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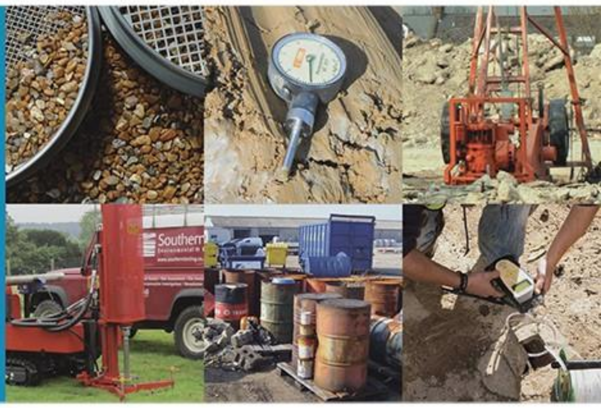
Basement Impact Assessment (BIA)



Project Name: Old Orchard Lodge Cottage

Location: Park Lane, Harefield, Uxbridge, UB9 6HJ

Client: Ammar Khaliq

Project ID: J15005

STL Report Ref: J15005-BIA

Report Date: 16 August 2022

Report Issue: 2

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REVISIONS AND ADDITIONAL MATERIAL

1 Document History and Status

Issue	Date	Purpose/Status	File Ref	Author	Check/Review
1	03/02/2022	First Issue	J15005-BIA	VF	JNR
2	16/08/2022	Updated to include structural calculations and building specification as per Clients request.	J15005-BIA	VF	DS

2 Document Details

Last saved	16th August 2022	
Author	**V Francis** BSc MSc FGS	
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Check / Review	**J Race**	
	D Spearman	
STL Project Number	J15005-BIA	
STL Project Name	Old Orchard Lodge Cottage	

3 Additional Supporting Documents

3.1 Supporting Documents

Document	Date	Issue	Producer
Desk Study Report (STL Ref.:J15005-DS)	03/02/2022	1	Southern Testing Laboratories Ltd.
Geotechnical Survey Report (ref: 10269)	Dec 2016	1	Fastrack Group
Foul & SuDS Drainage Assessment (ref: 10757)	30 July 2020	1	GTA Civils and Transport Ltd.
Soakaway Testing – Infiltration Test Result Summary (ref: CS/C1454)	02 Sept 2020	1	CGS Civils

For and on behalf of Southern Testing Laboratories Limited.

TABLE OF CONTENTS

TABLE OF APPENDICES

A NON-TECHNICAL SUMMARY

The site is currently a vacant plot of land, following the recent demolition of the former residential property. The site is located in Harefield, Uxbridge, approximately 500m south-west of Harefield Hospital. The approximate National Grid Reference of the site is TQ 04640 90449. The site location is indicated on Figure 1 within Appendix A.

Photographs showing the site and a detailed site description are presented in the Desk Study Report (J15005-DS).

It is proposed to construct a new two-storey detached dwelling with habitable basement space and associated parking and private garden. It is understood that the proposed basement will extend to around 3m below ground level and beneath the entire footprint of the property. A plan issued by the Client showing the existing layout and proposed development are included in Appendix A of the Desk Study report.

The following assessments are presented in this Desktop Basement Impact Assessment (BIA) report:

- Screening Exercise
- Additional supporting documents are included:
    - Desk Study and Walkover Survey (STL Ref. J15005-DS, dated 3rd February 2022).
- Preliminary Impact Assessment

The mapped soils indicate no superficial soils mapped across the majority of the site, but Gerrards Cross Gravels are mapped in the very south-easternmost corner. The bedrock is mapped as London Clay Formation, with Lambeth Group mapped nearby to the north-west of the site. A borehole, located just south of the recently demolished building, was undertaken by Fastrack Group in December 2016. The soils encountered consisted London Clay, with a superficial covering of gravel/cobbles (possibly Gerrards Cross Gravels) around 0.6m in thickness. In addition a trial pit located in the northern third, undertaken by CGS Civils in September 2020, found the soils to comprise loamy clay (topsoil) to 0.1m over London Clay.

Standing groundwater level was recorded at 2.65m on completion of the borehole. No long-term monitoring has been undertaken.

It is understood that the basement is to be formed using contiguous piled wall which will be designed as cantilevers. A steel frame will prop the capping beam from the temporary condition. The steel frame will also support the joists and masonry walls.

A Ground Movement Assessment has not been undertaken at this stage.

The desktop BIA has not identified significant likely hydrogeological or hydrological impacts relating to the proposed basement. Cumulative impacts of future developments in the area should be assessed on a case-by-case basis.

The desktop BIA has not identified a risk of fluvial and surface water flooding based on the results of the Desk Study report. The site is located within an area identified as having a limited potential for groundwater flooding. No formal flood risk assessment has been carried out for the site.

B INTRODUCTION

4 Authority

Our authority for carrying out this work is contained in a Project Order Form from Mr A Khaliq (the Client), dated 20th December 2021. This was on the basis of our proposal and cost estimate (Ref Q211986-2) dated 20th December 2021.

5 Object

The object of this study was to produce a Desktop Basement Impact Assessment (BIA) as part of the Client's planning application in accordance with the requirements of the London Borough of Hillingdon, and to consider the effects of a proposed basement development at Old Orchard Lodge Cottage, Park Lane, Harefield, Uxbridge, UB9 6HJ.

The purpose of the BIA is to enable London Borough of Hillingdon to consider a scheme's potential impact on local drainage and flooding and on the structural stability of neighbouring properties through its effect on groundwater conditions and ground movement in accordance with their planning policies.

6 Scope

This report references the following reports:

- Desk Study and Walkover Survey (Southern Testing Laboratories Ltd., 3rd February 2022, Ref. J15005-DS)

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The investigation was conducted and this report has been prepared for the sole internal use and reliance of Ammar Khaliq and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report may not be appropriate to alternative development schemes.

Detailed information on the proposed development, such as detailed final layout, loadings and serviceability limits was not provided. Accordingly, where geotechnical design advice is provided it is on the prescriptive basis allowed for by Eurocode 7: employing conventional and conservative design rules.

7 Report Authors and Contributors

This report has been reviewed by a geologist holding Chartered Geologist (CGeol) status with the Geological Society of London.

Details of the authors of the supplementary reports may be found within those respective documents.

C SITE OVERVIEW

The site is located in Harefield, Uxbridge, approximately 500m south-west of Harefield Hospital. The approximate National Grid Reference of the site is TQ 04640 90449. The site location is indicated on Figure 1 within Appendix A.

The site is currently a vacant plot of land, following the recent demolition of the former residential property. It is proposed to construct a new two-storey detached dwelling with habitable basement space and associated parking and private garden. It is understood that the proposed basement will extend to around 3m below ground level and beneath the entire footprint of the property.

The site is within a wider hillside setting but the slope is not estimated to be greater than 7 degrees. The site itself is generally flat and level.

The neighbouring properties include Old Orchard Lodge, a single-storey residential property, located around 10m north of the site. A lock-up garage associated with this property is located adjacent to the northernmost site boundary, approximately 2m from the proposed basement. Around 4m from the southern site boundary is The Old Orchard public house, which is a two-storey building with a possible lower ground floor level. The foundation dimensions of neighbouring properties are unknown at this stage.

The BIA has not identified a risk of fluvial or surface water flooding based on the results of the Desk Study report. However, there is considered to be a limited potential for groundwater flooding. No formal flood risk assessment has been carried out for the site.

There are no public highways or pedestrian pathways within 5m of the site.

There are no known tunnels within 50m of the proposed basement. There are underground utilities, including foul water drainage, located beneath the site.

It is understood the proposed basement will extend to approximately 3m below ground level, formed using contiguous piled walls.

D STRUCTURAL SPECIFICATION

A ‘Specification for Structural Works’ by RM DMS Structural Engineers (project ref: 21187, report dated 5 Jan 2022) has been provided. In addition, ‘Structural Calculations’ have been carried out by RM DMS Structural Engineers (project ref: 21187, report dated 8 June 2022). These reports can be found in Appendix B.

These reports indicate that the basement is to be formed using contiguous piled wall which will be designed as cantilevers. It is understood that a steel frame will prop the capping beam from the temporary condition, which will also support the joists and masonry walls.

The Client has also indicated that Optical Levelling will be undertaken to monitor local ground conditions, water movement and subsidence. Further details regarding optical levelling, provided by the client, are contained within Appendix B.

E SCREENING EXERCISE

8 Screening Framework

Using the information contained within the Desk Study, a 'Screening' process has been undertaken. The questions contained within this section are adapted from those outlined within the planning requirements of London Borough of Camden (CPG Basements, Ref [1]). It is considered that the adapted questions are pertinent to this Basement Impact Assessment.

The information in this section is based on the information in the supporting documents. A review of any issues identified is included in later sections of this report.

9 Subterranean Groundwater Flow

Question		Evidence
1a	**Is the site located directly above an aquifer?** The south-easternmost corner of the site is mapped as being underlain by Gerrards Cross Gravels which is a Secondary A Aquifer. From a previous borehole, undertaken just south of the former building, gravel material was only encountered to between 0.3 to 0.6m below current ground level. However a majority of the site is mapped as being underlain by the London Clay Formation, which are classified as unproductive strata. A shallow trial pit undertaken further north on the site did not encounter any superficial deposits.	**Desk Study Report** Envirocheck Report **Fastrack Group Geotechnical Survey Report** **CGS Civils Soakaway Testing – Infiltration Test Result Summary**
1b	**Will the proposed basement extend beneath the water table surface?** Yes. From the previous borehole undertaken on site the standing water level was at 2.65m on completion of the borehole. No long-term groundwater monitoring has been undertaken.	**Fastrack Group Geotechnical Survey Report**
2	**Is the site within 100m of a watercourse, well (used/disused) or potential spring line?** No.	**Desk Study Report** Walkover survey Envirocheck Report
3	**Is the site within the catchment of any known nearby ponds?** No.	**Desk Study Report** Walkover survey Envirocheck Report
4	**Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?** Yes, it is understood that the proposed building will cover 30% more surface than the demolished building. A new permeable driveway and parking area is also to be installed.	**Desk Study Report** Existing and proposed development plan Walkover survey
5	**As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?** Yes. The proportion of hard or covered surfaces present on the site will increase, as such the volume of surface water produced will increase. The proposed drainage strategy is not known.	**Desk Study Report** Existing and proposed development plan
6	**Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line?** No. The nearest surface water feature is over 250m from the site.	**Desk Study Report** Walkover survey Envirocheck Report

10 Land Stability

Question		Evidence
1	**Does the existing site include slopes, natural or manmade, greater than 7 degrees? (approximately 1 in 8)** No.	**Desk Study Report** Walkover survey
2	**Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degrees? (approximately 1 in 8)** No.	**Desk Study Report** Existing and proposed development plan
3	**Does the development neighbour land, including railway cuttings and the like, slope greater than 7 degrees? (approximately 1 in 8)** No.	**Desk Study Report** Walkover survey Envirocheck Report OS Maps
4	**Is the site within a wider hillside setting in which the general slope is greater than 7 degrees? (approximately 1 in 8)** No. The site is located within a wider hillside setting but the slope is not estimated to be greater than 7 degrees.	**Desk Study Report** Walkover survey OS Maps
5	**Is the London Clay the shallowest strata at the site?** The majority of the site is mapped as being directly underlain by London Clay, apart for a small section in the south-eastern corner which has superficial Gerrards Cross Gravels mapped. The single borehole, undertaken just south of the former building, encountered superficial soils to 0.6m over London Clay. Although, an additional shallow trial pit, located slightly further north, did not encounter any superficial soils.	**Desk Study Report** Envirocheck Report **Fastrack Group Geotechnical Survey Report** **CGS Civils Soakaway Testing – Infiltration Test Result Summary**
6	**Will any tree/s be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained? (Note that consent may be required to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a Conservation Area if the tree is over certain dimensions).** Yes, it is understood that some of the smaller tress across the site are to be removed. Some of the tress around the perimeter are to be retained. Some new trees and hedges are also proposed.	**Desk Study Report** Walkover Survey Existing and proposed development plan
7	**Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?** No. No evidence of seasonal shrink/swell subsidence was noted to the buildings surrounding the site.	**Desk Study Report** Walkover survey
8	**Is the site within 100m of a watercourse or a potential spring line?** No.	**Desk Study Report** Walkover survey Envirocheck Report
9	**Is the site within an area of previously worked ground?** No. The site is not mapped as being within an area of previously worked ground. However, given there has been previous development onsite Made Ground soils may be present. The previous borehole indicated 0.3m of Made Ground, but no Made Ground was noted in the shallow trial pit onsite.	**Desk Study Report** Walkover survey Historic Mapping Envirocheck Report **Fastrack Group Geotechnical Survey Report** **CGS Civils Soakaway Testing – Infiltration Test Result Summary**

Question		Evidence
10	**Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?** The south-easternmost corner of the site is mapped as being underlain by Gerrards Cross Gravels which is a Secondary A Aquifer. From a previous borehole on site gravel material was only encountered to between 0.3 to 0.6m below current ground level. However a majority of the site is mapped as being underlain by the London Clay Formation, which is classified as unproductive strata. A shallow trial pit undertaken further north did not encounter any superficial deposits. From the previous borehole undertaken on site the standing water level was at 2.65m on completion of the borehole. No long term groundwater monitoring has been undertaken. Dewatering will be required during construction.	**Desk Study Report** Envirocheck Report **Fastrack Group Geotechnical Survey Report** **CGS Civils Soakaway Testing – Infiltration Test Result Summary**
11	**Is the site within 50m of the any known nearby ponds?** No.	**Desk Study Report** Walkover survey Envirocheck Report
12	**Is the site within 5m of a highway or pedestrian right of way?** No.	**Desk Study Report** Walkover survey Existing and proposed development plan
13	**Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?** Unknown. The nearest structure to the proposed development is a lock-up garage which is located adjacent to the northern site boundary and approximately 2m from the proposed development. It is understood that the neighbouring property around 10m to the north does not have a basement or lower ground floor. The public house, around 4m to the south, may have a lower ground floor level.	**Desk Study Report** Walkover survey Existing and proposed development plan
14	**Is the site over (or within the exclusion zone of) any tunnels, e.g. Railway lines?** No.	**Desk Study Report** Walkover survey OS Mapping Envirocheck Report

11 Surface Flow and Flooding

Question		Evidence
1	**Is the site within the catchment of any known nearby ponds?** No.	**Desk Study Report** Walkover survey Envirocheck Report
2	**As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?** Unknown. It is assumed some increase will occur along with an increase in hard surfacing.	**Desk Study Report** Existing and proposed development plan
3	**Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?** Yes, it is understood that the proposed building will cover 30% more land than the demolished building. A new permeable driveway and parking area is also to be installed.	**Desk Study Report** Existing and proposed development plan Walkover survey
4	**Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?** Unknown.	**Desk Study Report** Existing and proposed development plan
5	**Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?** No.	**Desk Study Report** Existing and proposed development plan Walkover survey
6	**Is the site in an area known to be at risk from surface water flooding, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?** No. The site is located within an area at very low risk of surface water flooding. The Envirocheck report identified the site as having a limited potential for groundwater flooding to occur. No formal flood risk assessment has been undertaken for the site. The nearest surface water feature is indicated as 252m north of the site. The previous borehole undertake on site identified the standing water level at 2.65m on completion of the borehole.	**Desk Study Report** Envirocheck Report Walkover Survey **Fastrack Group Geotechnical Survey Report**

13 Non-Technical Summary of Screening Process

The screening process has identified the following issues to be carried forward to Scoping for further assessment:

- Based on a recorded standing water level of 2.65m, the basement construction will intersect the groundwater surface. Therefore appropriate dewatering and construction requirements will need to be considered.
- The proposed development will increase the proportion of hard services and consequently will increase the volume of surface water produced. Suitable surface water drainage at the site will need to be carefully considered to allow for the increase surface water.
- The foundation to the proposed basement may intersect underground utility services and drainage routes. A utility investigation should be carried out to assess the position and direction of these potential underground services and relevant utility may need to be informed of the works in order to determine their requirements.
- It is understood that some of the trees on the site are to be felled as part of the development and some new planting. The designer should be aware that precautions regarding swelling and shrinkage are applicable, and in this respect NHBC precautions provide a helpful guide with respect to minimum foundation depths and deepening particularly within the zone of influence of trees. Assessment of foundation depths should take into account trees, hedgerow and shrubs which are to be removed, remaining or are proposed which may be allowed to reach maturity.
- The foundation to the proposed basement is likely to be greater than those of the nearby garage and houses. An assessment should be made, if possible, of the depths of the neighbouring foundation to inform the structural designs for the proposed basement.
- A Ground Movement Assessment (GMA) may be required in order to assess the potential damage to neighbouring buildings.

