PF&CO CONSTRUCTION LTD

STRUCTURAL CALCULATIONS FOR:

YOUR ADDRESS GOES HERE – THIS IS AN EXAMPLE ONLY

INTERNAL WALL REMOVAL TO CREATE AN OPEN KITCHEN LAYOUT

These calculations have been checked and approved for sending by:

Engineer Signs off here – Example!

Friday, 22 March 2024

Please ensure that all measurements are correct for the actual site conditions – If changes are made, please confirm this with PF & Co Construction Ltd before ordering any materials.

PF & Co Construction Ltd do not accept responsibility for the steel members or any other structural members being the incorrect length unless specifically agreed in writing and a full survey has been carried out by PF & Co Construction Ltd as an additional fee outlined on the quotation provided.

☒ All dimensions have been taken from information provided by the client.

☐ A structural survey has been carried out by PF & Co Construction Ltd as an additional survey.

TABLE OF CONTENTS

PROJECT INFORMATION & TEAM DETAILS

The following information has been provided about the project & team at the stage of this design being commissioned and produced.

DRAWINGS ISSUED AND USED THROUGHOUT THIS DESIGN

Drawing Number	Revision	Drawing Title
Example	Example	Example
Example	Example	Example
Example	Example	Example
Example	Example	Example

TEAM DETAILS

Role on the project	Company Name	Key Contact	Contact details
Client	Example	Example	Example
Principal Designer	Example	Example	Example
Architect	Example	Example	Example
Structural Engineer	Example	Example	Example
Principal Contractor	Example	Example	Example

DRAWING NUMBERS ISSUED BY PF & CO CONSTRUCTION LTD ON COMPLETION OF THE DESIGN

Drawing Number	Revision	Drawing Title
Example	Example	Example
Example	Example	Example
Example	Example	Example
Example	Example	Example

SUMMARY CALCULATION INFORMATION & CHECKLIST

DESIGN INFORMATION CHECKLIST BEFORE ISSUING

As much as this is an internal check before calculations are issued to the client, it is essential that anyone reading this design package information has seen and understood all the items and information above. It must all be passed to the relevant parties as part of the Pre-construction / Tendering documents.

- ☒ Designers Hazard Assessment (Required)
- ☐ Construction sequencing (where applicable)
- ☐ Structural justification and calculations for all elements specified
- ☐ Appropriate supplier and product information (where applicable)
- ☐ Key survey information relevant to new project (where applicable)
- ☐ Detailed structural drawings ☐ Detailed structural sketches

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DESIGN INFORMATION SUMMARY

The design presented herein has been developed based on a set of assumptions deemed reasonable within the context of the preliminary findings. It is important to note that this initial assessment was conducted without the benefit of an intrusive survey. While these assumptions are considered to be a sound basis for the current phase of design development, they are subject to verification in subsequent, more detailed investigations. Proceeding with the design under these conditions is advised, with the understanding that adjustments may be necessary as more information becomes available.

MISSING TEXT – DUE TO BEING AN EXAMPLE

The design specifies the installation of a 152 x 152 UC 30 S355 universal column, with a total length of 3.3 meters, plus an additional 200mm for bearing purposes. This column is to be supported at each end by steel bearing spreaders measuring 500mm in length, 100mm in width, and 20mm in thickness. The inclusion of the 200mm bearing at both ends of the universal column is essential for distributing the load effectively across the steel spreaders, thereby ensuring the structural integrity and stability of the system under the expected loads.

CLIENT INFORMATION

This information package has been provided to allow the safe construction of your project; this should also form part of the Health & Safety file put together by the Principal Designer and handed over should the Clients interest change in the property, i.e. sold or rented. This is in line with the Construction Design & Management Regulations (CDM) 2015.

Although a summary has been provided on page 6, please ensure that the full calculations are referenced if anything is uncertain. Please give this design package to your Building Control Officer before works commencing on site, this will allow for any input on their behalf.

Throughout the works on site, the temporary stability of the structure is the responsibility of the Principal Contractor on site. PF & Co Construction Ltd will provide a designer's risk assessment for these works before final construction drawings are issued and work commences on site. This is provided in this information package (see page 6) with reference on how to use it in accordance with the Construction Drawings.

