	10.01	4.75	9490
5	3.775	-0.05	1.2	1.131		-2.05		4.75	9490
6	3.775	4.05	1.2	1.131		2.05		4.75	9490

Centre of loadings:

X_L 3.919

Y_L 2.306

Pile cap size 9.35 X 6.60 X 2.10

Total vertical l including pile cap

Load 3110 KN

P= 34261 kN

Total bending moment:

Mx= 10486.97 kNm

My= 4925.34 kNm

1SDL

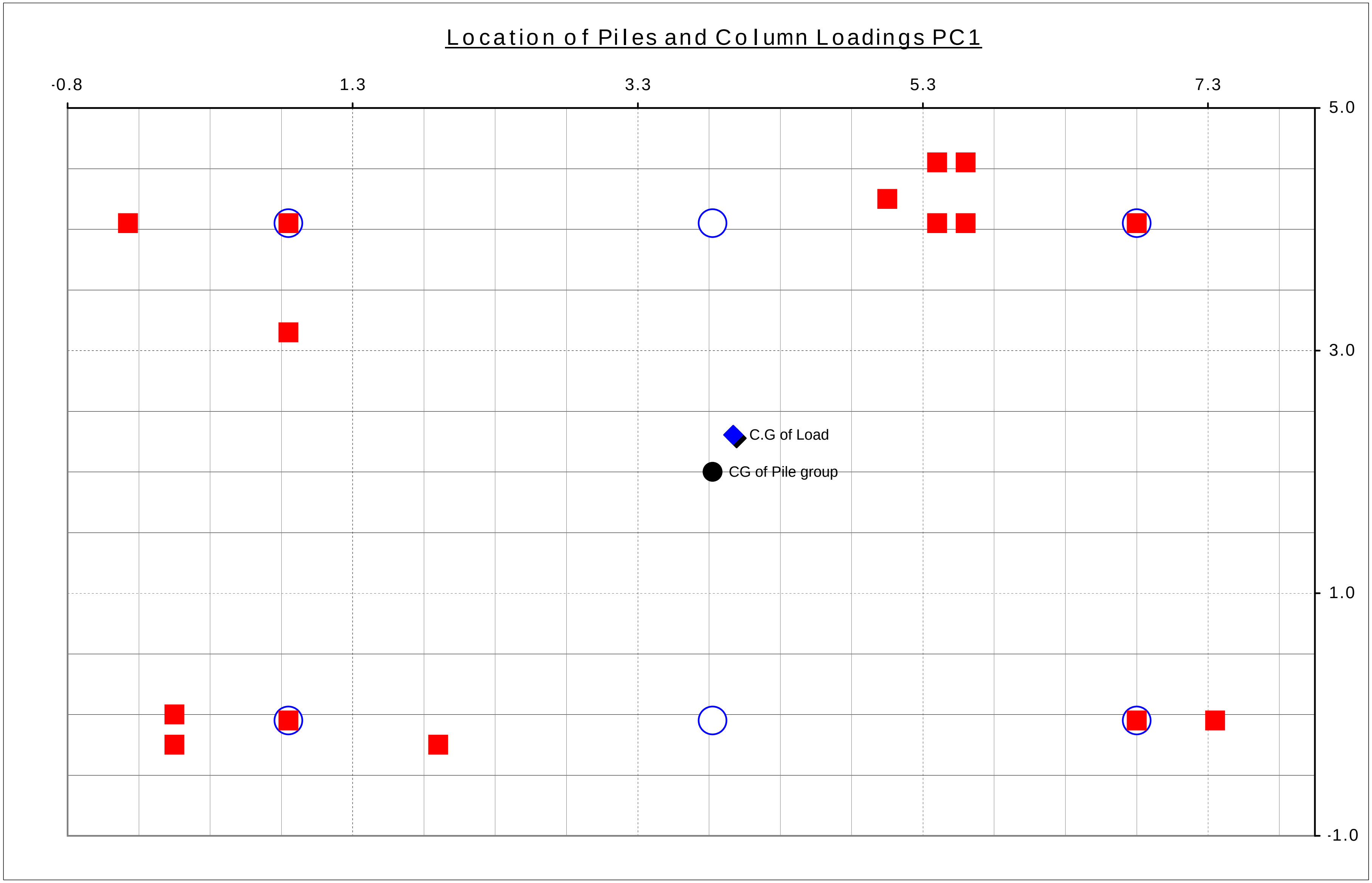
APPLIED LOADINGS

S / No	X (m)	Y (m)	P (kN)	Mx (kNm)	My (kNm)
37	1.85	-0.25	1560		
94	6.75	-0.05	4924		
384	0.80	4.05	2347		
428	0.80	3.15	1791		
N4525	0.80	-0.05	3566		
N4526	7.30	-0.05	452		
N4719	6.75	4.05	3527		
N4720	-0.33	4.05	607		
N12703	5.35	4.55	1485		
N13075	5.55	4.55	1387		
N13447		-0.25	1047		
N14764			1576		
2708	5.00	4.25	533		
1909	5.55	4.05	2998		
1911	5.35	4.05	3350		

Pile No.	Load on Pile	% tion
1	4443.64	0.47
2	5271.42	0.56
3	6148.83	0.65
4	6976.62	0.74
5	4857.53	0.51
6	6562.73	0.69

Critical load case

Pile No.	Max Load	Minimum Load	Utilisation
1	4951	2440	0.52
2	5551	2626	0.58
3	6203	3843	0.65
4	7814	3335	0.82
5	4971	2996	0.52
6	7009	3795	0.74


Location of Piles and Column Loadings PC1
-0.8
1.3
3.3
5.3
7.3
5.0
3.0
1.0
-1.0
C.G of Load
CG of Pile group

Waterman Emirates
Consulting Engineers and Facility Managers

Mostafawi Building, 8th Floor,
Khalid Bin Al-Waleed Road,
P.O.Box 117448
Dubai, United Arab Emirates

PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	DOCUMENT NO		DATE
		D C 3.16.2		9/12/2007
TITLE:	CALCULATION OF PILE LOADING FOR PILE CAP 2	DESIGNED	CHECKED	SHEET
		MG	GK	

Load Case	1SDL	1SDL	2SDWx	3SDWx	4SDWx	5SDWx	6SDWy	7SDWy	8SDWy	9SDWy	10SDE1	10SDE-1	11SDE1
DEAD	1	1	1	1	1	1	1	1	1	1	1	1	0.9
Reduced live	1	1	1	1			1	1					
LIVE	1	1	1	1			1	1					
WINDX			1	-1	1	-1	1	-1	1	-1			
WINDY													
SEISMIC-X											0.186	-0.1855	0.139
SEISMIC-Y													

Load Case	11SDE-1	12SDE1	12SDE-1	13SDE1	13SDE-1
DEAD	0.9	1	1	0.9	0.9
Reduced live					
LIVE					
WINDX					
WINDY					
SEISMIC-X	-0.186				
SEISMIC-Y		0.186	-0.186	0.139	-0.186

No of pile 6

fck 40

Centre of pile group:

X_{pg} 3.000 m

Y_{pg} 1.350 m

ΣIyy^2 40.72

ΣIxx^2 18.47

Total Area of pi 6.786 m^2

PILE INFORMATION

Pile No.	X (m)	Y (m)	Dia (m)	pile (m2)	rx = (X-X_{pg}) (m)	ry = (Y-Y_{pg}) (m)	Iyy=Ap*rx^2	IXX=Ap*ry^2	Capacity KN
1		-0.30	1.20	1.13	-3.00	-1.65	10.18	3.08	9490.00
2	6.00	-0.30	1.20	1.13	3.00	-1.65	10.18	3.08	9490.00
3		3.00	1.20	1.13	-3.00	1.65	10.18	3.08	9490.00
4	6.00	3.00	1.2	1.13	3.00	1.65	10.18	3.08	9490
5	3.00	-0.30	1.2	1.13	0.00	-1.65	0.00	3.08	9490
6	3.00	3.00	1.2	1.13	0.00	1.65	0.00	3.08	9490

Centre of loadings:

X_L 3.599

Y_L 1.309

Pile cap size 7.80 X 5.10 X 2.10

Total vertical l including pile cap Load 2005 KN

P= 38746 kN

Total bending moment:

Mx= -1602.83 kNm

My= 23209.23 kNm

1SDL

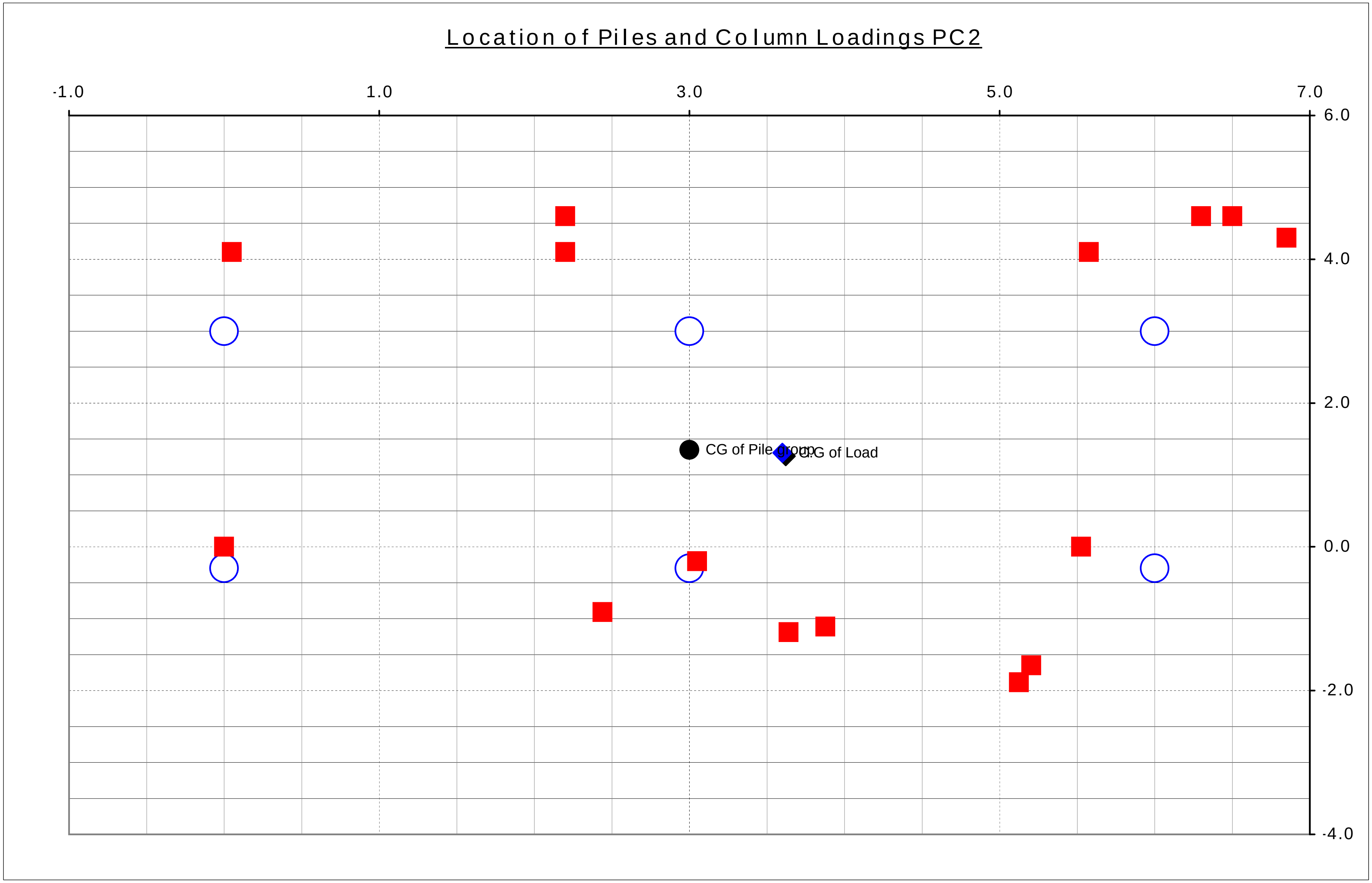
APPLIED LOADINGS

S/No	X (m)	Y (m)	P (kN)	Mx (kNm)	My (kNm)
N201	6.85	4.30	403		
N3001	6.50	4.60	2331		
N3047	6.30	4.60	388		
N3779	2.20	4.60	2024		
N3791	2.44	-0.91	696		
N3828	3.64	-1.19	2009		
N4051	5.13	-1.89	3015		
N4135	3.05	-0.20	1579		
N4288	5.20	-1.65	4546		
N4290	3.88	-1.11	3025		
N4309	5.53		2598		
N4310			3298		
N4361	5.58	4.10	2985		
N4362	0.05	4.10	2556		
5048	2.20	4.10	5288		

Pile No.	Load on Pile	Utilisation
1	4686	0.49
2	8554	0.90
3	4362	0.46
4	8230	0.87
5	6620	0.70
6	6296	0.66

Critical load case

Pile No.	Max Load	Minimum Load	Utilisation
1	4940	2335	0.52
2	8580	5013	0.90
3	5359	2293	0.56
4	8257	4443	0.87
5	6734	3693	0.71
6	6463	3368	0.68



Location of Piles and Column Loadings PC2
-1.0
1.0
3.0
5.0
7.0
6.0
4.0
2.0
0.0
-2.0
-4.0
CG of Pile group
CG of Load

Waterman Emirates
Consulting Engineers and Facility Managers

Mostafawi Building, 8th Floor,
Khalid Bin Al-Waleed Road,
P.O.Box 117448
Dubai, United Arab Emirates

PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	DOCUMENT NO		DATE
		D C 3.16.3		9/12/2007
TITLE:	CALCULATION OF PILE LOADING FOR PILE CAP 7& 8	DESIGNED	CHECKED	SHEET
		MG	GK	

	1SDL	1SDL	2SDWx	3SDWx	4SDWx	5SDWx	6SDWy	7SDWy	8SDWy	9SDWy	10SDE1	10SDE-1	11SDE1
DEAD	1	1	1	1	1	1	1	1	1	1	1	1	0.9
Reducedlive	1	1	1	1			1	1					
LIVE	1	1	1	1			1	1					
WINDX			1	-1	1	-1	1	-1	1	-1			
WINDY													
SEISMIC-X											0.186	-0.186	0.139
SEISMIC-Y													

	11SDE-1	12SDE1	12SDE-1	13SDE1	13SDE-1
DEAD	0.9	1	1	0.9	0.9
Reducedlive					
LIVE					
WINDX					
WINDY					
SEISMIC-X	-0.186				
SEISMIC-Y		0.186	-0.186	0.139	-0.186

No of pile 28

fck 40

Centre of pile group:

X_{pg} 6.550 m

Y_{pg} 6.536 m

ΣIyy^2 364.13

ΣIxx^2 640.06

Total Area of pile 21.771 m^2

PILE INFORMATION

Pile No.	X (m)	Y (m)	Dia (m)	Area of pile (m2)	$rx = (X-X_{pg})$ (m)	$ry = (Y-Y_{pg})$ (m)	$Iyy = Ap*rx^2$	$IXX = Ap*ry^2$	Capacity KN
1	-0.60		0.9	0.636	-7.15	-6.54	32.52	27.17	5410
2	1.90		1.2	1.131	-4.65	-6.54	24.45	48.31	9490
3	4.90		1.2	1.131	-1.65	-6.54	3.08	48.31	9490
4	8.20		1.2	1.131	1.65	-6.54	3.08	48.31	9490
5	11.20		1.2	1.131	4.65	-6.54	24.45	48.31	9490
6	13.70		0.9	0.636	7.15	-6.54	32.52	27.17	5410
7	1.90	3.00	0.9	0.636	-4.65	-3.54	13.76	7.95	5410
8	4.90	3.00	0.9	0.636	-1.65	-3.54	1.73	7.95	5410
9	8.20	3.00	0.9	0.636	1.65	-3.54	1.73	7.95	5410
10	11.20	3.00	0.9	0.636	4.65	-3.54	13.76	7.95	5410
11	1.90	5.25	0.9	0.636	-4.65	-1.29	13.76	1.05	5410
12	4.90	5.25	0.9	0.636	-1.65	-1.29	1.73	1.05	5410
13	8.20	5.25	0.9	0.636	1.65	-1.29	1.73	1.05	5410
14	11.20	5.25	0.9	0.636	4.65	-1.29	13.76	1.05	5410
15	-0.60	8.25	0.9	0.636	-7.15	1.71	32.52	1.87	5410
16	1.90	8.25	1.2	1.131	-4.65	1.71	24.45	3.32	9490
17	4.90	8.25	1.2	1.131	-1.65	1.71	3.08	3.32	9490
18	8.20	8.25	1.2	1.131	1.65	1.71	3.08	3.32	9490
19	11.20	8.25	1.2	1.131	4.65	1.71	24.45	3.32	9490
20	13.70	8.25	0.9	0.636	7.15	1.71	32.52	1.87	5410
21	1.90	12.38	0.9	0.636	-4.65	5.84	13.76	21.69	5410
22	4.90	12.38	0.9	0.636	-1.65	5.84	1.73	21.69	5410
23	8.20	12.38	0.9	0.636	1.65	5.84	1.73	21.69	5410
24	11.20	12.38	0.9	0.636	4.65	5.84	13.76	21.69	5410
25	1.90	16.50	0.9	0.636	-4.65	9.96	13.76	63.16	5410
26	4.90	16.50	0.9	0.636	-1.65	9.96	1.73	63.16	5410