F INITIAL SCOPING EXERCISE

14 Initial Basement Impact Assessment

The conceptual site model (CSM) is described in the table below:

Item	Description
Ground conditions	The mapped soils indicate no superficial soils mapped across the majority of the site, but Gerrards Cross Gravels are mapped in the very south-easternmost corner. The bedrock is mapped as London Clay Formation, with Lambeth Group mapped nearby to the north-west of the site. The recorded soils from a single 5m deep borehole, located just south of the former building, consisted London Clay, with a superficial covering of gravel/cobbles (possibly Gerrards Cross Gravels) around 0.6m in thickness. A trial pit (0.9m deep) located in the northern third of the site indicated loamy clay (topsoil) to 0.1m over London Clay.
Groundwater level	From the previous site investigation standing water level was recorded at 2.65m below ground level on completion of the borehole. No long-term monitoring has been undertaken
Topography	The site is within a hillside setting which slopes towards the west, but not estimated to be greater than 7 degrees. The site itself is generally flat and level.
Existing foundations on site	The depth of existing foundations, from the recently demolished building, are currently unknown.
Proposed foundations on site	The proposed formation level of the basement is understood to be around 3.0m below ground level. It is understood that the basement is to be formed using contiguous piled wall which will be designed as cantilevers. A steel frame will prop the capping beam from the temporary condition. The steel frame will also support the joists and masonry walls.
Neighbouring basements and foundations	The foundation dimensions of neighbouring properties are unknown at this stage. The nearest structure is a lock-up garage likely to have very shallow foundations. The Old Orchard Lodge does not appear to have a basement but the Old Orchard Public House may have a basement/lower ground floor level.
Highways and infrastructure	The nearest public highway is a lane around 30m from the northern site boundary.
Tunnels and utilities	There are no known tunnels within 50m of the site. Buried services, including sewer pipes, are located on site.
Potential impacts	The formation of the proposed basement will cause horizontal and vertical ground movements in the surrounding area. Structural damage such as subsidence may occur to the walls and foundations of the adjacent buildings. Based on the limited ground investigation to date, the proposed basement would penetrate below the groundwater surface. The formation and excavation of the proposed basement may have an effect on the current routes of potential underground services that may be situated underneath the site.
Proposed mitigation	A ground movement assessment of any impacts relating to adjacent structures/buildings. Construction methods will need to be assessed to ensure that the stability of the surrounding land is maintained. The presence of groundwater should be considered in the design of any temporary and permanent retaining systems and the effects of hydrostatic uplift should be considered in the design of the basement. The basement will need to be fully tanked. Liaison may be require with the local utility companies.
Residual impacts	n/a

15 Land Stability / Slope Stability

This Basement Impact Assessment has identified potential issues relating to ground movements in the surrounding soils.

It is understood that the basement is to be formed using contiguous piled wall which will be designed as cantilevers. A steel frame will prop the capping beam from the temporary condition. The steel frame will also support the joists and masonry walls. A specification for structural works and structural calculations have been provided and are included within Appendix B.

A Ground Movement Assessment has not been undertaken and may be required in order to estimate the potential category of damage to the neighbouring buildings, and to estimate the ground movements affecting any underground utilities.

The BIA has concluded that there will not be risks or slope stability impacts to the development or adjacent sites.

Construction controls are required to help ensure that ground movements related to be basement construction are kept as small as practicable.

16 Hydrogeology and Groundwater Flooding

The BIA has concluded, based on the results of the Desk Study, that the site is located within an area with limited potential for groundwater flooding. A formal flood risk assessment should be carried out for the site.

The BIA has concluded that there should be no significant impacts to the wider hydrogeological environment.

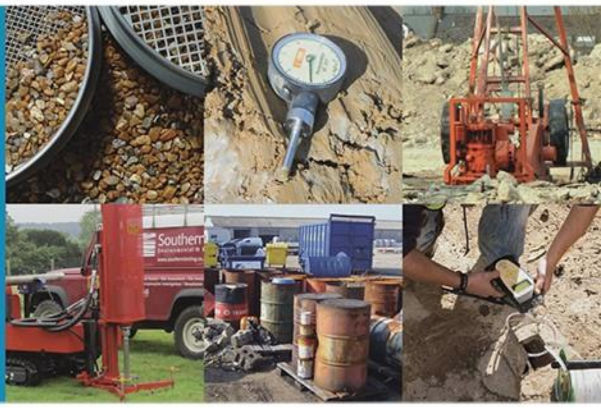
17 Hydrology, Surface Water Flooding, and Sewer Flooding

The BIA has concluded, based on the results of the Desk Study, there is not considered to be a significant risk of flooding related to surface water or sewers to the subject site. However, a formal flood risk assessment is recommended to be carried out for the site.

The BIA has concluded that there should be no significant impacts to the wider hydrological environment.

APPENDIX A

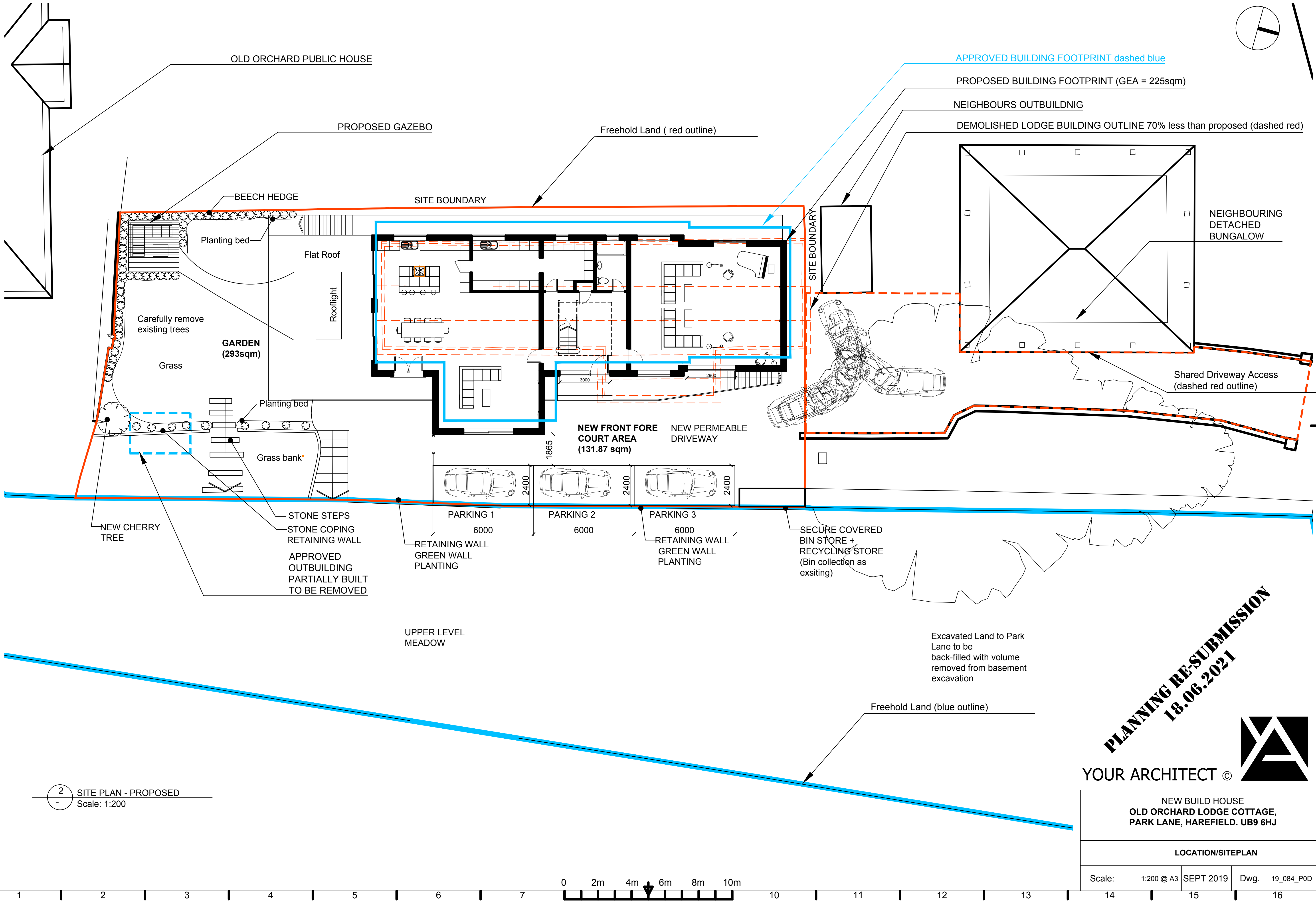
Site Location Plan



Site:	Old Orchard Lodge Cottage, Harefield	Project ID	J15005
Figure 1	Site Location Plan	Date:	01/02/2022

General Notes: 1. Copyright: this drawing cannot be reproduced without the consent of the owner; 2. Do not scale from this drawing. All dimension are to be checked on site; 3. All dimensions, levels and drain lines to be checked on site prior to commencement of work. Any discrepancies should be brought to the designers attention.

RevNo	Revision note	Date	Signature	Checked
B	Difference between approved scheme & proposed scheme clarified	27.09.2021		
C	Amended to suit Hillingdon's comments	13.10.2021		
D	Amended to suit Hillingdon's comments - staircase from basement	22.11.2021		



2 SITE PLAN - PROPOSED
Scale: 1:200

YOUR ARCHITECT ©

NEW BUILD HOUSE
OLD ORCHARD LODGE COTTAGE, PARK LANE, HAREFIELD. UB9 6HJ

LOCATION/SITEPLAN

Scale:	1:200 @ A3	SEPT 2019	Dwg.	19_084_P0D

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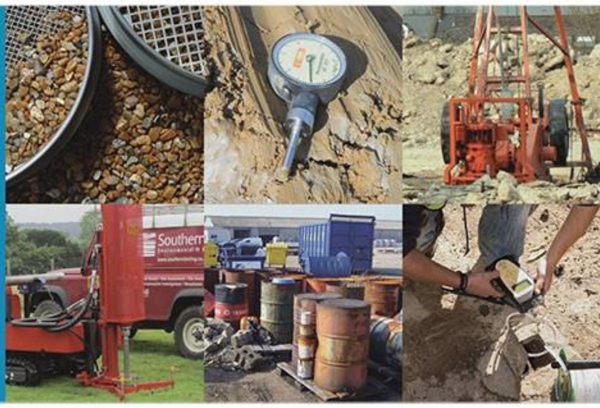
APPENDIX B

Structural Specification & Calculations



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Specification for Structural Works

Old Orchard Lodge Cottage Park Lane Harefield UB9 6HJ

CLIENT

Ammar Khaliq

40 Honepot Lane London NW9 9 QL

PROJECT NO:21187

05 January 2022

Specification for Structural Works

General

1. Do not scale from the drawings. The Contractor is to check all dimensions on site before carrying out works.

2. This specification is to be read in conjunction with the Architect's and all other Consultants' drawings and specifications, which should be used to verify layout, setting out, finishes etc. Any discrepancies are to be brought to the attention of the Architect prior to construction.

3. Where notes in the specification differ from the drawings and details, clarification should be sought from the Engineer.

4. The Contractor is to inform the Architect and Structural Engineer if the existing fabric, including foundations, is opened up and found to be inadequate, unsuitable to support the proposed works, or at variance from the details shown on the drawings.

5. Items noted on the drawings "to be confirmed on site" are to be exposed by the Contractor for inspection by the Structural Engineer at the earliest opportunity.

6. Do not cut any holes or chases through any structural members without first obtaining the written consent of the Structural Engineer.

7. The Client must appoint a principle designer and they must inform the Health and Safety Executive of the works by filling in and submitting an F10 form prior to starting work on site where a project is notifiable.

8. The Contractor must ensure that the Contract Administrator has agreed all necessary Party Wall notices prior to carrying out works under, on or adjacent to a Party Wall.

9. The Contractor is to ensure that the Building Control Officer and Structural Engineer are notified to carry out inspections of any structural work prior to covering up with finishes.

10. This specification and design uses Eurocodes which is cited in Building Regulations part A & is the current best practice. All Contractor design using loads from our design is to be similarly compliant with Eurocodes unless agreed otherwise in writing.

Temporary Works

1. The Contractor is entirely responsible for maintaining the stability of all existing buildings and structures, within and adjacent to the works, and of all the works from the date of possession of the site until practical completion of the works.

2. The Contractor shall design, install and maintain all necessary temporary works and shall submit proposals for the temporary supports and sequence of construction for the works, to the Structural

Engineer and Contract Administrator at least 10 working days prior to starting on site. These proposals shall be supported by design calculations unless agreed otherwise by the Structural Engineer in writing.

Stability

1. The Contractor is to accept full responsibility for the stability and structural integrity of the works during the Contract and provide temporary support as necessary. They shall also prevent overloading of any completed, partially completed or existing elements.

Tolerances

1. All tolerances are to be agreed with the Architect and in accordance with their drawings and specifications, and the Contractor will be responsible for ensuring that sufficient tolerances are provided and integrated throughout all elements of the works.

2. The Contractor is to take account of tolerances detailed elsewhere in all relevant project drawings and specifications when complying with the above clause.

3. Unless otherwise indicated on the drawings and specifications provided by the Architect or Engineer the setting out dimensions and levels of the finished structural works shall be within the maximum tolerances given below.

Description	Maximum Tolerance
All dimensions of 3m and over	+/- 5mm
All dimensions less than 3m	+/- 3mm

Materials and Workmanship

1. All articles, materials and goods shall be new and of good quality, suitable for the required purpose and shall conform to the appropriate Eurocode, British Standard (if still applicable), or other applicable quality standard where such exists. Where references to the above are made it shall be inferred that the latest edition applies, together with subsequent amendments, unless otherwise specified.