These calculations are intended to be handed over and kept by any owner of the property. PF & Co Construction Ltd are not the Principal Designers on this project.

All dimensions are to be checked on site before ordering, if the length is longer or a different section size is required, please contact PF & Co Construction Ltd before ordering.

DESIGNER HAZARD ASSESSMENT

Person Reference	Persons at Risk
S	Site Managers
W	Workers
O	Other Site Personnel
G	General Public
A	All

Assessed Risk Value		
Assessed Risk Value(ARV) = Consequence (C) X Likelihood (L)		
Low Risk = 1 – 5	Medium Risk = 6 - 10	High Risk = 11 - 25

Likelihood					
1	5	4	3	2	1
2	10	8	6	4	2
3	15	12	9	6	3
4	20	16	12	8	4
5	25	20	15	10	5
	5	4	3	2	1
	Consequence				

Likelihood		Consequence	
Certain	5	Multi Fatality	5
Probable	4	Fatal	4
Likely	3	Major Injury	3
May Occur	2	3 Day Injury	2
Unlikely	1	Accident	1

Control Measures		
CMR = Control Measures Responsibility Ref = Reference number for residual hazards		
CMR		Description
C	Client =	Residual risk requiring client/main contractor control
D	PF & Co Construction Ltd	Risk mitigated by design. No further action required
S	Principle Contractor	Residual risk requiring main contractor control
M	Miscellaneous	Risk controls by other/multiple parties, as specified in DRA

The following symbol is used on PF & Co Construction Ltd design drawings to identity where residual hazards remain on the design.

"C" CMR Designation

"1" Sequential residual risk number in designer risk identification

C 1

Designer Risk Assessment	
Revision:	01
Location:	Kitchen wall removal
Rev. Date	Friday, 22 March 2024

Hazard Control Reference		Hazards	Person Ref	Uncontrolled			Control Measures	Controlled		
CMR	Ref.			C	L	ARV		C	L	ARV
S	1	Strength of concrete in Pad stones	A	5	2	10	• Principal Contractor to ensure sufficient time is allowed for the concrete to cure and get to maximum strength (Use suppliers guidance) before installing and securing the steel beams No Weight is to be placed on the pad stones until concrete is fully cured	5	1	5
S	2	**Working at Heights** • Fall from Height • Death • Fractures • Sprains & Strains	S, W	4	3	12	• Principle Contractor to ensure that all operatives work to an approved method of works. All works should be carried out in accordance with the Working at Heights Regulation 2005	4	1	4
S	3	**Construction Sequencing**	S	5	2	10	Principal contractor to establish the safe sequencing of steel beam installation taking into consideration temporary propping and roof stability	5	1	5
S	4	**Dust** Removal of masonry walls	A	3	3	9	• Principal contractor to ensure they control dust at all time, using tools with extractors on where possible and RPE at all time.	3	1	3
S	5	**Dust** Drilling and cutting timbers.	A	3	3	9	• Principal contractor to ensure they control dust at all times, using tools with extractors on and RPE at all time.	3	1	3

LOADINGS USED THROUGHOUT THESE CALCULATIONS

Design Load Assumptions

Item	Description	Load
Imposed Load		
Live Load	Domestic	1.50kN/m²
Flat Roof Load	Snow/flat roof live load	1.50kN/m²
Pitch Roof Load	45-degree pitch roof live load	0.30kN/m²
Dead Load		
Warm Pitched Roof		
Roofing Tiles	Concrete, stone aggregate, plain, 75mm gauge	0.90kN/m²
Battens	25x38mm tantalised softwood	0.05kN/m²
felt	Breathable felt	negligible
Insulation	Celotex GA400 – 60mm + 60mm = 120mm total	0.04kN/m²
Rafters	47x195mm Grade C24 at 400mm centres	0.15kN/m²
Vapour control	Vapour control	negligible
Plasterboard/skim	12.5mm + skim	0.15kN/m²
Services		0.25kN/m²
	Total =	1.54kN/m²
	Total – excluding Rafter s/wt. =	1.39kN/m²
Cold Flat Roof		
Chippings	12.5mm reflective chippings	0.20kN/m²
Felt	3 layers felt	0.10kN/m²
Plywood on firrings	Exterior grade 22mm plywood + firrings	0.20kN/m²
Joists	47x195mm Grade C24 at 400mm centres	0.15kN/m²
Insulation	Celotex XR4120, 120mm thick	0.04kN/m²
Insulated plasterboard	Celotex PL4000, 40mm thick+12.5mm plasterboard	0.10kN/m²
Services		0.25kN/m²
	Total =	1.04kN/m²
	Total – excluding Joist s/wt. =	0.89kN/m²
Intermediate Floors		
Boarding	22mm t&g flooring grade chipboard	0.17kN/m²
Joists	47x195mm Grade C24 at 400mm centres	0.15kN/m²
Insulation	Rockwool quilt insulation (10kg/m³) 100mm thick	0.01kN/m²
Ceiling	12.5mm Gyproc Fireline plasterboard + skim	0.15kN/m²
	Total =	0.48kN/m²
	Total – excluding Joist s/wt. =	0.33kN/m²