Centre of loadings:

X_L 6.630 0.08 Pile cap size 16.25 X 19.02 X 2.10

Y_L 5.390 -1.15 Load 15575.7 KN

Total vertical loa excluding pile cap

P= 91158.81 kN

Total bending moment:

Mx= -104420.07 kNm

My= 7286.89 kNm

1SDL

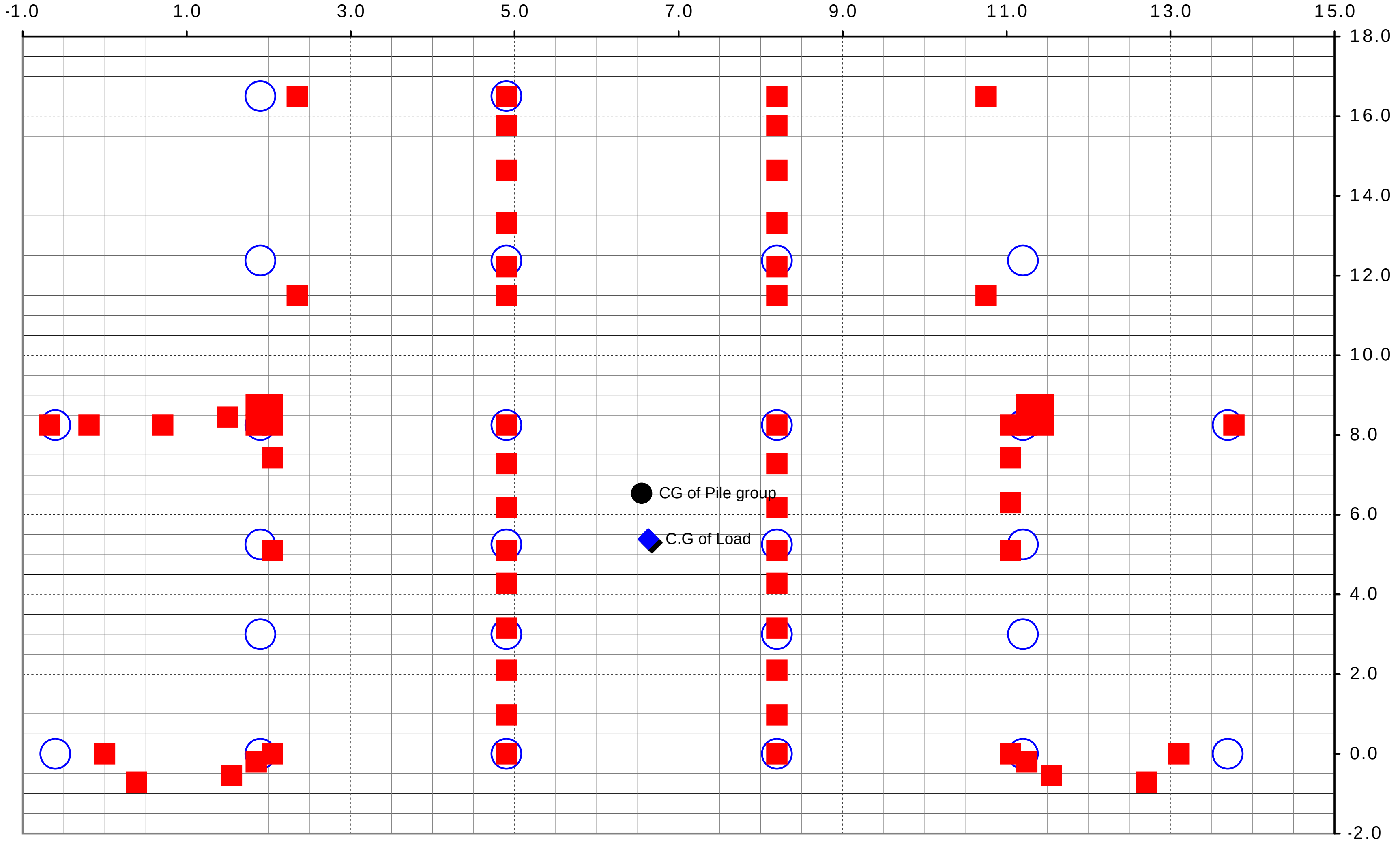
APPLIED LOADINGS					
Node Number	X (*m*)	Y (*m*)	P (*kN*)	Mx (*kNm*)	My (*kNm*)
46	-0.19	8.25	603		
70	0.71	8.25	958		
147	1.85	8.25	3245		
157	4.90	12.22	226		
158	8.20	12.22	223		
161	4.90	13.32	261		
162	8.20	13.32	241		
165	4.90	14.64	263		
166	8.20	14.64	243		
169	4.90	15.77	245		
170	8.20	15.77	245		
500	2.05	7.43	1349		
501	11.05	7.43	1101		
725	11.05	6.30	1553		
849	4.90	7.28	1117		
850	8.20	7.28	1139		
893	4.90	6.18	1223		
894	8.20	6.18	1195		
1619	4.90	4.28	1106		
1620	8.20	4.28	1077		
1663	4.90	3.15	975		
1664	8.20	3.15	941		
1707	4.90	2.10	955		
1708	8.20	2.10	923		
1751	4.90	0.98	1194		
1752	8.20	0.98	1187		
N199	1.50	8.45	429		
N1105	1.85	8.75	1541		
N1220	1.55	-0.55	487		
N2157	11.55	-0.55	494		
N3023	11.25	8.75	1725		
N3066	11.45	8.75	1791		
N3458	2.05	8.75	1672		
N4047	12.71	-0.72	1530		
N4050	0.39	-0.72	1379		
N4080	11.25	-0.20	1719		
N4081	1.85	-0.20	1678		
N4368	-0.68	8.25	241		
N4373	13.78	8.25	867		
N4477	11.05	5.10	4132		
N4479	4.90	5.10	2661		
N4480	2.05	5.10	4717		
N4481	8.20	5.10	2582		
N4708	2.05	8.25	4166		
N4709	4.90	8.25	2003		
N4710	8.20	8.25	2068		
N4711	11.05	8.25	1924		
N4770	2.35	16.49	683		
N4771	2.35	11.49	652		
N4772	4.90	16.49	452		
N4773	4.90	11.49	418		
N4774	8.20	16.49	457		
N4775	8.20	11.49	418		
N4776	10.75	16.49	705		
N4777	10.75	11.49	670		
N4884	8.20		2220		
N4886	13.10		1399		
N4887	11.05		4543		
N4889	4.90		2219		
N4890	2.05		4477		
N4891			1373		
4751	11.45	8.25	3773		
5466	11.25	8.25	3101		