Excavation and Filling

1. A site investigation has been carried out and the report is available from the Engineer unless already issued with the tender documents. A number of trial pits have been excavated and records of them are available from the Engineer unless already issued with the tender documents.

2. Before beginning any excavation the Contractor must ensure that they have located any live services in the neighbourhood of the intended excavation.

3. No excavation within 3 metres of an existing foundation is to be taken below the level of the existing foundation unless a method statement has been agreed in writing with the Engineer.

4. The Contractor must not excavate below the level of the underside of a Party Wall foundation within 3 metres, or undermine the bearing of a Party Wall foundation within a 45 degree line from the edge of the base within 6 metres until all necessary Party Wall awards are in place and method statements have been agreed.

5. The Engineer and Building Control Officer shall be given the opportunity of examining all excavations, filling and hardcore before they are concreted or covered up. The Contractor shall give at least 24 hours' notice of when excavations will be ready for inspection. If a good foundation bearing is not obtained at the level shown, the Engineer is to be informed.

6. Excavations shall not be left exposed longer than necessary in order to avoid deterioration from the weather or other causes, and if necessary they should be protected. In clay formations the excavations shall not be left exposed for more than 24 hours. If the formation deteriorates it shall be cleaned out and reformed to the Engineer's satisfaction before any concrete is placed.

7. The Engineer is to be informed immediately if any significant change in strata occurs at formation level.

8. Hardcore for filling shall consist of selected clean broken stone, concrete, hard sound brick, slag or other approved materials, and shall be chemically inert. The materials shall be broken down to a maximum 75mm gauge with a sufficient proportion of fines for thorough compaction. Hardcore shall be well consolidated by means of roller, vibrating plate or mechanical punner. Care shall be taken to ensure that no damage is caused to any foundations, walls or services.

Foundations

1. New foundations have been designed to suit an allowable bearing pressure not exceeding 175kN/m^2. The Contractor is to ensure that all new foundations bear onto an even natural bearing formation of undisturbed subsoil and is to notify the Building Control Officer for their inspection before concreting.

2. If the Building Control Officer requests amendments to the foundations or if conditions differ from those noted above, the Contract Administrator and Structural Engineer are to be notified immediately. The Contractor shall not proceed without receiving instructions from the Contract Administrator.

3. Foundations are to be cast symmetrically about piers, stanchions, or walls, unless noted otherwise on the drawings.

4. In the absence of any detailed testing information for clay soils, depths of new foundations are to be designed in accordance with National House Building Council (NHBC) Standard Chapter 4.2 Building near trees, assuming a highly shrinkable clay soil.

Masonry

1. Workmanship is to comply generally with BS EN 1996-1-1, 2 & 3. Brickwork to be to BS EN 772-3 & 7 and BS EN 771-1. Blockwork to be to BS 6073-2.
New brickwork above the damp proof course (d.p.c.) is to be minimum class 3 set in 1:1:6 (cement:lime:sand) mortar, unless noted otherwise on the drawings.

2. New blockwork is to be minimum strength 7.0 N/mm^2 set in 1:1:6 (cement:lime:sand) mortar, unless noted otherwise on the drawings.

3. Brickwork and blockwork are to be laid properly bonded as agreed with the Architect and fully bonded into existing masonry. All junctions in structural walls are to be fully tooth bonded unless agreed otherwise.

4. All masonry below the d.p.c. is to be set in 1:3 (Cement:Sand with plasticiser) mortar with sulphate resisting cement.

5. New brickwork below the d.p.c. is to be Class B engineering bricks.

6. New blockwork below the d.p.c. is to be specified as suitable for such use by the manufacturer, and of minimum strength 7.0N/mm^2, or as noted otherwise on the drawings.

7. Do not use frozen materials or lay masonry when the ambient air temperature is at or below 3°C and falling or unless it is at least 1°C and rising.

8. Unless noted otherwise on drawings or Architects specification, Cavity wall ties shall be Ancon Staifix RT2 stainless steel ties (or similar equivalent) to BS EN 845-1:2003 spaced at 450mm centres vertically, 900mm centres horizontally staggered, and at 225mm centres vertically at 225mm from all openings, corners and reveals. Minimum embedment to be 62.5mm into each masonry leaf.

9. Wall ties elsewhere are to be, to BS EN 845-1:2003, as noted on the drawings. Minimum embedment to be 62.5mm into each masonry leaf.

10. Bricks and blocks shall not be stored on any floor without first obtaining written consent from the Engineer. The Contractor shall ensure that the loadings imposed on the permanent works by the storage of materials does not overstress any part of the permanent works or cause excessive deflection.

11. In dry weather, bricks are to be soaked in water before being laid, and tops of walls to be raised are to be similarly soaked before work is recommenced.

12. Brickwork and blockwork is to be carried up in a uniform manner and is to be raked back and not toothed up, no section rising more than one metre above the remainder. Brickwork built with standard 65mm bricks

shall rise at the rate of four courses to 300mm. No more than sixteen courses shall be built in a day without prior permission of the Engineer.

13. Crack control brick reinforcement is to be provided over doors, over and under windows and at changes in profile (e.g. where the building steps from two storeys to one storey), as follows: 2 layers of Bekeart Bricktor in the two bed joint immediately adjacent to the opening. To extend 600mm beyond the opening on both sides and 600mm either side of the change in profile.

14. Vertical movement joints should be provided in masonry walls built with cementitious mortar to minimise the risk of major cracking, as shown in the following table:

Material	Joint Width (mm)	Normal Spacing
Clay brick	16	12m (15m maximum)
Calcium silicate brick	10	7.5 to 9m
Concrete block and brick	10	6m
Any masonry parapet wall	10	Half the above spacing and 1.5m from corners (double the frequency)
The spacing of the first movement joint from a return should not be more than half of the above dimension.		

Provide flat straight stainless steel ties within the joint at 225mm vertical centres de-bonded with sleeves over one half. Joints to be filled with suitable compressible material with minimum 10mm deep weather proof sealant to the external leaf. In cavity walls, provide cavity wall ties (as clause 9), at 225mm centres vertically within 225mm of either side of the joint. Positions of joints to be agreed with the Architect prior to construction.

15. Steel columns, posts and proprietary windposts to be tied to internal block leaf within cavity walls using Halfen HTS framing cramps at 225mm vertical centres, or similar equivalent product, fixed to steel in accordance with manufacturers specification.

16. Proprietary wall starter systems such as Furfix or similar may be used to tie new masonry extensions to existing masonry in locations where approved by the Structural Engineer.

17. Use proprietary head restraints as detailed by Halfen or Ancon to tie tops of internal block walls to the underside of concrete floor slabs.

18. All masonry walls to be restrained by timber floors and roofs with lateral restraint straps at 1200mm c/c as noted in the Timber specification section.

Concrete

1. Materials and workmanship are to comply generally with BS EN 1992-1-1 and BS EN 13670.

2. Mass concrete foundations to be designated concrete FND 2 unless a site investigation is carried out with testing of ground water to prove sulphate levels are Class 1 or below. Ground bearing slabs to be designated concrete C20/25 with mesh as noted on the drawings, cast on a well compacted hardcore sub-base.

3. All reinforced concrete not in contact with the ground to be designated concrete C28/35 to BS 8500 and BS EN 206-1 with CEM1 OPC to BS EN 197 and 20mm max aggregate. All reinforced concrete in contact with the ground such as foundations or retaining walls to be constructed in designated concrete C28/35 using sulphate resistant cement and 20mm max aggregate to BS 8500 and BS EN 206-1.

4. The Contractor shall provide details of all admixtures to be used in the concrete and agree their use with the Engineer before any concrete is delivered to site.

5. Cement replacements such as Ground Granulated Blast furnace Slag (GGBS) or Pulverised Fuel Ash (PFA) may be used to replace up to 70% of the cement content of the concrete. Using these cement replacement products reduces carbon dioxide emissions as they are by-products of materials from other industries. The Contractor should send the mix specification to the Engineer for and obtain approval prior to ordering any concrete. If used, the Contractor must adjust their formwork strike times to suit any loss of early strength gain.

6. Concrete for padstones is to be 2:3:6 (cement:fine sand:coarse sand) nominal mix, with OPC and 10mm max aggregate.

7. Ready mixed concrete must be obtained from a plant which holds a current Certificate of Accreditation under the Quality Scheme for Ready Mixed Concrete.

8. Site-mixed concrete may be used when agreed with the Engineer. An agreed pre-batched and bagged proprietary concrete must be used unless an alternative site batched concrete has been agreed with the Engineer.

9. Do not place concrete when the ambient air temperature is less than 5°C and take all necessary measures to ensure that the temperature of the placed concrete will not fall below 5°C for the specified curing period.

10. Concrete Cubes to be tested for compressive strength for all reinforced concrete elements. 3 samples per pour or per 50m^3. One 7 day test, one 28 day test and one sample for future testing if required. All tests to be carried out by UKAS accredited laboratory or equivalent. Testing to BS EN 206-1, annex B and BS 8500-1, annex B. Results are to be submitted to the Engineer within 5 working days of test.

11. The Contractor is to provide suitable curing for all concrete elements to comply with the requirements of BS 8110-1:1997 table 6.1, or Eurocode Equivalent.

Table 6.1 - Minimum Periods of Curing and Protection

Type of cement	Ambient Conditions after casting	Minimum periods of curing and protection	
		Average surface temperature of concrete	
		5˚C to 10˚C	*t* ˚C (any termperature between 10˚C and 25˚C)
		Days	Days
CEM I 42.5 or CEM I 52.5 to BS EN 191-1	Average	4	$\frac{60}{t+10}$
SRPC 42.5 to BS 4027	Poor	6	$\frac{80}{t+10}$
All cements indicated in Table A.17 of BS 8500-1:2002 except for CEM I 42.5 or CEM I 52.5 to BS EN 197-1, SRPC 42.5 to BS 4027 and supersulphated cement.	Average	6	$\frac{80}{t+10}$
	Poor	10	$\frac{140}{t+10}$
All	Good	No special requirements	
NOTE 1 Abbreviations for the type of cement used are as follows: CEM I 42.5 : Portland cement (class 42.5) (see BS 12); CEM I 52.5 : Portland cement (class 52.5) (see BS 12); SRPC 42.5 : Sulphate-resisting Portland cement (class 42.5) (see BS 4027). NOTE 2 Ambient conditions after casting are as follows: good : damp and protected (relative humidity greater than 80%; protected from sun and wind); average : intermediate between good and poor; poor : dry or unprotected (relative humidity less than 50%; not protected from sun and wind).			

12. All holes shall be formed and all inserts cast in at the time of pouring concrete. No part of the concrete works shall be drilled or cut away without the approval of the Structural Engineer.

13. Reinforcement shall be:
    (i) deformed bars to BS 4449:2005, grade B500, prefix H (or T) on drawings and schedules (ii) mesh to BS 4483

14. Reinforcement shall be fixed adequately using tying wire or steel clips. Concrete cover is to be as specified on the drawings. Reinforcement chairs and proprietary spacers are to be provided as necessary to maintain the specified cover. Broken bricks, tiles or other debris must not be used.

15. Unless noted otherwise on drawings, all reinforcement is to be lapped 40d (where d is diameter of the smaller bar).

16. All formwork and supporting members shall be sufficiently strong to resist the pressure of the wet concrete and to ensure that the specified tolerances for the finished work are achieved.

17. Unless otherwise specified by the Structural Engineer or Architect the formwork shall be such that the resulting concrete finish shall be Type A of Clause 6.2.7.3 of BS 8110-1:1997, i.e.:

    Type A finish. This finish is obtained by the use of properly designed formwork or moulds of timber, plywood, plastics, concrete or steel. Small blemishes caused by entrapped air or water may be expected, but the surface should be free from voids, honeycombing and other blemishes.

18. The minimum period before striking formwork shall be in accordance with BS 8110-1:1997 table 6.2, or Eurocode Equivalent.

Table 6.2 – Minimum period before striking formwork

Type of Formwork	Minimum period before striking	
	Surface temperature of concrete	
	16°C and above	*t*°C (any temperature between 0°C and 16°C)
Vertical formwork to columns, walls and large beams	12h	$\frac{300}{t+10}$ h
Soffit formwork to slabs	4 days	$\frac{100}{t+10}$ days
Soffit formwork to beams and props to slabs	10 days	$\frac{250}{t+10}$ days
Props to beams	14 days	$\frac{360}{t+10}$ days
NOTE: This table can be applied to CEM I and SRPC of higher cement strength classes.		

Timber

1. TIMBER PROCUREMENT

   Timber (including timber for wood based products): obtained from well-managed forests and/or plantations in accordance with:

   - The laws governing forest management in the producer country or countries.
   - International agreements such as the Convention on International Trade in Endangered Species of wild fauna and flora (CITES).

   Documentation: provide either:

   - Documentary evidence (which has been or can be independently verified) regarding the provenance of all timber supplied.
   - Evidence that suppliers have adopted and are implementing a formal environmental purchasing policy for timber and wood based products.

2. New timber in the works is to be selected structural timber not inferior to European Redwood/Whitewood grade C16 to BS EN 338:2009, unless noted otherwise on the drawings.

3. Timber that in the opinion of the Engineer is inferior in quality or condition or is not suitable for the requirements of the work is not to be used.

4. All existing timber is to be inspected for signs of damage, decay or infestation at the beginning of the project by a specialist. Refer to specialist's report for all information in connection with timber treatment or replacement.

5. New timber in the works is to be vacuum impregnated with preservative to BS EN 1995-1-1 and BS EN 351-1 and the manufacturer's recommendations. Cut ends are to be thoroughly treated with brush applied coats of appropriate preservative before fixing. All preservatives are to be to the Architect's approval.

6. Timber shall be stored under cover, clear of the ground and protected from the weather.

7. Structural timbers may only be drilled or cut for services with the approval of the Structural Engineer. Drill holes and notches in joists to be in accordance with NHBC Standards Chapter 6.4-S9 and BS EN 1995-1-1.

8. Sizes of new structural timbers noted on the drawings are sawn basic sizes.

9. All proprietary joist hangers, straps, connectors etc. to be provided by Simpson Strong-tie or Expamet, unless approved otherwise, and shall be fit for purpose.

10. All timber connectors, screws, nails, joist hangers, steel straps etc. are to be galvanised or sherardised. All such items are to be fixed in accordance with the manufacturer's recommendations, unless shown otherwise on the drawings.

11. All doubled or tripled up timbers shall be fixed together with M12 bolts or threaded rods at 600mm centres, using double toothplate connectors between timbers, and 50mm square steel washers (3mm thick), unless shown otherwise on the drawings.

12. Unless otherwise specified, securely fix full depth solid timber noggins between joists as follows:

    (i) Joist spans of up to 3.5m: one row at third spans and at the bearings.

    (ii) Joist spans over 3.5m: rows at quarter spans, mid span and at the bearings.

    (iii) At positions of joints in ply sheeting.

13. Wall plates for roofs are to be tied down using 1200mm long 30 x 2.5mm galvanised mild steel straps at maximum 1200mm centres with 100mm bob end. Straps are to be nailed to the top plate and plugged and screwed to the internal face of the wall with a minimum of 3 No.12 wood screws 50mm long.