KEY ASSUMPTIONS USED THROUGHOUT THE DESIGN

The following key assumptions have been made throughout this design:

- Architectural Drawings are the correct dimensions.

- Existing building is in sound structural condition; this is for the contractor to regularly monitor and identify to PF & Co Construction Ltd if this is not the case as works progress.

- Existing foundations are well constructed, and there are no movement or subsidence issues currently or previously.

- Any changes to the layout or structure will be confirmed with PF & Co Construction Ltd to confirm that these do not affect this design.

- The appointed Building Control Officer will monitor and confirm that the design is constructed as set out in the document.

- Temporary works are to be fully considered by the construction team, consider the Hazard Assessment included within these calculations. It is for the construction team to ensure the temporary stability of the structure. However, PF & Co Construction Ltd are happy to advise if required.

- These structural calculations are based upon information provided by the client. Should any variation between site conditions and the information provided by the client be identified, these calculations will be void.

- Construction work not to be started until calculations have been approved by Building Control.

MISSING TEXT - EXAMPLE

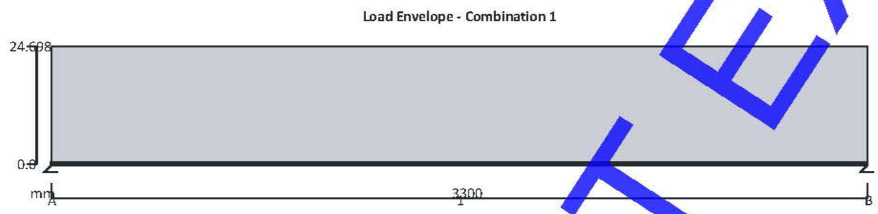
STRUCTURAL CALCULATIONS

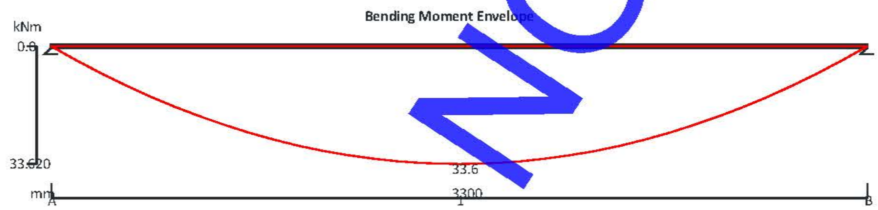
STEEL BEAM ANALYSIS & DESIGN (EN1993)

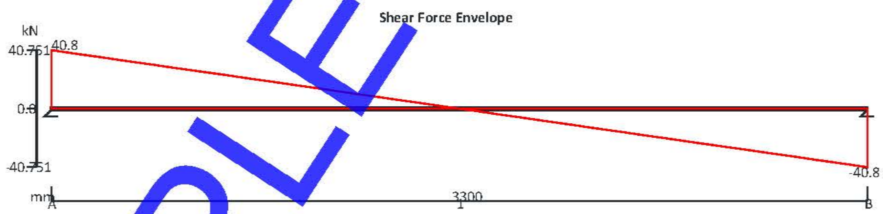
STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

TEDDS calculation version 3.0.14







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads	Permanent self weight of beam × 1
	Floor & Wall - Permanent full UDL 4 kN/m
	FFL - Variable full UDL 6 kN/m
	Roof load - Permanent full UDL 4 kN/m