Critical load case

Pile No.	Load on Pile	%	Pile No.	Max Load	Mini Load	Utilisation
1	3251.02	0.60	1	3898	1170	0.721
2	5836.17	0.61	2	6954	2128	0.733
3	5904.06	0.62	3	6984	2185	0.736
4	5978.75	0.63	4	7016	2249	0.739
5	6046.65	0.64	5	7046	2307	0.742
6	3433.07	0.63	6	3977	1325	0.735
7	2971.49	0.55	7	3223	1451	0.596
8	3009.68	0.56	8	3210	1479	0.593
9	3051.69	0.56	9	3228	1509	0.597
10	3089.89	0.57	10	3245	1538	0.6
11	2737.97	0.51	11	2918	1578	0.539
12	2776.16	0.51	12	2896	1606	0.535
13	2818.18	0.52	13	2872	1637	0.531
14	2856.37	0.53	14	2863	1665	0.529
15	2394.79	0.44	15	2529	1337	0.468
16	4313.98	0.45	16	4464	2640	0.47
17	4381.88	0.46	17	4425	2957	0.466
18	4456.57	0.47	18	4531	3027	0.477
19	4524.47	0.48	19	4705	2697	0.496
20	2576.84	0.48	20	2729	1362	0.504
21	1998.50	0.37	21	2317	784	0.428
22	2036.69	0.38	22	2350	798	0.434
23	2078.71	0.38	23	2385	814	0.441
24	2116.90	0.39	24	2418	828	0.447
25	1570.39	0.29	25	2691	-173	0.497
26	1608.58	0.30	26	2723	-159	0.503
27	1650.59	0.31	27	2759	-144	0.51
28	1688.78	0.31	28	2791	-130	0.516

Summary of Total force			
LC	P	Mx	My
1SDL	91159	-104420	7287
2SDWx	89588	-72423	18744
3SDWx	92730	-136417	-4171
4SDWx	70478	-42974	16137
5SDWx	73620	-106968	-6778
6SDWy	89588	-72423	18744
7SDWy	92730	-136417	-4171
8SDWy	70478	-42974	16137
9SDWy	73620	-106968	-6778
10SDE1	70911	-70098	44315
10SDE-1	73187	-79843	-34955
11SDE1	63990	-63818	33954
11SDE-1	65982	-72346	-35423
12SDE1	62928	91083	6199
12SDE-1	81170	-241025	3161
13SDE1	58000	57133	5352
13SDE-1	73965	-233528	2693

Location of Piles and Column Loadings for PC7&PC8



Waterman Emirates
Consulting Engineers and Facility Managers

Mostafawi Building, 8th Floor,
Khalid Bin Al-Waleed Road,
P.O.Box 117448
Dubai, United Arab Emirates

PROJECT:	Structural validation - scheme design peer review for DFC 03F Tower	DOCUMENT NO		DATE
		D C 3.16.4		9/12/2007
TITLE:	Calculation of pile loading for pile cap 7& 8 with out tension piles for seismic load which produce tension	DESIGNED	CHECKED	SHEET
		MG	GK	

	13SD	1SDL	2SDWx	3SDWx	4SDWx	5SDWx	6SDWy	7SDWy	8SDWy	9SDWy	10SDE1	10SDE-1	11SDE1
DEAD	0.9	1	1	1	1	1	1	1	1	1	1	1	0.9
Reducedlive		1	1	1			1	1					
LIVE		1	1	1			1	1					
WINDX			1	-1	1	-1	1	-1	1	-1			
WINDY													
SEISMIC-X											0.186	-0.186	0.139
SEISMIC-Y	-0.19												

	11SDE-1	12SDE1	12SDE-1	13SDE1	13SDE-1
DEAD	0.9	1	1	0.9	0.9
Reducedlive					
LIVE					
WINDX					
WINDY					
SEISMIC-X	-0.186				
SEISMIC-Y		0.186	-0.186	0.139	-0.186

No of pile 24

fck 40

Centre of pile group:

X_{pg} 6.550 m

Y_{pg} 5.217 m

ΣIyy^2 333.15

ΣIxx^2 353.97

Total Area of pile 19.227 m^2

PILE INFORMATION

Pile No.	X (m)	Y (m)	Dia (m)	Area of pile (m2)	rx = $(X-X_{pg})$ (m)	ry = $(Y-Y_{pg})$ (m)	Iyy= $Ap*rx^2$	IXX= $Ap*ry^2$	Capacity KN
1	-0.60		0.9	0.636	-7.15	-5.22	32.52	17.31	5410
2	1.90		1.2	1.131	-4.65	-5.22	24.45	30.78	9490
3	4.90		1.2	1.131	-1.65	-5.22	3.08	30.78	9490
4	8.20		1.2	1.131	1.65	-5.22	3.08	30.78	9490
5	11.20		1.2	1.131	4.65	-5.22	24.45	30.78	9490
6	13.70		0.9	0.636	7.15	-5.22	32.52	17.31	5410
7	1.90	3.00	0.9	0.636	-4.65	-2.22	13.76	3.13	5410
8	4.90	3.00	0.9	0.636	-1.65	-2.22	1.73	3.13	5410
9	8.20	3.00	0.9	0.636	1.65	-2.22	1.73	3.13	5410
10	11.20	3.00	0.9	0.636	4.65	-2.22	13.76	3.13	5410
11	1.90	5.25	0.9	0.636	-4.65	0.03	13.76	0.00	5410
12	4.90	5.25	0.9	0.636	-1.65	0.03	1.73	0.00	5410
13	8.20	5.25	0.9	0.636	1.65	0.03	1.73	0.00	5410
14	11.20	5.25	0.9	0.636	4.65	0.03	13.76	0.00	5410
15	-0.60	8.25	0.9	0.636	-7.15	3.03	32.52	5.85	5410
16	1.90	8.25	1.2	1.131	-4.65	3.03	24.45	10.40	9490
17	4.90	8.25	1.2	1.131	-1.65	3.03	3.08	10.40	9490
18	8.20	8.25	1.2	1.131	1.65	3.03	3.08	10.40	9490
19	11.20	8.25	1.2	1.131	4.65	3.03	24.45	10.40	9490
20	13.70	8.25	0.9	0.636	7.15	3.03	32.52	5.85	5410
21	1.90	12.38	0.9	0.636	-4.65	7.16	13.76	32.60	5410
22	4.90	12.38	0.9	0.636	-1.65	7.16	1.73	32.60	5410
23	8.20	12.38	0.9	0.636	1.65	7.16	1.73	32.60	5410
24	11.20	12.38	0.9	0.636	4.65	7.16	13.76	32.60	5410

Centre of loadings:

XL 6.586   Pile cap size 16.25 X 19.01 X 2.10

YL 3.378   Load 15570 KN

Total vertical load: excluding pile cap

P= 73964.75 kN

Total bending moment:

Mx= -135982.78 kNm

My= 2692.61 kNm

1SDL

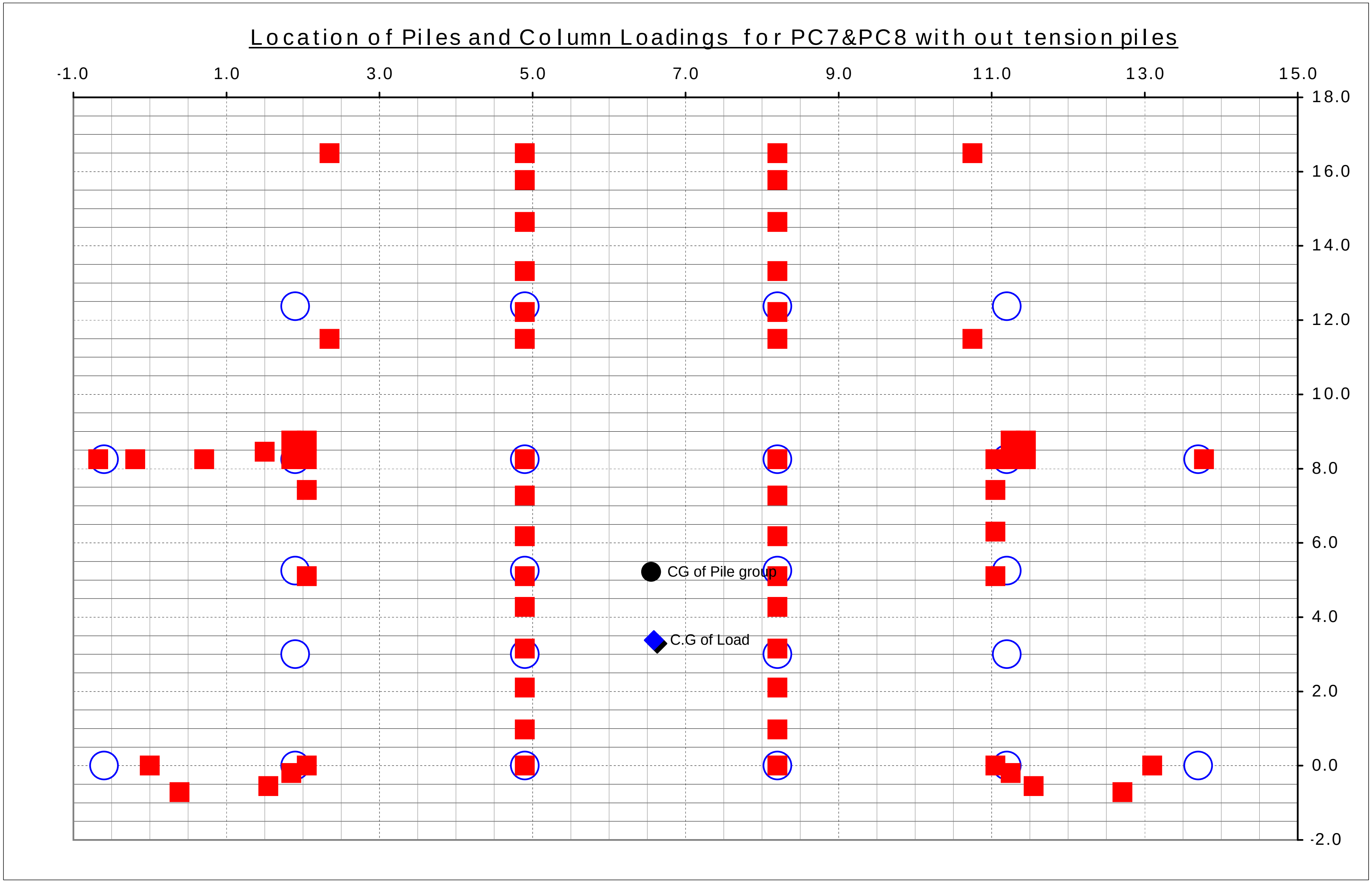
APPLIED LOADINGS

Node Number	X (*m*)	Y (*m*)	P (*kN*)	Mx (*kNm*)	My (*kNm*)
46	-0.19	8.25	17		
70	0.71	8.25	61		
147	1.85	8.25	1685		
157	4.90	12.22	351		
158	8.20	12.22	348		
161	4.90	13.32	246		
162	8.20	13.32	233		
165	4.90	14.64	225		
166	8.20	14.64	213		
169	4.90	15.77	72		
170	8.20	15.77	72		
500	2.05	7.43	464		
501	11.05	7.43	247		
725	11.05	6.30	1134		
849	4.90	7.28	253		
850	8.20	7.28	254		
893	4.90	6.18	797		
894	8.20	6.18	786		
1619	4.90	4.28	814		
1620	8.20	4.28	809		
1663	4.90	3.15	1035		
1664	8.20	3.15	1016		
1707	4.90	2.10	1120		
1708	8.20	2.10	1102		
1751	4.90	0.98	1745		
1752	8.20	0.98	1746		
N199	1.50	8.45	382		
N1105	1.85	8.75	145		
N1220	1.55	-0.55	187		
N2157	11.55	-0.55	189		
N3023	11.25	8.75	212		
N3066	11.45	8.75	163		
N3458	2.05	8.75	206		
N4047	12.71	-0.72	2798		
N4050	0.39	-0.72	2688		
N4080	11.25	-0.20	2638		
N4081	1.85	-0.20	2602		
N4368	-0.68	8.25	0		
N4373	13.78	8.25	56		
N4477	11.05	5.10	3568		
N4479	4.90	5.10	1899		
N4480	2.05	5.10	4005		
N4481	8.20	5.10	1798		
N4708	2.05	8.25	1815		
N4709	4.90	8.25	369		
N4710	8.20	8.25	382		
N4711	11.05	8.25	255		
N4770	2.35	16.49	365		
N4771	2.35	11.49	840		
N4772	4.90	16.49	127		
N4773	4.90	11.49	656		
N4774	8.20	16.49	131		
N4775	8.20	11.49	654		
N4776	10.75	16.49	380		
N4777	10.75	11.49	850		
N4884	8.20		3306		
N4886	13.10		2066		
N4887	11.05		6375		
N4889	4.90		3295		
N4890	2.05		6311		
N4891			2043		
4751	11.45	8.25	1590		
5466	11.25	8.25	1775		

Pile No.	Load on Pile	%Utilisation
1	3686	0.68
2	6575	0.69
3	6602	0.70
4	6633	0.70
5	6660	0.70
6	3759	0.69
7	2965	0.55
8	2981	0.55
9	2998	0.55
10	3013	0.56
11	2415	0.45
12	2431	0.45
13	2448	0.45
14	2463	0.46
15	1669	0.31
16	2991	0.32
17	3018	0.32
18	3048	0.32
19	3076	0.32
20	1743	0.32
21	674	0.12
22	689	0.13
23	706	0.13
24	722	0.13

Summary of Total force

LC	P	Mx	My
1SDL	91159	15800	7287
2SDWx	89588	45725	18744
3SDWx	92730	-14125	-4171
4SDWx	70478	49973	16137
5SDWx	73620	-9878	-6778
6SDWy	89588	45725	18744
7SDWy	92730	-14125	-4171
8SDWy	70478	49973	16137
9SDWy	73620	-9878	-6778
10SDE1	70911	23420	44315
10SDE-1	73187	16676	-34955
11SDE1	63990	20573	33954
11SDE-1	65982	14671	-35423
12SDE1	62928	174073	6199
12SDE-1	81170	-133978	3161
13SDE1	58000	133624	5352
13SDE-1	73965	-135983	2693



Location of Piles and Column Loadings for PC7&PC8 with out tension piles
-1.0
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
CG of Pile group
C.G of Load

UBC CHECK LIST BY SEAOC RF : 3.1.2.1

IV EARTHQUAKE DESIGN — LOADS

IV. EARTHQUAKE DESIGN — LOADS

A. Terms used to Calculate Earthquake Load "*E*" and Resulting Earthquake Design Forces

Z	Zone Factor (Table 16-I)
S_A, S_B, S_C, S_D, S_E or S_F	Soil Profile Types (Table 16-J)
N_a, N_v	Near-source Factors (Zone 4 only) (Tables 16-S, 16-T)
C_a, C_v	Seismic Coefficients (Soil Type and Seismic Zone) (Tables 16-S, 16-T)
R	Response Factor (Table 16-N) ($R \approx R_W/1.4$)
V	Base Shear (Section 1630.2)
ρ	Redundancy Factor [Section 1630.1.1, Formula (30-3)]
E	Earthquake Load [Section 1630.1.1, Formula (30-1)*]
Earthquake Design Forces	LRFD or Strength Design (Section 1612.2) Allowable Stress Design (ASD) or Working Stress Design (Section 1612.3)

* For calculation of E_m, see Section 1630.1.1, Formula (30-2).

IV EARTHQUAKE DESIGN — LOADS

B. Minimum Design Lateral Forces and Related Effects

1. **LRFD Load Combinations**. Where load and resistance factor design (LRFD) (Strength Design) is used, the basic load combinations of Section 1612.2.1 are required. Factored load combinations of this section shall be multiplied by 1.1 for concrete and masonry. (Section 1612.2.1). The 1.1 factor accounts for the incompatability between the ϕ factors of American Concrete Institute (ACI) 318 and the load factors of Section 1612.2.1, Formulas (12-5) and (12-6). (Reference: S.K. Ghosh, "Design of Reinforced Concrete Buildings under the 1997 UBC," *Building Standards,*™ May-June 1998.)