14. Lateral restraint straps to the perimeter of all floors, roofs and where otherwise noted on the drawings are to be minimum 700mm long 30 x 5mm galvanised mild steel straps at maximum 1200mm centres with 100mm bob end. Straps perpendicular to joists are to be fixed to the tops of three joists over solid blocking infill and notched in a maximum of 6mm. Straps parallel to joists are to be fixed to the side face of the joist. Straps to be fixed with a minimum of 3 (No.12) wood screws 50mm long.

15. Where sections of floor or roof are separated by a steel beam install 1250mm long 30 x 5mm straps at 1200mm c/c for continuity.

16. Where lateral restraint straps for floors are to be tied into existing 215mm thick (min) solid brick walls, cast bobbed end into a 225x100x150dp mass concrete anchor block into pocket and dry packed at top with 3:1 sharp sand cement well rammed in.

Steelwork

1. The design, fabrication and erection of the structural steelwork is to be in accordance with the current version of BS EN 1993-1-1 and BS EN 1090-2 and the latest edition of the National Structural Steelwork Specification (NSSS and NSSS CE Marking version) for Building Construction, and all clauses, including appendices are deemed to be part of this specification.

2. All structural steel sections are to be Grade S355 (unless agreed otherwise or noted otherwise on the drawings) to the applicable code from the following list; BS 4-1:2005, BS EN 10210-2:2006, BS EN 10025-2:2004.

3. The steel connections are to be designed and detailed by the Contractor to suit the loadings provided by the Engineer.

4. The steelwork fabricator is to obtain dimensions from site. Settings out dimensions are to be obtained from the Architect's drawings.

5. Shop fabrication drawings showing layout, connections and fixing details, and connection calculations where requested, are to be submitted to the Engineer and Architect for comment at least two weeks before any fabrication is carried out.

6. All bolts are to be grade 8.8 Black Bolts (unless noted otherwise on the drawings) to BS 4190. Designed steel to steel connections to use a minimum of 2No. M16 bolts unless noted otherwise in the details.

7. All welding is to comply with BS EN 1011 Parts 1 & 2. Site welding shall not be permitted except with the written approval of the Structural Engineer. Where permitted, all site welding to be 100% tested (unless agreed otherwise with Engineer) in accordance with the National Structural Steelwork Specification (NSSS). All site weld test reports to be submitted to the Structural Engineer at least 10 working days prior to the covering of the site welded areas with permanent finishes.

8. All welds are to be 6mm fillet welds or full strength butt welds unless noted otherwise on the drawings. Carry out additional weld testing in accordance with the National Structural Steelwork Specification for Building Construction on any critical welds specified by the Structural Engineer.

9. Unless noted otherwise, ends of all steelwork built into brickwork are to be concrete encased. Min 50mm concrete cover.

10. Unless noted otherwise, all steelwork in contact with the ground to be wrapped in D49 mesh and encased in concrete, 50mm minimum cover.

11. Unless noted otherwise, steel columns within box frames installed to form openings in existing masonry walls are to be bolted to the existing masonry using M12 resin anchors at 600mm c/c staggered vertically (100mm min embedment unless noted otherwise). Use Hilti HIT-HY-70 resin system or similar equivalent. Masonry reveals must be made good with new masonry fully tooth bonded into existing prior to fixing.

12. New steel beams or frames below existing walls are to be installed on the centreline of the wall unless noted otherwise on the drawings. Dry pack to be 3:1 sharp sand cement well rammed in.

13. Steel baseplates to have grout access and vent hole, and must be levelled with steel shims positioned symmetrically around baseplate perimeter. Do not use a central pack.

14. Column bases to be grouted in accordance with BS EN 1090-2. For spaces less than 25mm – obtain instructions. For spaces 25-50mm use 1:1 cement:sand mortar, just fluid enough to pour. Tamped well as filling proceeds. For spaces 50-80mm deep use 2:1 cement:sand mortar, just damp, tamped well against fixed supports. Portland Cement to BS EN 197-1 – CEM 1 42.5 or 52.5. Sand to BS EN 12620, grade 0/4 or 0/2 (MP). Additives not required.

Steelwork Paint Systems for Corrosion and Fire Protection

1. All painting shall be carried out in accordance with BS EN ISO 12944, BS EN 1090-2 and the paint manufacturer's instructions. Paint systems as specified below are by Sherwin-Williams Protective & Marine Coatings (contact: 01204 556 457 or sales.uk@sherwin.com). Contractor to provide details of any alternative manufacturers and paint specifications for approval prior to fabrication).

   For a warm, dry building with no risk of condensation on steelwork i.e. internal steelwork concealed and fire protected with plaster finishes:
   - After preparation by blast cleaning to Sa 2½ to BS EN ISO 8501-1 (Welds/edges/areas with surface imperfections: To BS EN ISO 8501-3, preparation grade), all surfaces, which shall be dry, shall be painted with one coat of zinc phosphate primer (75 microns dry film thickness (dft) Sherwin-Williams Protective & Marine Coatings Epigrip C400V3). This coat should be applied in the works with any subsequent damage made good on site.

   For steelwork within the perimeter wall of a building, such as within the inner leaf of a cavity wall but not in contact with the external leaf:
   - After preparation by blast cleaning to Sa 2½ to BS EN ISO 8501-1 (Welds/edges/areas with surface imperfections: To BS EN ISO 8501-3, preparation grade), all surfaces, which shall be dry, shall be painted with one coat of zinc phosphate primer (125 microns dry film thickness (dft) Sherwin-Williams Protective & Marine Coatings Epigrip C400V3). This coat should be applied in the works with any subsequent damage made good on site.

   For steelwork in contact with the external leaf:
   - Apply locally to contact area, 400 microns dft of Sherwin-Williams Protective & Marine Coatings Epigrip M922 (shop applied spray) or 400 microns dft of Sherwin-Williams Protective & Marine Coatings Epigrip M922m (mastic version applied by brush on site).
   - these paints can be applied directly to a blast cleaned substrate.

   As an alternative to using a bituminous paint product to coat ends of steel beams in contact with external walls etc, use 2 coats of 125 microns dft of Sherwin-Williams Protective & Marine Coatings Epigrip L524, over 75 microns dft of Sherwin-Williams Protective & Marine Coatings Epigrip C400V3.

2. Fire protection to all steelwork to suit the Architect's details. Any structural steel elements not suitably protected by the Architect's finishes or to be left exposed in the permanent condition are to be protected using intumescent paint system and dft loading schedule as specified by Sherwin-Williams Protective & Marine Coatings to suit the steel section size, and level of fire protection required.

3. Where intumescent paint is applied, provide the Engineer and Architect with a copy of the intumescent loading schedule as specified by the supplier, and a certificate to confirm the actual dry film thickness measured. This can be carried out by an independent specialist or self-certified by the Contractor.

4. Where indicated on the drawings the steelwork and fixings shall be hot dipped galvanised to BS EN ISO 1461 in order to give a uniform zinc deposit of at least 100 microns.

5. Galvanised steelwork that is to be painted with a RAL colour finish should then be treated as follows: - Flash/sweep blast using non-metallic abrasive within 20-30 microns typical or clean & degrease with Enviroguard W500, fresh water rinse & allow to dry before applying Leigh's L703 mordant wash.
   - Apply one coat of primer - Sherwin-Williams Protective & Marine Coatings Epigrip K267 100 microns dft.
   - Apply finish coat of Sherwin-Williams Protective & Marine Coatings Resistex C137V2 Special Finish, 50 micron dft.

6. Galvanised steelwork that is to be finished in a light or dark metallic grey (micaceous iron oxide):
   - Flash/sweep blast using non-metallic abrasive within 20-30 microns typical or clean & degrease with Enviroguard W500, fresh water rinse & allow to dry before applying Leigh's L703 mordant wash.
   - Apply one coat of primer - Sherwin-Williams Protective & Marine Coatings Epigrip K267 75 microns dft.
   - Apply finish coat of Sherwin-Williams Protective & Marine Coatings Epigrip K267 75 microns dft.

7. Where steelwork is galvanised, in order to minimise problems with Liquid Metal Assisted Cracking (LMAC), the following restrictions should be adhered to for all connections designed by the Contractor:

   - Partial end plates – Avoid: use full end plates or bolted cleat connections.
   - Part depth stiffeners – Avoid: use full depth stiffeners welded with intermittent fillet welds.
   - Use intermittent fillet welds for attachment of brackets.

Prior to erection or application of other coatings, all galvanised structural steelwork is to be visually inspected for cracks or indications of LMAC cracking. Inspection is to be carried out by a suitably qualified person trained and competent in visual inspection for LMAC. Where suspected LMAC defects are identified inform the Engineer immediately.

Lintels

1. Prestressed concrete lintels to BS EN 845-2 by Supreme Concrete Ltd, Coppingford Hall, Coppingford Rd, Sawtry, Huntingdon PE28 5GP, Tel. 01487 833 300. Sizes and types as indicated on the drawings. End bearing lengths are to be at least 150mm for spans up to 1.5m, and 225mm for spans up to 2m, unless noted otherwise on the drawings.

2. Galvanized steel lintels are to be to BS EN 10346 by Catnic, Pontypandy Industrial Estate, Caerphilly, Mid Glamorgan CF83 3GL, Telephone 029 2033 7900. Sizes and types as indicated on the drawings. End bearing lengths are to be at least 150mm for spans up to 1.5m, and 225mm for spans up to 2m, unless noted otherwise on the drawings.

3. The Contractor shall submit details to the Engineer and Contract Administrator for any alternative lintel type or manufacturer and obtain the Contract Administrator's written approval, prior to commencement of the work.

Underpinning and Retaining Walls

1. The Contractor shall be responsible for ensuring that their operations do not in any way impair the safety or condition of the existing structure or the adjacent properties. They shall provide any temporary supports required for this purpose, and shall carefully inspect the condition of the structure both before and during the execution of the work and immediately inform the Engineer and Architect if they consider that any more stringent procedure than that specified is necessary.

2. Before starting the work the Contractor is to check for any services that could be damaged by the work and shall provide for the maintenance of drainage services during the works and for the reinstatement of any services interrupted or disturbed by the excavations.

3. Before completing the bulk excavation, the Contractor must install any temporary propping to the underpins and retaining walls in accordance with the temporary works design and sequence, and this temporary support shall remain in place until the drainage and permanent support structure has been installed.

4. Underpinning and retaining wall installation is to be carried out in short sections not exceeding 1000mm in length, in the numbered sequence shown on the drawings. Retaining walls may be installed in longer sections where agreed in the Contractors temporary design and sequence of works.

5. Before underpinning, projecting portions of the existing footings are to be carefully cut off as detailed and the underside of the footings are to be cleaned and hacked free of any dirt, soil or loose material.

6. The Engineer and Building Control Officer shall be given the opportunity of examining all excavations, prior to any underpinning or retaining walls being cast.

7. Unless noted otherwise on the drawings, mass concrete underpinning is to be constructed in concrete nominal 1:2:4 mix using sulphate resistant cement and 20mm max aggregate, or designated concrete GEN 3 (C16/20) in accordance with BS8500 and BS EN 206-1.

8. Unless noted otherwise on the drawings, reinforced concrete underpinning and retaining walls are to be constructed in designated concrete C28/35 using sulphate resistant cement and 20mm max aggregate in accordance with BS8500 and BS EN 206-1. Cover to reinforced concrete in contact with the ground to be a minimum of 75mm unless noted otherwise.

9. Underpinning and retaining walls are to be cast to the widths and depths shown on the drawings. As far as practicable excavation and concreting of any section of underpinning or retaining wall shall be carried out on the same day. Un-concreted sections shall be kept covered to prevent the ingress of water.

10. Concrete underpinning is to be stopped off approximately 100mm below the underside of the existing footing, and the final pinning up over the whole extent of the latter is to be carried out with a semi-dry fine concrete, well rammed in as soon as possible after the foundation has set hard. The pinning-up concrete is to consist of 1 part by volume of sulphate resistant cement to 3 parts of aggregate (well graded from 10mm maximum size down to fine sand) with a water/cement ratio by weight of 0.35.

11. Excavation to any section of underpinning shall not be commenced until at least 48 hours after completion of any adjacent section of the work.

12. The joint between adjacent sections of mass concrete underpinning is to be formed by creating a rough surface against which the first section is cast. Then, having thoroughly cleaned the exposed concrete face, the adjacent section may be cast. The joint between adjacent sections of reinforced concrete underpins or retaining walls should be prepared as above, however reinforced concrete underpins are to be dowelled together in accordance with the reinforcement detail drawings.

13. The Contractor shall prepare a Sequence of Work and submit it to the Contract Administrator for his comments prior to the commencement of the work.

14. The Contractor is to keep a record of the sequence and dimensions of the underpinning actually carried out, including details of excavation, casting concrete and pinning up for each section.

15. Holes and penetrations for services through underpins and retaining walls are to be set out and detailed by the Architect, including waterproofing details such as puddle flanges or hydrophilic strips, and installed prior to the pouring of concrete.

STRUCTURAL CALCULATIONS

Using

MASTERSERIES POWERPAD

STRUCTURAL ENGINEERS

RM DMS

85-90 Paul Street
London
EC2A 4NE
Tel: (0203) 701 3875

RM DMS
Design and Management Studios
Where innovation meets commercially minded structural engineering design
Telephone +44 203 553 2808
Email rm@rm-dms.co.uk
www.rm-dms.co.uk

STRUCTURAL CALCULATIONS

OLD ORCHARD LODGE COTTAGE PARK LANE HAREFIELD UB9 6HJ

CLIENT

Ammar Khaliq

40 Honepot Lane London NW9 9 QL

PROJECT NO:21187

08 June 2022

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 2 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

LOADINGS

PITCHED ROOF CONSTRUCTION-TRADITIONAL

Roof live load…………	0.6KN/m2
Tiling…………	0.600
Felt & Battens…………	0.050
Purlins & Rafters…………	0.150
Ceiling joists & insulation…………	0.100
Plasterboard live load…………	0.250
Ceiling live load…………	0.250

TRUSSED

Roof live load…………	0.600KN/m2
Tiling…………	0.600
Felt & Battens…………	0.050
Trusses & insulation…………	0.250
Plasterboard & Skim…………	0.250
Ceiling live load…………	0.250

FLAT ROOF CONSTRUSTION

Roof live load…………	0.750KN/m2
Balcony live load…………	3.000
Snow build-up…………	1.250
Chippings & bitumen…………	0.300
3 layers felt…………	0.150
Boarding,joists & insulation…………	0.250
Plasterboard & skim…………	0.250

TIMBER FLOOR CONSTRUCTION

Conference facility…………	5.000KN/m2
Residential live load…………	1.500
Public live load…………	5.000
Boarding & Joists…………	0.250
Plasterboard & Skim…………	0.250

WALL CONSTRUCTION-MASONRY

102mm facing brickwork…………	2.250KN/m2
100mm blockwork…………	1.400
2 skims of plaster…………	0.250

STUDWORK WALL CONSTRUCTION

2 sides of plasterboard & skim…………	0.500KN/m2
Studwork…………	0.100

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DESIGN STATEMENT

The project involves the construction of a new dwelling with a basement formed using contiguous piles which will be designed as cantilevers.