	RL - Variable full UDL 3 kN/m	

Load combinations

Load combination 1	Support A	Permanent × 1.35
		Variable × 1.50
		Permanent × 1.35
		Variable × 1.50
	Support B	Permanent × 1.35
		Variable × 1.50

Analysis results

Maximum moment;	M_{max} = **33.6** kNm;	M_{min} = **0** kNm
Maximum shear;	V_{max} = **40.8** kN;	V_{min} = **-40.8** kN
Deflection;	δ_{max} = **3.8** mm;	δ_{min} = **0** mm
Maximum reaction at support A;	R_{A_max} = **40.8** kN;	R_{A_min} = **40.8** kN
Unfactored permanent load reaction at support A;	$R_{A\_Permanent}$ = **13.7** kN	
Unfactored variable load reaction at support A;	$R_{A\_Variable}$ = **14.9** kN	
Maximum reaction at support B;	R_{B_max} = **40.8** kN;	R_{B_min} = **40.8** kN
Unfactored permanent load reaction at support B;	$R_{B\_Permanent}$ = **13.7** kN	
Unfactored variable load reaction at support B;	$R_{B\_Variable}$ = **14.9** kN	

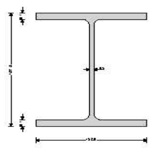
Section details

Section type; **UC 152x152x30 (British Steel Section Range 2022 (BS4-1))**

Steel grade; **S355**

EN 10025-2:2004 - Hot rolled products of structural steels

Nominal thickness of element;	$t = \max(t_f, t_w)$ = **9.4** mm
Nominal yield strength;	f_y = **355** N/mm²
Nominal ultimate tensile strength;	f_u = **470** N/mm²
Modulus of elasticity;	E = **210000** N/mm²



Partial factors - Section 6.1

Resistance of cross-sections; γ_{M0} = **1.00**

Resistance of members to instability; γ_{M1} = **1.00**

Resistance of tensile members to fracture; γ_{M2} = **1.10**

Lateral restraint

Span 1 has full lateral restraint

Effective length factors

Effective length factor in major axis; K_y = **1.000**

Effective length factor in minor axis; K_z = **1.000**

Effective length factor for torsion; $K_{LT.A}$ = **1.000**;

$K_{LT.B}$ = **1.000**;

Classification of cross sections - Section 5.5

$\varepsilon = \sqrt{[235 \text{ N/mm}^2 / f_y]}$ = **0.81**

Internal compression parts subject to bending - Table 5.2 (sheet 1 of 3)

Width of section; $c = d$ = **123.6** mm

$c / t_w = 23.4 \times \varepsilon <= 72 \times \varepsilon$; Class 1

Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section; $c = (b - t_w - 2 \times r) / 2$ = **65.6** mm

$c / t_f = 8.6 \times \varepsilon <= 9 \times \varepsilon$; Class 1

Section is class 1

Check shear - Section 6.2.6

Height of web; $h_w = h - 2 \times t_f$ = **138.8** mm

Shear area factor; η = **1.000**

$h_w / t_w < 72 \times \varepsilon / \eta$

Shear buckling resistance can be ignored

Design shear force; $V_{Ed} = \max(\text{abs}(V_{max}), \text{abs}(V_{min}))$ = **40.8** kN

Shear area - cl 6.2.6(3); $A_v = \max(A - 2 \times b \times t_f + (t_w + 2 \times r) \times t_f, \eta \times h_w \times t_w)$ =
1156 mm²

Design shear resistance - cl 6.2.6(2); $V_{c,Rd} = V_{pl,Rd} = A_v \times (f_y / \sqrt{[3]}) / \gamma_{M0}$ = **236.9** kN

PASS - Design shear resistance exceeds design shear force

Check bending moment major (y-y) axis - Section 6.2.5

Design bending moment; $M_{Ed} = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min}))$ = **33.6** kNm

Design bending resistance moment - eq 6.13; $M_{c,Rd} = M_{pl,Rd} = W_{pl.y} \times f_y / \gamma_{M0}$ = **87.9** kNm

PASS - Design bending resistance moment exceeds design bending moment

Check vertical deflection - Section 7.2.1

Consider deflection due to variable loads

Limiting deflection; $\delta_{lim} = L_{s1} / 360$ = **9.2** mm

Maximum deflection span 1; $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min}))$ = **3.786** mm

PASS - Maximum deflection does not exceed deflection limit

MASONRY BEARING DESIGN (EN1996)

MASONRY BEARING DESIGN

In accordance with EN1996-1-1:2005 + A1:2012, incorporating Corrigenda February 2006 and July 2009 and the UK National Annex.