2. **Allowable Stress Design Load Combinations**. Where allowable stress design (working stress design) is used, the basic load combinations of Section 1612.3.1 or 1612.3.2 shall be used. When using the load combinations of Section 1612.3.1, no increase in allowable stresses shall be permitted. (Section 1612.3)

3. **Load Combinations**. The earthquake loads as determined from Formula (30-1) shall be used in the load combinations set forth in Section 1612. (Section 1630.1.1)

4. **Determination of Reliability/Redundancy Factor ρ Seismic Zones 3 and 4**. For determination of E in Formula (30-1), the earthquake load (E_H) due to the base shear, V, as set forth in Section 1630.2 or the design lateral force, F_p, as set forth in Section 1632 shall be adjusted by a Reliability/Redundancy Factor ρ as set forth in Section 1630.1.1.

   a. The Reliability/Redundancy Factor ρ as determined from Formula (30-3) shall not be less than 1.0 and need not be greater than 1.5. (Section 1630.1.1)

   b. For special moment-resisting frames, except when used in dual systems, the layout and configuration of the frames shall be such that ρ does not exceed 1.25. (Section 1630.1.1)

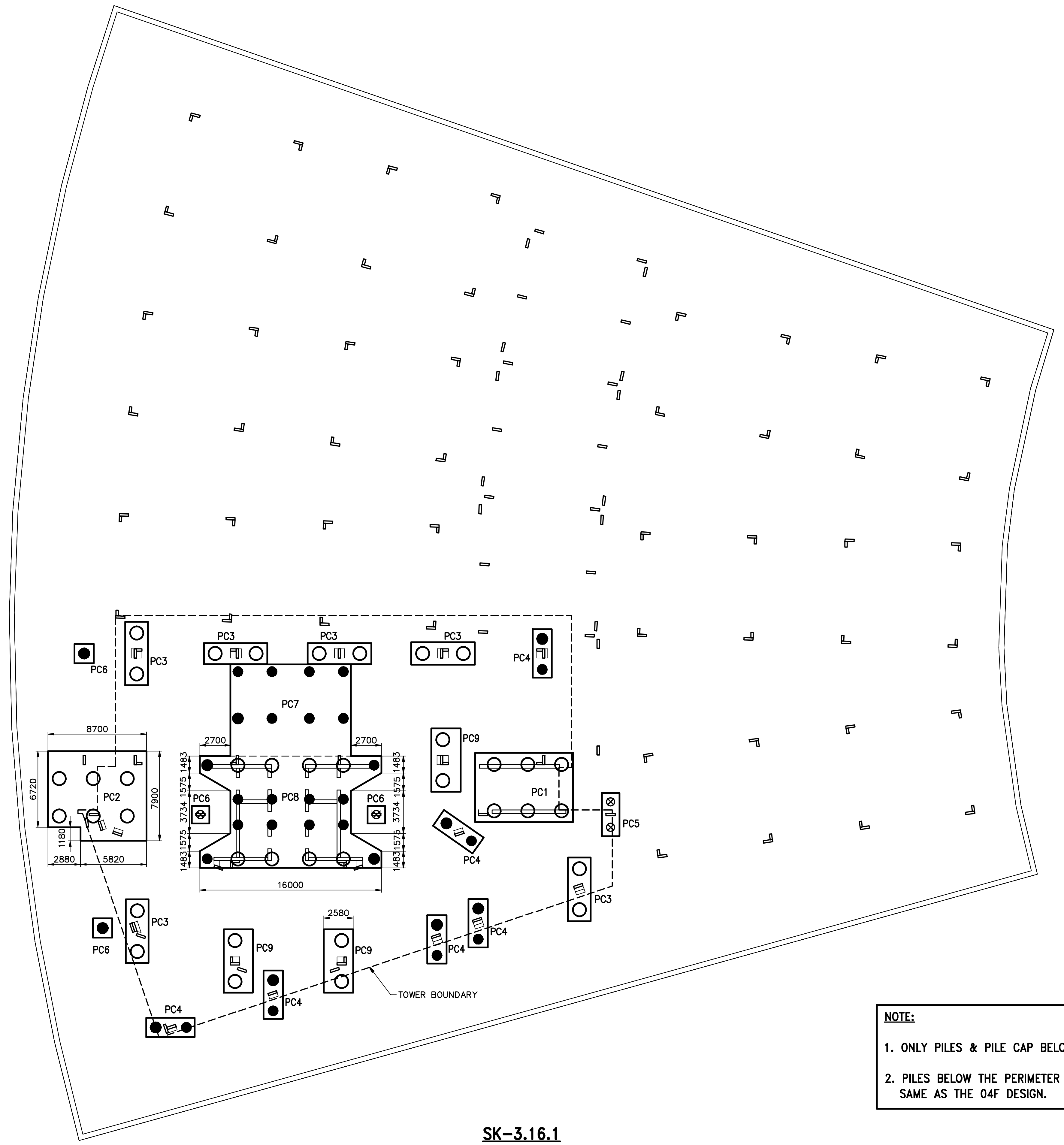
   c. For determination of r_{max} (the maximum element story shear ratio), the calculation of r_i shall be based on the requirements stated in Section 1630.1.1 for (braced frames), (moment frames), (shear walls) and (dual systems).

5. **Vertical Component**. The load effect from the vertical component of the earthquake ground motion shall be considered in the design. For Strength Design, E_v= 0.5 C_a ID. (Section 1630.1.1)

C. Static Approach

1. ***Z* Factor**. The Seismic Zone factor, Z, should be at least _________. (Section 1629.4.1)

2. **Importance Factor *I* = 1.25**. An importance factor I of 1.25 should be used in Formulas (30-4, 30-5, 30-6 and 30-7). (Table 16-K)



LEGEND

- ○ 1200 DIA
- ● 900 DIA
- ⊗ 750 DIA

PILECAP SCHEDULE

MARK	LENGTH	WIDTH	DEPTH
PC1	8640	6100	2000
PC2	REFER DETAILS	REFER DETAILS	2000
PC3	2000	5600	1500
PC4	1700	4273	1500
PC5	1550	3800	1500
PC6	1550	1550	1000
PC7	10600	8100	1500
PC8	REFER DETAILS	REFER DETAILS	2000
PC9	2580	5600	1500

NOTE:

1. ONLY PILES & PILE CAP BELOW THE TOWER ARE REARRANGED.
2. PILES BELOW THE PERIMETER BASEMENT WALL TO REMAIN THE SAME AS THE 04F DESIGN.

SK-3.16.1