A steel frame will prop the capping beam for the temporary condition.

The steel frame will also support the joists and masonry walls. Of the upper floor the frame extends up to support the roof structure.

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Job ref	: 21187
Sheet	: **Sheet Ref / 4 -**
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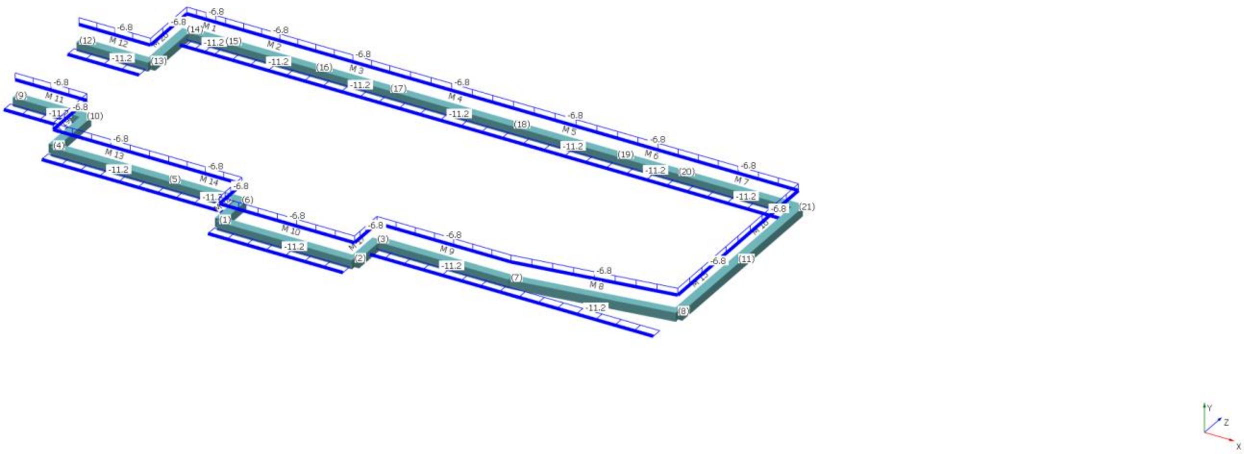
MasterFrame : Graphics



Load Diagram - 001 : Dead plus Live (Ultimate) - All Groups
Frame Geometry - Full Frame - 3D Front View

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MASTERFRAME DATA FILE

LOADING CASES AND LOAD COMBINATION

Load Group Labels

Load Group UT	Unity Load Factor (All Cases)
Load Group D1	Dead Load
Load Group L1	Live Load

Load Case 001 : Dead plus Live (Ultimate)

Load Combination + 1.00 UT + 1.40 D1 + 1.60 L1

Load Case 002 : Live Only (Serviceability)

Load Combination + 1.00 UT + 1.00 L1

THE NODAL CO-ORDINATES

Node	X (m)	Y (m)	Z (m)	Node	X (m)	Y (m)	Z (m)
1	9.489	0.000	-13.595	2	16.279	0.000	-13.595
3	16.279	0.000	-11.635	4	0.000	0.000	-11.635
5	5.814	0.000	-11.635	6	9.489	0.000	-11.635
7	23.010	0.000	-11.635	8	30.745	0.000	-10.500
9	-3.600	0.000	-8.700	10	0.000	0.000	-8.700
11	30.745	0.000	-5.250	12	-3.600	0.000	-3.150
13	0.000	0.000	-3.150	14	0.000	0.000	0.000
15	1.950	0.000	0.000	16	6.487	0.000	0.000
17	10.210	0.000	0.000	18	16.422	0.000	0.000
19	21.659	0.000	0.000	20	24.703	0.000	0.000
21	30.745	0.000	0.000				

MEMBER PROPERTIES

Members 1-20

```
M ... ...          450x450 E 26.00E6 G 10.0E6
 A 2025E-4          Ix 341719E-8        Iy 341719E-8        J 1366875E-8
```

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Job ref	: 21187
Sheet	: **Sheet Ref / 5 -**
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MEMBER LOADING

Member Self Weight Density Load Included in Load Group D1, defined by Modulus of Elasticity

E kN/mm^2	Density kN/m^3
>= 200.00	77.01
>= 20.00	24.00
>= 2.00	10.00 Members 1-20

```
    L1 UDLZ -007.000           ( kN/m )
```

Members 1-20 - MasterFrame Pro Loads

```
    D1 D     024.000           ( kN/m³)
```

NODAL LOADING AND SUPPORT CONDITIONS

NODES 1-8 & 14-21

```
      UT Rs 1 1 1 1 1 0
```

NODES 9-13

```
      UT Rs 1 1 1 0 1 1
```

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Nodal Deflections (001 : Dead plus Live (Ultimate))								
Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.02
2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
8	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
20	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
21	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02

Nodal Deflections (002 : Live Only (Serviceability))								
Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Date **:08 June 2022**
Checked :
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Nodal Deflections (002 : Live Only (Serviceability))								
Load Case	**Nodal Displacements (mm)**				**Nodal Rotation (degrees)**			
	δX →	**δY ↑**	**δZ ↗**	**δXYZ**	**θX →**	**θY ↑**	**θZ ↗**	**θXYZ**
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Member Forces (001 : Dead plus Live (Ultimate))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				x-x	**y-y**	**x-x**	**y-y**	**x-x**	**y-y**	
1	14	0.00C	0.00	1.09	10.92	0.47	-3.55	0.55	1.77	0.01
	15	0.00C	0.00	-12.18	-10.92	-10.35	-3.55	@ 0.156	@ 0.975	@ 1.268
2	15	0.00C	0.00	15.86	25.41	-10.35	-19.21	8.14	9.61	0.21
	16	0.00C	0.00	-15.01	-25.41	-8.40	-19.21	@ 2.314	@ 2.269	@ 2.269
3	16	0.00C	0.00	10.53	20.85	-8.40	-12.94	-0.25	6.47	0.08
	17	0.00C	0.00	-14.80	-20.85	-16.35	-12.94	@ 1.564	@ 1.862	@ 2.010
4	17	0.00C	0.00	20.15	34.79	-16.35	-36.02	13.49	18.01	0.65
	18	0.00C	0.00	-22.12	-34.79	-22.45	-36.02	@ 2.982	@ 3.106	@ 3.044
5	18	0.00C	0.00	20.77	29.33	-22.45	-25.60	9.26	12.80	0.31
	19	0.00C	0.00	-14.86	-29.33	-6.97	-25.60	@ 3.037	@ 2.619	@ 2.776
6	19	0.00C	0.00	6.24	17.05	-6.97	-8.65	-4.10	4.32	0.09
	20	0.00C	0.00	-14.47	-17.05	-19.49	-8.65	@ 0.913	@ 1.522	@ 1.735
7	20	0.00C	0.00	22.47	33.84	-19.49	-34.07	17.62	17.04	0.76
	21	0.00C	0.00	-18.64	-33.84	-7.91	-34.07	@ 3.323	@ 3.021	@ 3.142
8	7	6.29C	-1.93	29.50	42.86	-37.46	-55.84	26.50	27.92	1.91
	8	6.29T	1.93	-23.69	-42.86	-14.73	-55.84	@ 4.300	@ 3.909	@ 4.065
9	3	0.00C	0.00	20.45	37.69	-20.29	-42.29	10.44	21.14	0.71
	7	0.00C	0.00	-25.35	-37.69	-36.79	-42.29	@ 3.029	@ 3.366	@ 3.298
10	1	0.00C	0.00	22.28	38.02	-14.71	-43.03	21.76	21.52	1.21
	2	0.00C	0.00	-23.92	-38.02	-20.29	-43.03	@ 3.259	@ 3.395	@ 3.327
11	9	0.00C	0.00	12.25	20.16	-7.35	-12.10	3.67	6.05	0.06
	10	0.00C	0.00	-12.25	-20.16	-7.35	-12.10	@ 1.800	@ 1.800	@ 1.800
12	12	0.00C	0.00	12.25	20.16	-7.35	-12.10	3.67	6.05	0.06
	13	0.00C	0.00	-12.25	-20.16	-7.35	-12.10	@ 1.800	@ 1.800	@ 1.800
13	4	0.00C	0.00	18.82	32.56	-10.45	-31.55	15.58	15.77	0.63
	5	0.00C	0.00	-20.74	-32.56	-16.01	-31.55	@ 2.791	@ 2.907	@ 2.849
14	5	0.00C	0.00	12.86	20.58	-16.01	-12.61	-3.87	6.30	0.13
	6	0.00C	0.00	-12.15	-20.58	-14.71	-12.61	@ 1.874	@ 1.838	@ 1.801
15	8	0.00C	14.29	17.86	0.00	-15.63	0.00	7.81		0.15
	11	0.00C	-14.29	-17.86	0.00	-15.63	0.00	@ 2.625		@ 2.625
16	11	0.00C	-7.91	17.86	0.00	-15.63	0.00	7.81		0.15
	21	0.00C	7.91	-17.86	0.00	-15.63	0.00	@ 2.625		@ 2.625
17	2	0.00C	20.29	6.67	0.00	-2.18	0.00	1.09		0.00
	3	0.00C	-20.29	-6.67	0.00	-2.18	0.00	@ 0.980		@ 0.000
18	1	0.00C	-14.71	6.67	0.00	-2.18	0.00	1.09		0.00
	6	0.00C	14.71	-6.67	0.00	-2.18	0.00	@ 0.980		@ 0.000
19	4	0.00C	-10.45	12.48	0.00	-7.33	0.00	4.12		0.03
	10	0.00C	10.45	-7.49	0.00	0.00	0.00	@ 1.820		@ 1.702

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Checked :
Approved :

Member Forces (001 : Dead plus Live (Ultimate))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				x-x	**y-y**	**x-x**	**y-y**	**x-x**	**y-y**	
20	13	0.00C	-0.47	8.04	0.00	0.00	0.00	4.75		0.04
	14	0.00C	0.47	-13.40	0.00	-8.44	0.00	@ 1.166		@ 1.323

Member Forces (002 : Live Only (Serviceability))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				x-x	**y-y**	**x-x**	**y-y**	**x-x**	**y-y**	
1	14	0.00C	0.00	0.00	6.83	0.00	-2.22		1.11	0.00
	15	0.00C	0.00	0.00	-6.83	0.00	-2.22		@ 0.975	@ 0.000
2	15	0.00C	0.00	0.00	15.88	0.00	-12.01		6.00	0.09
	16	0.00C	0.00	0.00	-15.88	0.00	-12.01		@ 2.269	@ 2.269
3	16	0.00C	0.00	0.00	13.03	0.00	-8.09		4.04	0.04
	17	0.00C	0.00	0.00	-13.03	0.00	-8.09		@ 1.862	@ 1.862
4	17	0.00C	0.00	0.00	21.74	0.00	-22.51		11.26	0.31
	18	0.00C	0.00	0.00	-21.74	0.00	-22.51		@ 3.106	@ 3.106
5	18	0.00C	0.00	0.00	18.33	0.00	-16.00		8.00	0.15
	19	0.00C	0.00	0.00	-18.33	0.00	-16.00		@ 2.619	@ 2.619
6	19	0.00C	0.00	0.00	10.65	0.00	-5.41		2.70	0.02
	20	0.00C	0.00	0.00	-10.65	0.00	-5.41		@ 1.522	@ 1.522
7	20	0.00C	0.00	0.00	21.15	0.00	-21.30		10.65	0.27
	21	0.00C	0.00	0.00	-21.15	0.00	-21.30		@ 3.021	@ 3.021
8	7	3.93C	0.00	0.00	26.79	0.00	-34.90		17.45	0.75
	8	3.93T	0.00	0.00	-26.79	0.00	-34.90		@ 3.909	@ 3.909
9	3	0.00C	0.00	0.00	23.56	0.00	-26.43		13.21	0.42
	7	0.00C	0.00	0.00	-23.56	0.00	-26.43		@ 3.366	@ 3.366
10	1	0.00C	0.00	0.00	23.77	0.00	-26.89		13.45	0.44
	2	0.00C	0.00	0.00	-23.77	0.00	-26.89		@ 3.395	@ 3.395
11	9	0.00C	0.00	0.00	12.60	0.00	-7.56		3.78	0.03
	10	0.00C	0.00	0.00	-12.60	0.00	-7.56		@ 1.800	@ 1.800
12	12	0.00C	0.00	0.00	12.60	0.00	-7.56		3.78	0.03
	13	0.00C	0.00	0.00	-12.60	0.00	-7.56		@ 1.800	@ 1.800
13	4	0.00C	0.00	0.00	20.35	0.00	-19.72		9.86	0.23
	5	0.00C	0.00	0.00	-20.35	0.00	-19.72		@ 2.907	@ 2.907
14	5	0.00C	0.00	0.00	12.86	0.00	-7.88		3.94	0.04
	6	0.00C	0.00	0.00	-12.86	0.00	-7.88		@ 1.838	@ 1.838
15	8	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	11	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
16	11	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	21	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
17	2	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	3	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
18	1	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	6	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000

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Approved	:

Member Forces (002 : Live Only (Serviceability))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				x-x	y-y	x-x	y-y	x-x	y-y	
19	4	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	10	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
20	13	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	14	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000

Support Reactions (001 : Dead plus Live (Ultimate))

Load Case	Directional Reactions (kN)			Moment Reactions (kNm)		
	Rx → (kN)	Ry ↑ (kN)	Rz ↗ (kN)	Mx → (kN)	My ↑ (kN)	Mz ↗ (kN)
1	0.000	28.946	38.024	-2.178	-43.030	0.000
2	0.000	30.589	38.024	-2.178	43.030	0.000
3	0.000	27.116	37.694	2.178	-42.286	0.000
4	0.000	31.304	32.558	-7.326	-31.549	0.000
5	0.000	33.592	53.138	0.000	18.944	0.000
6	0.000	18.816	20.580	2.178	12.605	0.000
7	0.000	54.854	81.010	-7.350	-13.556	0.000
8	0.000	41.549	43.316	-11.578	55.842	0.000
9	0.000	12.247	20.160	0.000	-12.096	7.348
10	0.000	19.736	20.160	0.000	12.096	3.105
11	0.000	35.721	0.000	0.000	0.000	-22.200
12	0.000	12.247	20.160	0.000	-12.096	7.348
13	0.000	20.284	20.160	0.000	12.096	-7.816
14	0.000	14.483	10.920	8.439	-3.549	0.000
15	0.000	28.044	36.327	0.000	-15.663	0.000
16	0.000	25.539	46.256	0.000	6.275	0.000
17	0.000	34.950	55.636	0.000	-23.080	0.000
18	0.000	42.888	64.114	0.000	10.419	0.000
19	0.000	21.102	46.374	0.000	16.950	0.000
20	0.000	36.942	50.882	0.000	-25.424	0.000
21	0.000	36.498	33.835	15.628	34.072	0.000
Total	0.000	607.446	769.328	-2.188	0.000	-12.215

Support Reactions (002 : Live Only (Serviceability))