Tedds calculation version 1.0.14

Summary table

Load	Local concentration		Spreader		Utilisation	
	Design force	Resistance	Design stress	Resistance		
1	41.7 kN	44.0 kN	2.11 N/mm²	2.20 N/mm²	0.959	Pass

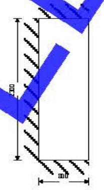
Masonry panel details

Panel length; L = **800** mm

Panel height; h = **2300** mm

Panel support conditions

Top, bottom and one vertical edge supported



Effective height of masonry wall - Section 5.5.1.2

Vertical restraints; $L < 15 \times t_{ef}$ (Wall restrained at the top and bottom and stiffened on one vertical edge (with one free edge))

Horizontal restraints; **Simply supported**

Reduction factor - eq. 5.5; $\rho_2 = \mathbf{1.00}$

Reduction factor - eq. 5.6; $\rho_3 = 1/(1 + [(\rho_2 \times h) / (3 \times L)]^2) \times \rho_2 = \mathbf{0.52}$

Effective height of wall - eq. 5.2; $h_{ef} = \rho_3 \times h = \mathbf{1199}$ mm

Wall construction details

Wall type;	**Single leaf panel**
Overall wall thickness;	t = **100.0** mm

Effective thickness of masonry wall - Section 5.5.1.3

Effective thickness;	t_{ef} = t = **100.0** mm

Masonry material details

Unit type;	**Aggregate concrete - Group 1**
Compressive strength of masonry unit;	f_c = **7.3** N/mm²
Height of unit;	h_u = **215** mm
Width of unit;	w_u = **100** mm
Conditioning factor;	k = **1.0**

- Conditioning to the air dry condition in accordance with cl.7.3.2

Shape factor - Table A.1;	d_{sf} = **1.38**
Mean compressive strength of masonry unit;	$f_b = f_c \times k \times d_{sf}$ = **10.07** N/mm²
Specific weight of units;	γ = **18** kN/m³
Mortar type;	**M4 - General Purpose**
Compressive strength of mortar;	f_m = **4.0** N/mm²
Compressive strength factor - Tbl. NA 4;	K = **0.75**
Characteristic compressive strength - eq. 3.1;	$f_k = K \times f_b^{0.7} \times f_m^{0.3}$ = **5.73** N/mm²
Short term secant modulus of elasticity factor;	K_E = **1000**
Modulus of elasticity - cl.3.7.2;	$E_w = K_E \times f_k$ = **5727** N/mm²

Design compressive strength of masonry

Category of manufacturing control;	**Category II**
Class of execution control;	**Class 2**
Partial factor for compressive strength;	γ_M = **3.00**
Cross-sectional area of wall;	A = L × t = **0.08** m²; (A < 0.1 m²)
Design compressive strength of masonry;	$f_d = f_k / \gamma_M \times (0.7 + 3 \times A / 1\ m^2)$ = **1.79** N/mm²

Partial safety factors for design loads

Partial safety factor for permanent load;	γ_{fG} = **1.35**
Partial safety factor for variable load;	γ_{fQ} = **1.50**

Superimposed vertical loading details

Permanent UDL at top of wall;	g_k = **0.00** kN/m
Variable UDL at top of wall;	q_k = **0.00** kN/m
Eccentricity of permanent UDL load;	e_{gu} = **0** mm
Eccentricity of variable UDL load;	e_{qu} = **0** mm

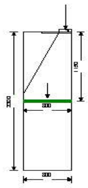
Slenderness ratio of masonry wall - Section 5.5.1.4