Load Case	Directional Reactions (kN)			Moment Reactions (kNm)		
	Rx → (kN)	Ry ↑ (kN)	Rz ↗ (kN)	Mx → (kN)	My ↑ (kN)	Mz ↗ (kN)
1	0.000	0.000	23.765	0.000	-26.894	0.000
2	0.000	0.000	23.765	0.000	26.894	0.000
3	0.000	0.000	23.559	0.000	-26.429	0.000
4	0.000	0.000	20.349	0.000	-19.718	0.000
5	0.000	0.000	33.212	0.000	11.840	0.000
6	0.000	0.000	12.863	0.000	7.878	0.000
7	0.000	0.000	50.631	0.000	-8.472	0.000
8	0.000	0.000	27.072	0.000	34.901	0.000
9	0.000	0.000	12.600	0.000	-7.560	0.000
10	0.000	0.000	12.600	0.000	7.560	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	12.600	0.000	-7.560	0.000
13	0.000	0.000	12.600	0.000	7.560	0.000
14	0.000	0.000	6.825	0.000	-2.218	0.000
15	0.000	0.000	22.705	0.000	-9.789	0.000
16	0.000	0.000	28.910	0.000	3.922	0.000
17	0.000	0.000	34.773	0.000	-14.425	0.000
18	0.000	0.000	40.072	0.000	6.512	0.000
19	0.000	0.000	28.984	0.000	10.593	0.000
20	0.000	0.000	31.801	0.000	-15.890	0.000
21	0.000	0.000	21.147	0.000	21.295	0.000
Total	0.000	0.000	480.830	0.000	0.000	0.000

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Job ref	: 21187
Sheet	: **Sheet Ref / 9 -**
Made By	:
Date	:**08 June 2022**
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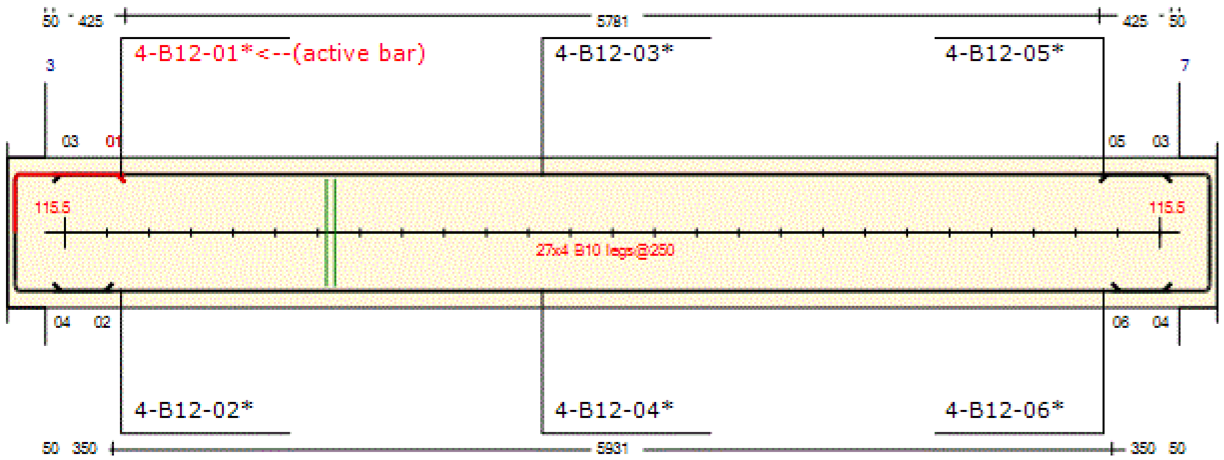

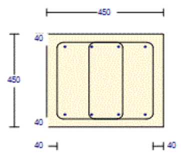

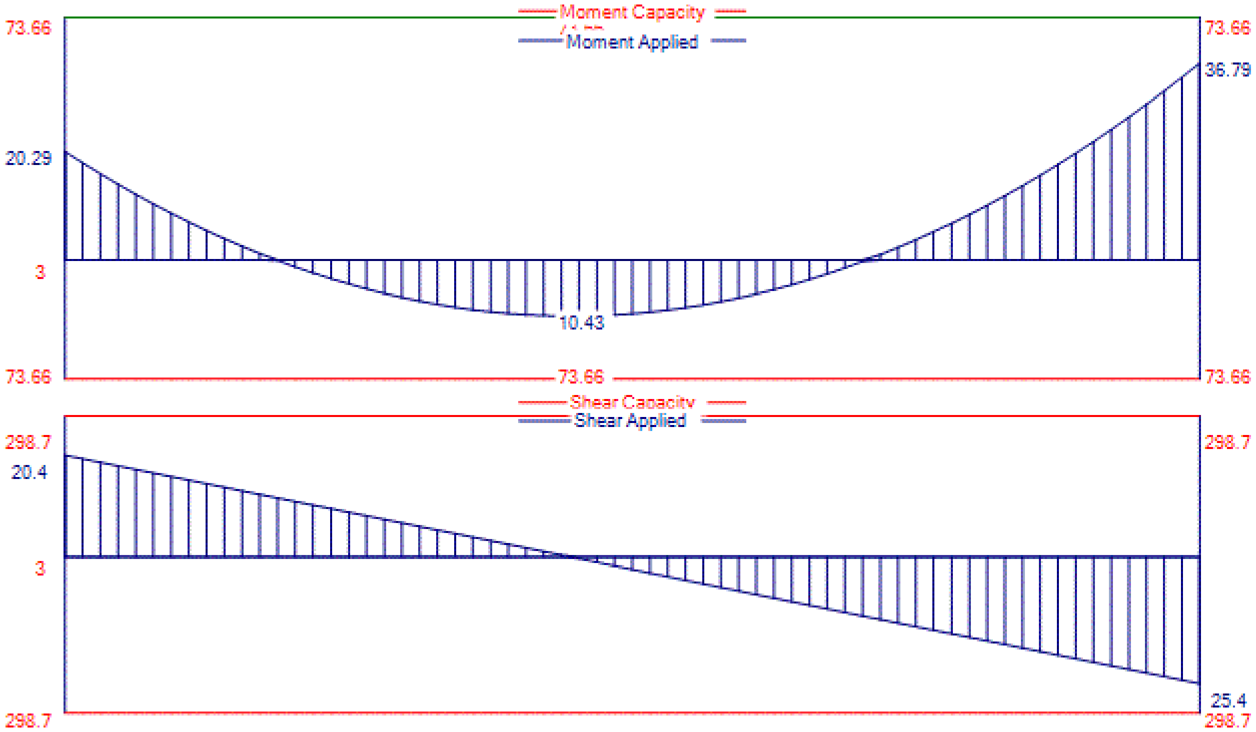

Basic Data

Design to	BS 8110: 1997
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44

Minor Axis Moments

My max = 42.3 kN.m	Minor axis moments ignored by user

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	20.3 / 73.7	0.275	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 127	

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Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 10 -**
Made By	:
Date	**:08 June 2022**
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In-Span Steel @ 3049 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	10.4 / 73.7	0.142	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 65 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	36.8 / 73.7	0.499	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 231	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	25 • 1000 / (394 • 450)	0.143 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_{sv} , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	20.4/ 298.7	0.068	OK

Nominal Shear Zone at 6730 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_{sv} , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	25.3/ 298.7	0.085	OK

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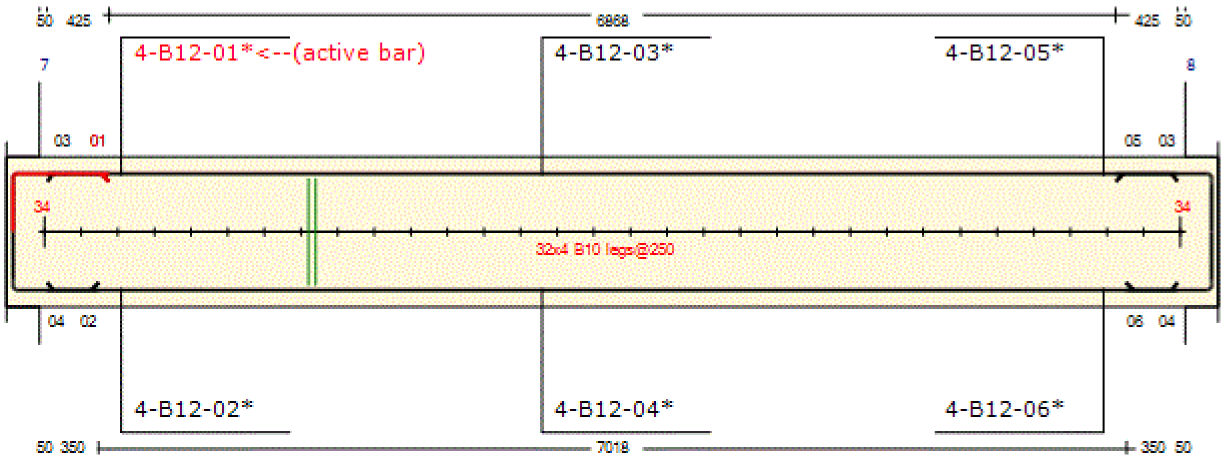

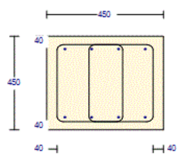

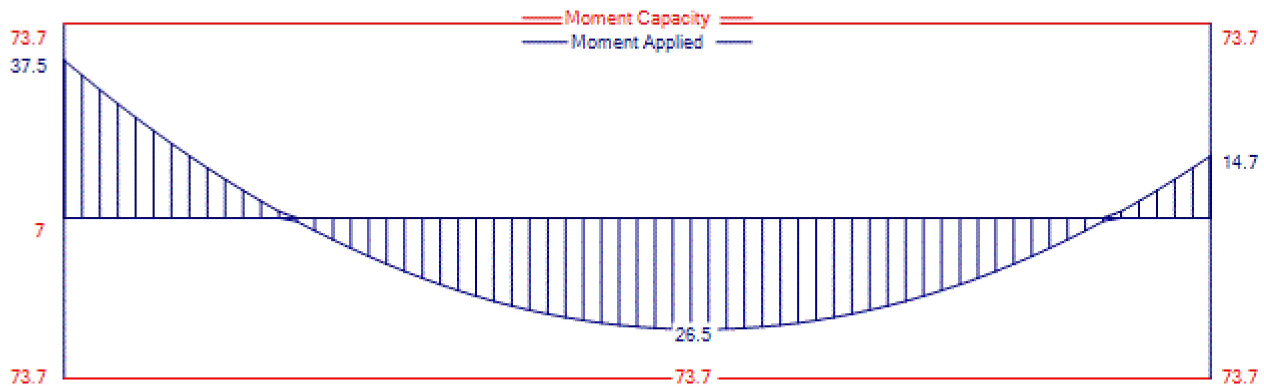

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Job ref	: 21187
Sheet	: **Sheet Ref / 11 -**
Made By	:
Date	:**08 June 2022**
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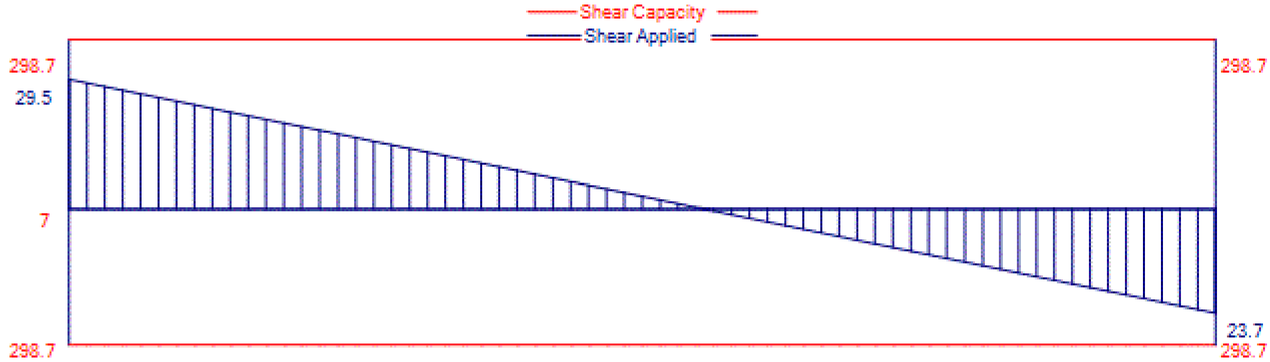
Approved	:



Basic Data

Design to	BS 8110: 1997		
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44		

Minor Axis Moments

My max = 55.8 kN.m	Minor axis moments ignored by user		

Torsional Design

Main Rectangular Section assumed to resist Torsion

T, V_{tmin} , V_{tu}(mod) , H_{min} , H_{max} , X_1 , Y_1	1.93, 0.40, 3.27, 450, 450, 360, 360(V_{tu} modified to Cl 2.4.5)		
V_t = 2•T/(H_{min} ² (H_{max} - H_{min} /3))	2 x 1.93 / (450² x (450- 450/3)	0.06 N/mm²	OK
Combined (V + V_t) / V_{tu}(mod) <= 1	(0.166 + 0.064) / 3.273	0.070	OK
V_t < V_{tmin}	No Special torsional reinforcement required		

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	37.5 / 73.7	0.509	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 235	

In-Span Steel @ 4275 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	26.5 / 73.7	0.360	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 166 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	14.7 / 73.7	0.200	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 92	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	30 • 1000 / (394 • 450)	0.166 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn($A_{s}v$, S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	29.5/ 298.7	0.099	OK

Nominal Shear Zone at 7817 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn($A_{s}v$, S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	23.7/ 298.7	0.079	OK

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Job ref	: 21187
Sheet	: **Sheet Ref / 12 -**
Made By	:
Date	**:08 June 2022**
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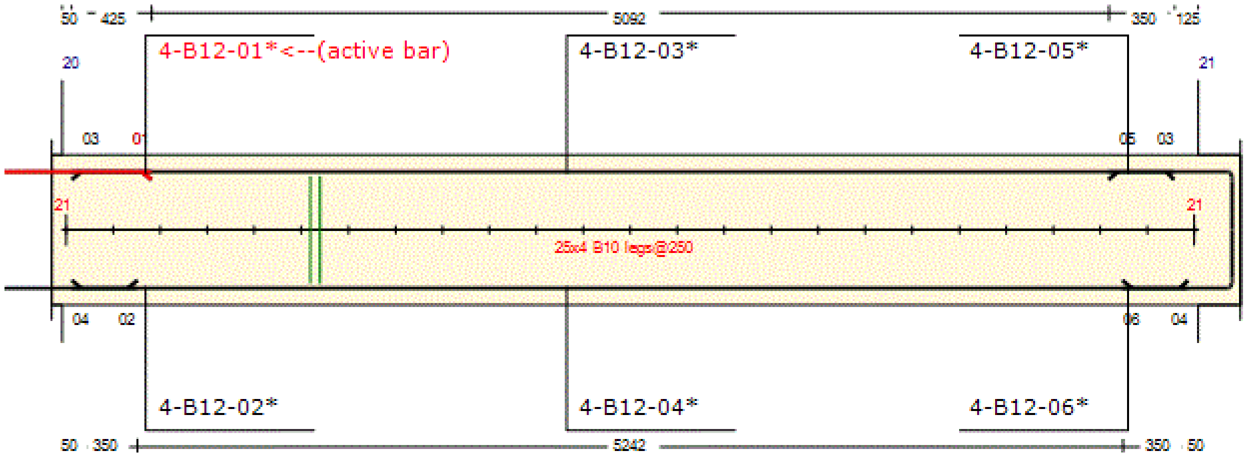

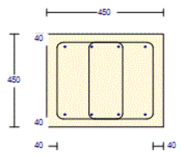

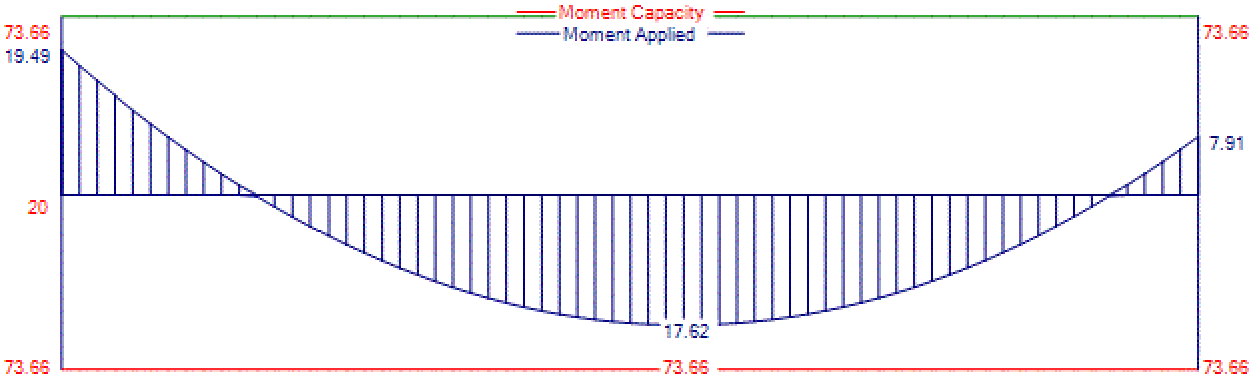

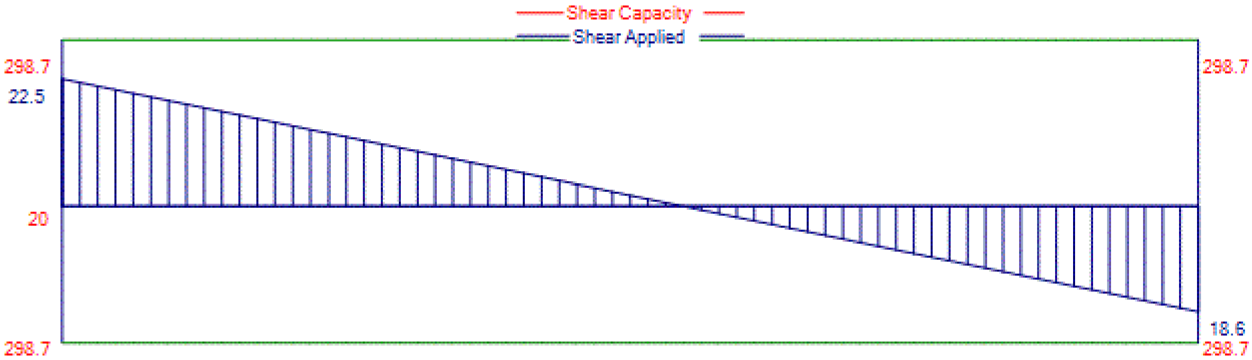

Basic Data

Design to	BS 8110: 1997
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44

Minor Axis Moments

My max = 34.1 kN.m	Minor axis moments ignored by user

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	19.5 / 73.7	0.265	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 122	

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Job ref	: 21187
Sheet	: Sheet Ref / 13 -
Made By	:
Date	:08 June 2022
Checked	:
Approved	:

In-Span Steel @ 3304 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	17.6 / 73.7	0.239	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 110 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	7.9 / 73.7	0.107	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 50	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	22 • 1000 / (394 • 450)	0.127 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	22.5/ 298.7	0.075	OK

Nominal Shear Zone at 6041 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	18.6/ 298.7	0.062	OK

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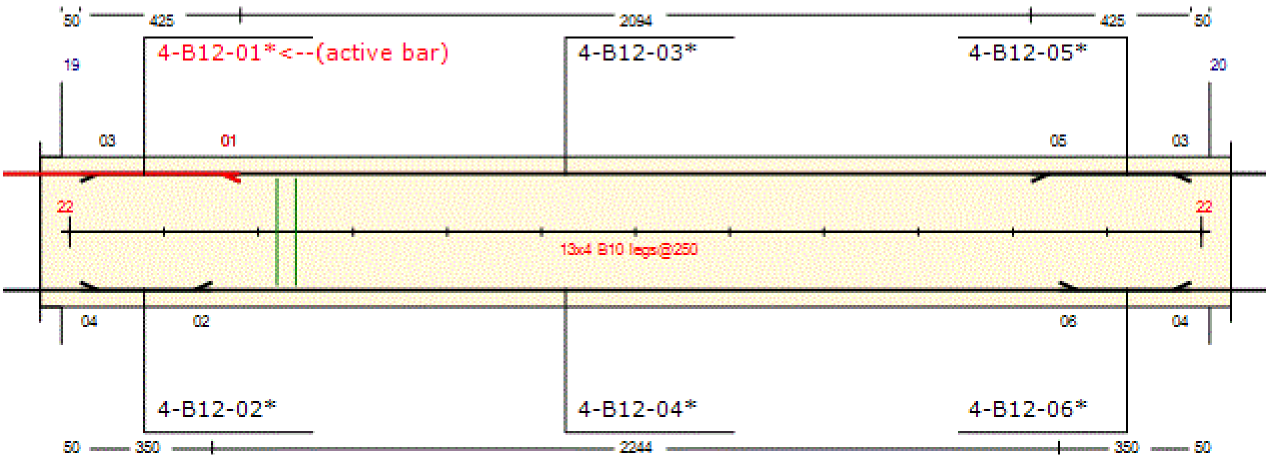

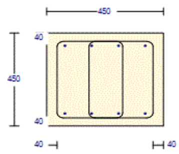

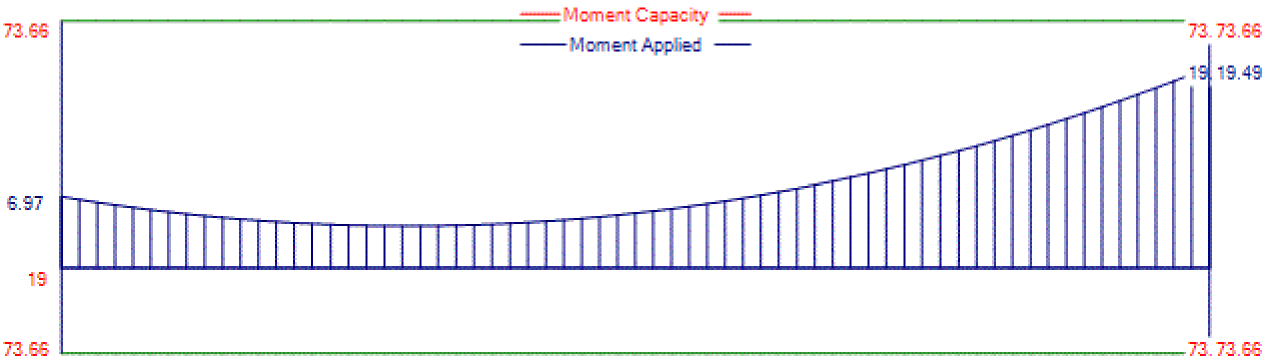

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Job ref	: 21187
Sheet	: **Sheet Ref / 14 -**
Made By	:
Date	**:08 June 2022**
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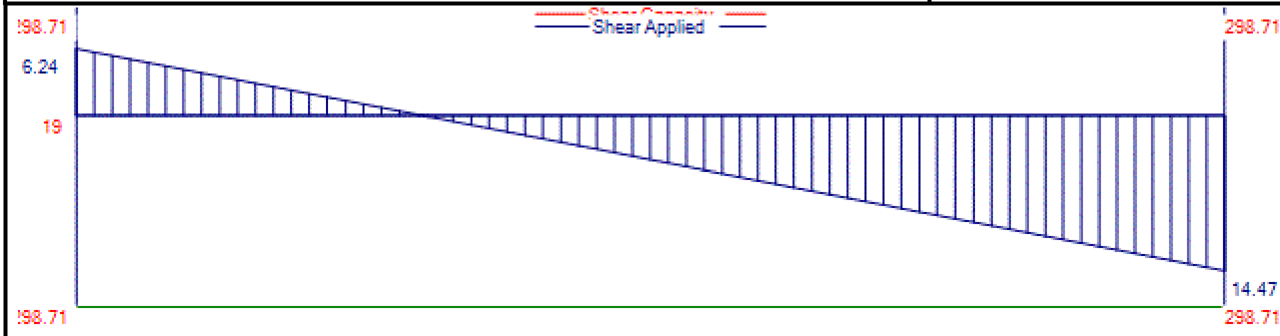

Basic Data

Design to	BS 8110: 1997		
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44		

Minor Axis Moments

My max = 8.6 kN.m	Minor axis moments ignored by user		

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	7.0 / 73.7	0.095	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 44	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	19.5 / 73.7	0.265	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 122	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	14 • 1000 / (394 • 450)	0.082 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	6.2/ 298.7	0.021	OK

Nominal Shear Zone at 3043 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	14.5/ 298.7	0.048	OK

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Job ref	: 21187
Sheet	: **Sheet Ref / 15 -**
Made By	:
Date	**:08 June 2022**
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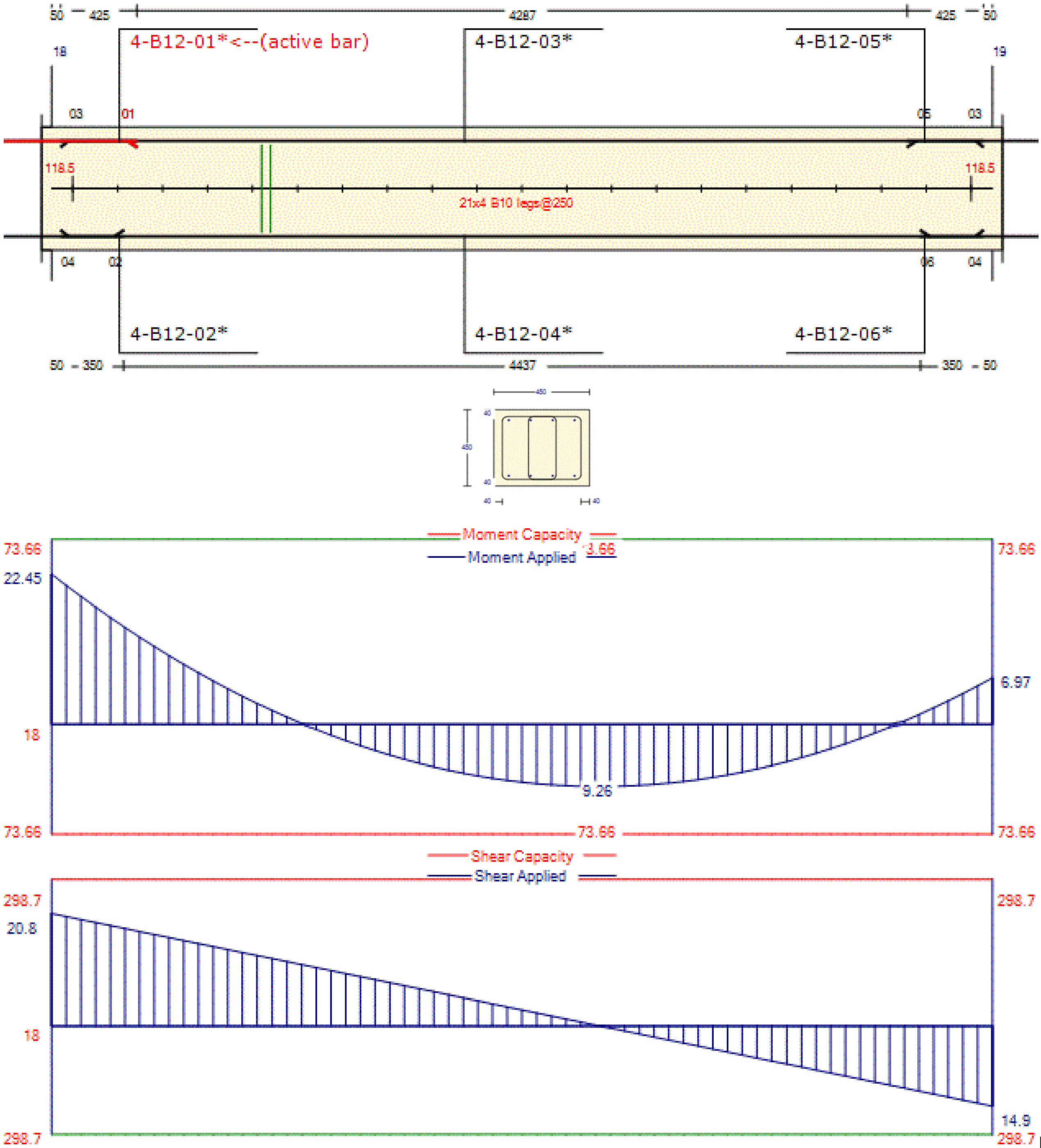

Basic Data

Design to	BS 8110: 1997		
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44		

Minor Axis Moments

My max = 25.6 kN.m   Minor axis moments ignored by user

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	22.4 / 73.7	0.305	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 141	

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Job ref	: 21187
Sheet	: **Sheet Ref / 16 -**
Made By	:
Date	:**08 June 2022**
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In-Span Steel @ 3027 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	9.3 / 73.7	0.126	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 58 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	7.0 / 73.7	0.095	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 44	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	21 • 1000 / (394 • 450)	0.117 N/mm²	OK

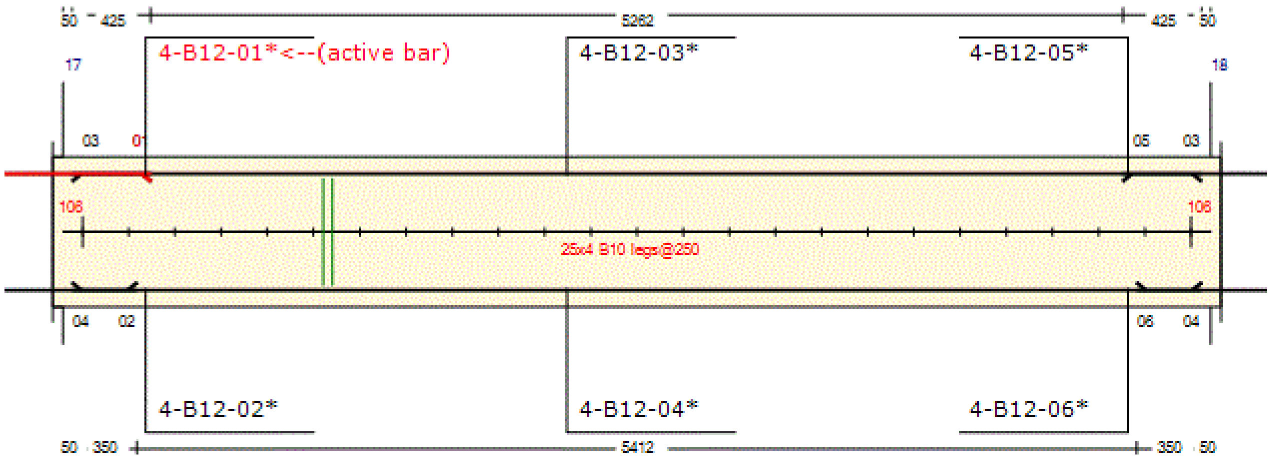
Nominal Shear Zone at 1 mm

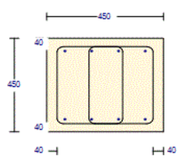
vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	20.8/ 298.7	0.070	OK