Slenderness ratio limit;	λ_{lim} = **27**

Slenderness ratio; $\lambda = h_{ef} / t_{ef} =$ **12.0**

PASS - Slenderness ratio is less than slenderness limit

Concentrated Load 1 details - Beam Bearing Load



Permanent concentrated load; G_{kc1} = **12.00** kN
Variable concentrated load; Q_{kc1} = **17.00** kN
Eccentricity of concentrated load; e_{c1} = **0** mm
Length of concentrated load; L_{c1} = **200** mm
Width of concentrated load; w_{c1} = **100** mm
Height of concentrated load; h_{c1} = **2300** mm
Distance of load to right vertical edge; r_{11} = **0** mm
Distance of load to nearest vertical edge; a_{11} = **0** mm

Walls subjected to concentrated loads - Section 6.1.3

Eccentricity check; $e_{c1} <= t / 4$

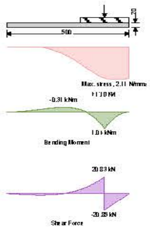
PASS - Eccentricity of load is less than t/4

Area of bearing; $A_{b1} = L_{c1} \times w_{c1}$ = **20000** mm^2
Effective length of bearing at mid-height; $l_{efm1} = L$ = **800** mm
Effective bearing area; $A_{ef1} = l_{efm1} \times t$ = **80000** mm^2
Bearing area ratio check; $A_{ratio1} = \text{Min}(A_{b1} / A_{ef1}, 0.45)$ = **0.25**
Initial enhancement factor; $\beta_{init1} = \text{Max}((1 + 0.3 \times a_{11} / h_{c1}) \times (1.5 - 1.1 \times A_{ratio1}), 1.0)$ = **1.23**
Maximum enhancement factor; $\beta_{max1} = \text{Min}(1.25 + a_{11} / (2 \times h_{c1}), 1.5)$ = **1.25**
Enhancement factor for concentrated loads; $\beta_1 = \text{Min}(\beta_{init1}, \beta_{max1})$ = **1.23**
Design value of the concentrated load; $N_{Edc1} = G_{kc1} \times \gamma_{fG} + Q_{kc1} \times \gamma_{fQ}$ = **41.70** kN

Design value concentrated load resistance; $N_{Rdc1} = \beta_1 \times A_{b1} \times f_d$ = **43.96** kN

PASS - Design resistance exceeds applied concentrated load

Design of spreader beam



Type of spreader; **Steel spreader plate**

Type of bearing onto spreader; **Point load**

Location of load from RHS of spreader; P_{11} = **100** mm

Length of spreader; L_{sp1} = **500** mm

Height of spreader; h_{sp1} = **20** mm

Width of spreader; w_{sp1} = **100** mm

Eccentricity of load on spreader; e_{sp1} = **0** mm

Modulus of elasticity; E_{sp1} = **210000** N/mm^2

Second moment of area; $I_{sp1} = 1/12 \times w_{sp1} \times h_{sp1}^3$ = **66667** mm^4

Modulus of the wall; $k_0 = E_w / h$ = **2.49** N/mm^2/mm

Winkler's constant; $K_{c1} = k_0 \times w_{sp1}$ = **249.00** N/mm/mm

Characteristic of the system; $\alpha_1 = (K_{c1} / (4 \times E_{sp1} \times I_{sp1}))^{1/4}$ = **0.00817** mm^{-1}

Classification of spreader; $\alpha L_1 = \alpha_1 \times L_{sp1}$ = **4.08**; **Medium**

Krilov's functions for the spreader length; $B_{\alpha l1} = 1/2 \times (\cosh(\alpha L_1) \times \sin(180 \times \alpha L_1 / \pi) + \sinh(\alpha L_1) \times \cos(180 \times \alpha L_1 / \pi))$ = **-20.72**

	$C_{\alpha l1} = 1/2 \times \sinh(\alpha L_1) \times \sin(180 \times \alpha L_1 / \pi) =$ **-11.98**
	$D_{\alpha l1} = 1/4 \times (\cosh(\alpha L_1) \times \sin(180 \times \alpha L_1 / \pi) - \sinh(\alpha L_1) \times \cos(180 \times \alpha L_1 / \pi)) =$ **-1.63**
Krilov's functions at the point load;	$A_{\alpha P11} = \cosh(\alpha_1 \times P_{11}) \times \cos(180 \times \alpha_1 \times P_{11} / \pi) =$ **0.93**
	$B_{\alpha P11} = 1/2 \times (\cosh(\alpha_1 \times P_{11}) \times \sin(180 \times \alpha_1 \times P_{11} / \pi) + \sinh(\alpha_1 \times P_{11}) \times \cos(180 \times \alpha_1 \times P_{11} / \pi)) =$ **0.80**
Using method of initial conditions	
Initial moment of LH edge;	$M_{01} =$ **0** kNm
Initial shear of LH edge;	$V_{01} =$ **0** kN
Which gives;	$(4 \times \alpha_1^2 \times C_{\alpha l1} \times \delta_{01} + 4 \times \alpha_1 \times D_{\alpha l1} \times \Phi_{01}) \times E_{sp1} \times I_{sp1} - B_{\alpha P11} / \alpha_1 \times N_{Edc1} =$ **0.00** kNm
and;	$(4 \times \alpha_1^3 \times B_{\alpha l1} \times \delta_{01} + 4 \times \alpha_1^2 \times C_{\alpha l1} \times \Phi_{01}) \times E_{sp1} \times I_{sp1} - A_{\alpha P11} \times N_{Edc1} =$ **0.00** kN
Therefore,	
Initial deflection of LH edge;	$\delta_{01} =$ **-0.10125** mm
Initial rotationof LH edge;	$\Phi_{01} =$ **0.000567**
Location of maximum deflection;	$x_{def1} =$ **442.4** mm
Krilov's functions at the spreader length;	$A_{\alpha xdef1} = \cosh(\alpha_1 \times x_{def1}) \times \cos(180 \times \alpha_1 \times x_{def1} / \pi) =$ **-16.53**
	$B_{\alpha xdef1} = 1/2 \times (\cosh(\alpha_1 \times x_{def1}) \times \sin(180 \times \alpha_1 \times x_{def1} / \pi) + \sinh(\alpha_1 \times x_{def1}) \times \cos(180 \times \alpha_1 \times x_{def1} / \pi)) =$ **-12.46**
Distance of point load right of loaction;	$p_{1def1} =$ **42.4** mm
Krilov's functions at the spreader length;	$D_{\alpha p1def1} = 1/4 \times (\cosh(\alpha_1 \times p_{1def1}) \times \sin(180 \times \alpha_1 \times p_{1def1} / \pi) - \sinh(\alpha_1 \times p_{1def1}) \times \cos(180 \times \alpha_1 \times p_{1def1} / \pi)) =$ **0.01**
Particular integral due to load;	$\delta'_1 = D_{\alpha p1def1} / \alpha_1^3 \times N_{Edc1} / (I_{sp1} \times E_{sp1}) =$ **0.038** mm
Maximum deflection;	$\delta_{max1} = A_{\alpha xdef1} \times \delta_{01} + B_{\alpha xdef1} \times \Phi_{01} / \alpha_1 + \delta'_1 =$ **0.847** mm
Location of maximum moment;	$x_{M1} =$ **400** mm
Krilov's functions at the spreader length;	$C_{\alpha xM1} = 1/2 \times \sinh(\alpha_1 \times x_{M1}) \times \sin(180 \times \alpha_1 \times x_{M1} / \pi) =$ **-0.81**
	$D_{\alpha xM1} = 1/4 \times (\cosh(\alpha_1 \times x_{M1}) \times \sin(180 \times \alpha_1 \times x_{M1} / \pi) - \sinh(\alpha_1 \times x_{M1}) \times \cos(180 \times \alpha_1 \times x_{M1} / \pi)) =$ **2.84**
Distance of point load right of loaction;	$p_{1M1} =$ **0** mm
Krilov's functions at the spreader length;	$B_{\alpha p1M1} = 1/2 \times (\cosh(\alpha_1 \times p_{1M1}) \times \sin(180 \times \alpha_1 \times p_{1M1} / \pi) + \sinh(\alpha_1 \times p_{1M1}) \times \cos(180 \times \alpha_1 \times p_{1M1} / \pi)) =$ **0.00**
Particular integral due to load;	$M'_1 = -B_{\alpha p1M1} / \alpha_1 \times N_{Edc1} =$ **0.00** kNm
Maximum moment;	$M_{Edsp1} = (4 \times \alpha_1^2 \times C_{\alpha xM1} \times \delta_{01} + 4 \times \alpha_1 \times D_{\alpha xM1} \times \Phi_{01}) \times (I_{sp1} \times E_{sp1}) + M'_1 =$ **1.04** kNm
Location of maximum shear;	$x_{V1} =$ **400** mm
Krilov's functions at the spreader length;	$B_{\alpha xV1} = 1/2 \times (\cosh(\alpha_1 \times x_{V1}) \times \sin(180 \times \alpha_1 \times x_{V1} / \pi) + \sinh(\alpha_1 \times x_{V1}) \times \cos(180 \times \alpha_1 \times x_{V1} / \pi)) =$ **-7.31**

$C_{\alpha xV1}$ = 1/2 × sinh(α_1 × x_{V1}) × sin(180 × α_1 × x_{V1} / π) = **-0.81**

Distance of point load right of loaction; p_{1V1} = **0** mm

Krilov's functions at the spreader length; $A_{\alpha p1V1}$ = cosh(α_1 × p_{1V1}) × cos(180 × α_1 × p_{1V1} / π) = **1.00**

Particular integral due to load; V'_1 = -$A_{\alpha p1V1}$ × N_{Edc1} = **-41.70** kN

Shear at concentrated point load; V_1 = (4 × α_1^3 × $B_{\alpha xV1}$ × δ_{01} + 4 × α_1^2 × $C_{\alpha xV1}$ × Φ_{01}) × (I_{sp1} × E_{sp1}) + V'_1 = **-20.85** kN

Maximum shear; V_{Edsp1} = Max(Abs(V_1), N_{Edc1} - Abs(V_1)) = **20.85** kN

Maximum allowable stress under spreader; σ_{Rdsp1} = β_1 × f_d = **2.20** N/mm²

Maximum reaction; N_{Edsp1} = K_{c1} × δ_{max1} = **210.82** kN/m

Design stress; σ_{Edsp1} = N_{Edsp1} / w_{sp1} = **2.11** N/mm²

PASS - Design stress under spreader is less than the allowable bearing stress

Walls subjected to mainly vertical loading - Section6.1.2

Eccentricity of permanent UDL at mid-height below concentrated load

e_{gmu1} = e_{gu} × h_{c1} / (2 × h) = **0.0** mm

Eccentricity of variable UDL at mid-height below concentrated load

e_{qmu1} = e_{qu} × h_{c1} / (2 × h) = **0.0** mm

Eccentricity of concentrated load at mid-height; e_{mc1} = e_{c1} / 2 = **0.0** mm

Initial eccentricity - cl.5.5.1.1(4); e_{init} = h_{ef} / 450 = **2.7** mm

Concentrated load at mid-height as UDL; N_{mc1} = N_{Edc1} / l_{efm1} = **52.13** kN/m

Vertical load at mid-height; N_{Ed1} = (g_k + γ × t × (h - h_{c1} / 2)) × γ_{fG} + q_k × γ_{fQ} + N_{mc1} = **54.92** kN/m

Design moment at mid-height; M_{Ed1} = g_k × γ_{fG} × e_{gmu1} + q_k × γ_{fQ} × e_{qmu1} + N_{mc1} × e_{mc1} = **0.00** kNm/m

Eccentricities due to loads - eq. 6.7; e_{m1} = Abs(M_{Ed1}) / N_{Ed1} + e_{init} = **2.7** mm

Slenderness ratio limit for creep eccentricity; λ_c = **27**

Eccentricity due to creep; e_{k1} = **0.0** mm

Eccentricity at mid-height - eq. 6.6; e_{mk1} = Max(e_{m1} + e_{k1}, 0.05 × t) = **5.0** mm

From eq. G2; A_{11} = 1 - 2 × e_{mk1} / t = **0.90**

From eq. G3; u_1 = (h_{ef} / t_{ef} × (1 / K_E)$^{1/2}$ - 0.063) / (0.73 - 1.17 × e_{mk1} / t) = **0.47**

Capacity reduction factor - eq. G1; Φ_{m1} = A_{11} × exp(-(u_1^2) / 2) = **0.81**

Design vertical resistance of panel - eq.6.2; N_{Rd1} = Φ_{m1} × t × f_d = **144.56** kN/m

PASS - Design value of vertical resistance exceeds applied vertical load

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