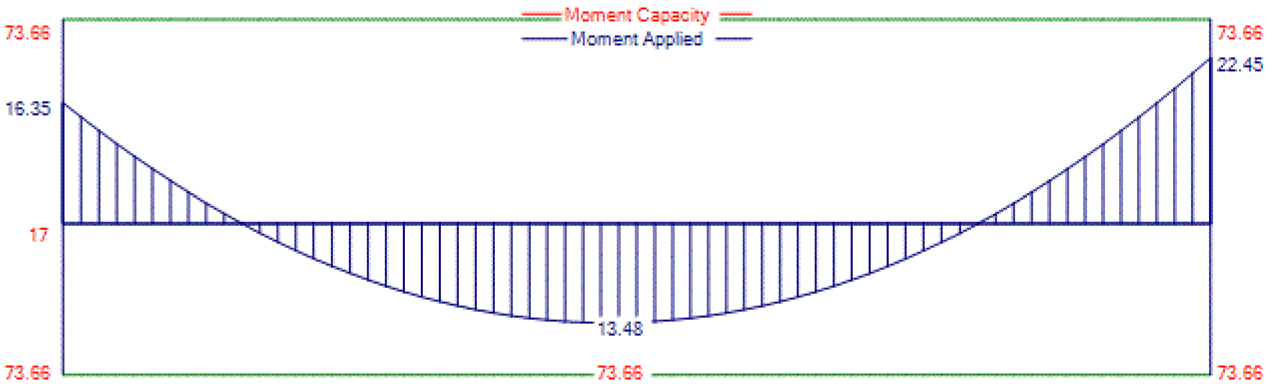
Nominal Shear Zone at 5236 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	14.9/ 298.7	0.050	OK

MEMBER CBL1ID 4







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Job ref	: 21187
Sheet	: **Sheet Ref / 17 -**
Made By	:
Date	**:08 June 2022**
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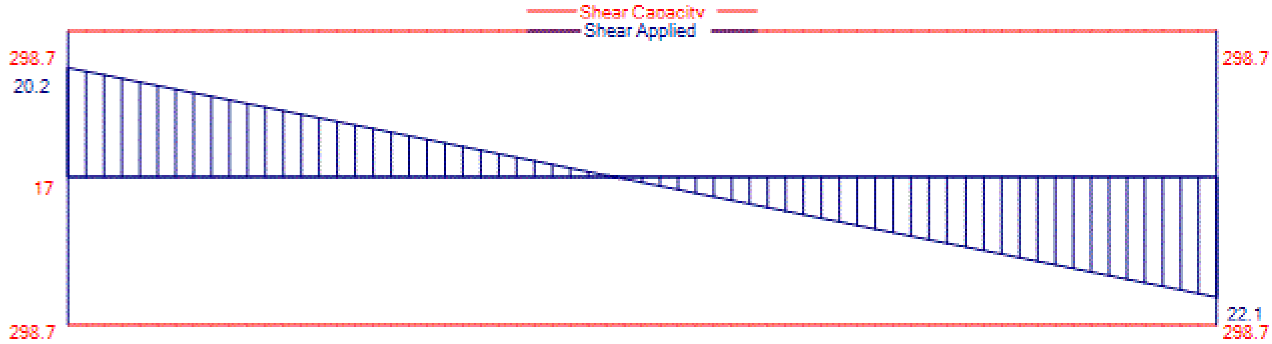

Bas

ic Data

Design to	BS 8110: 1997		
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44		

Minor Axis Moments

My max = 36.0 kN.m	Minor axis moments ignored by user		

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	16.3 / 73.7	0.222	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 102	

In-Span Steel @ 3008 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	13.5 / 73.7	0.183	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 85 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	22.5 / 73.7	0.305	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 141	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	22 • 1000 / (394 • 450)	0.125 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	20.1/ 298.7	0.067	OK

Nominal Shear Zone at 6211 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	22.1/ 298.7	0.074	OK

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Job ref	: 21187
Sheet	: **Sheet Ref / 18 -**
Made By	:
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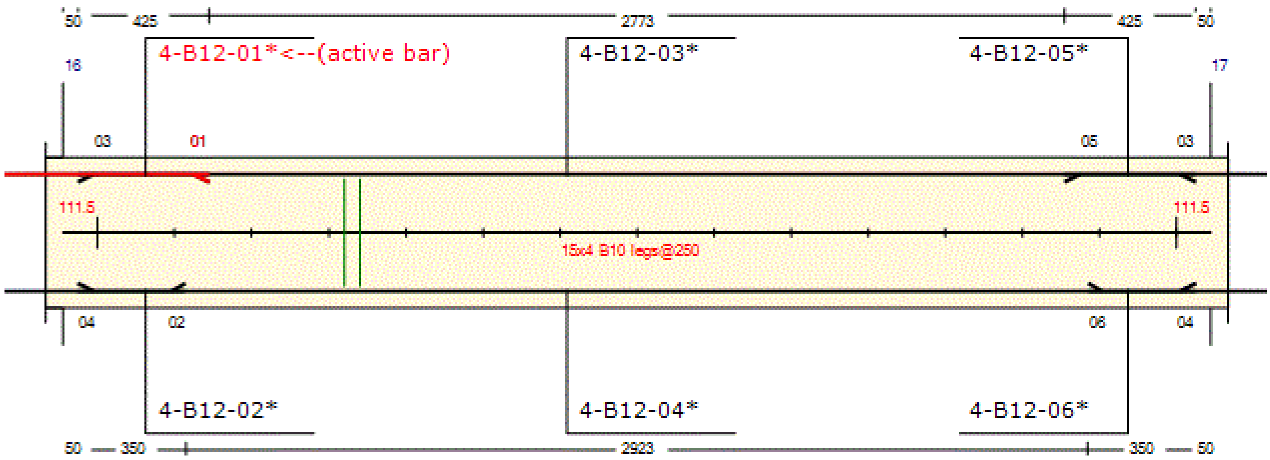
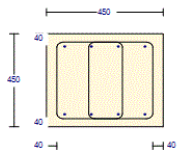
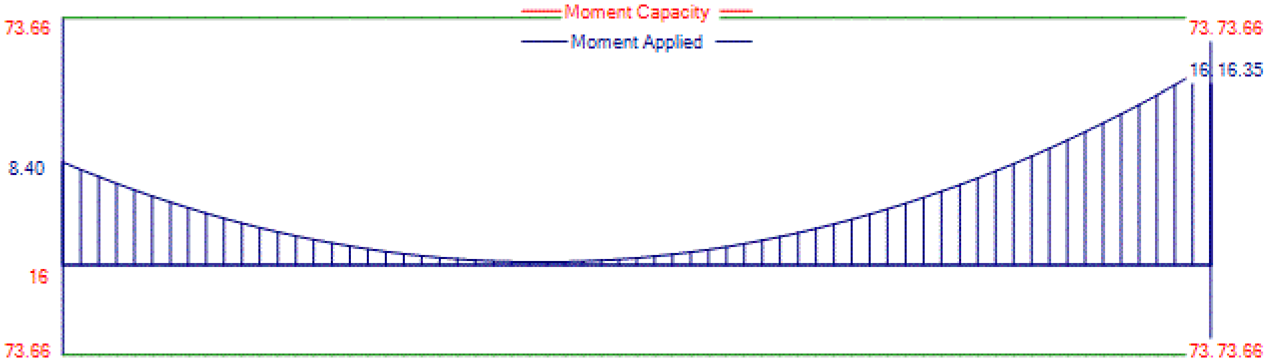
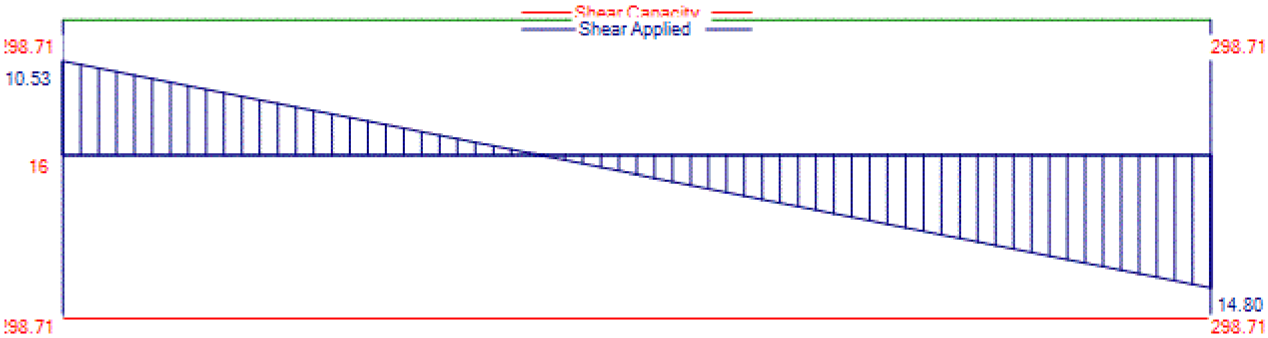
Approved	:

MEMBER CBL1ID 3









Basic Data

Design to	BS 8110: 1997
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44

Minor Axis Moments

My max = 12.9 kN.m	Minor axis moments ignored by user

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	8.4 / 73.7	0.114	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 53	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07

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Job ref	: 21187
Sheet	: **Sheet Ref / 19 -**
Made By	:
Date	**:08 June 2022**
Checked	:
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Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	16.3 / 73.7	0.222	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 102	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	15 • 1000 / (394 • 450)	0.083 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	10.5/ 298.7	0.035	OK

Nominal Shear Zone at 3722 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	14.8/ 298.7	0.050	OK

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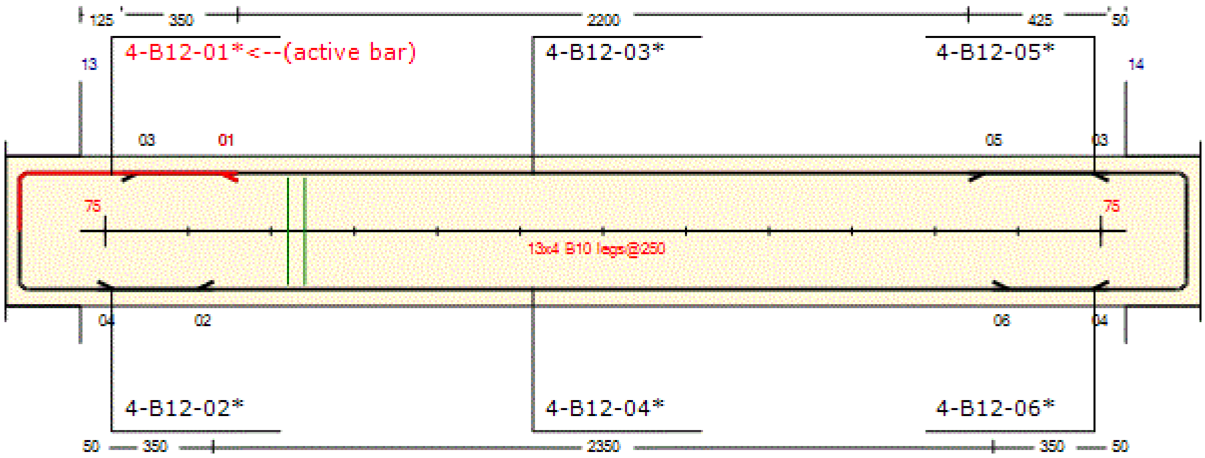

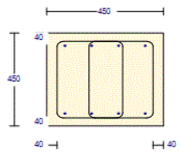

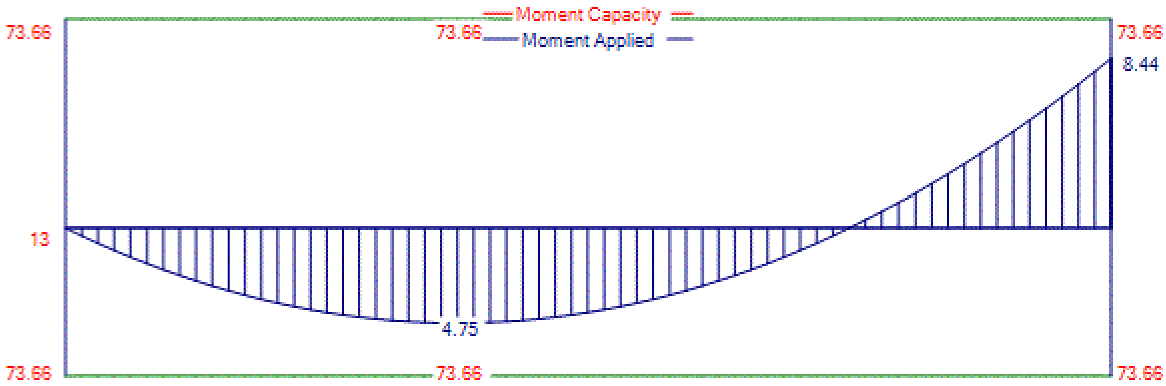

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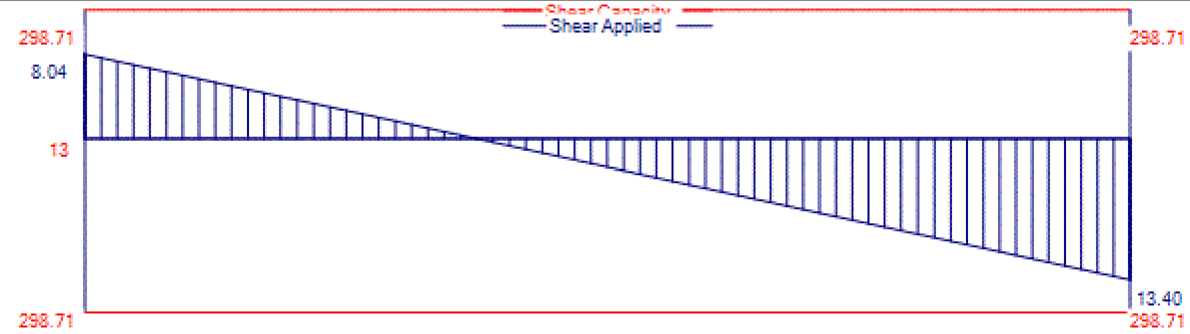

Basic Data

Design to	BS 8110: 1997		
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44		

Torsional Design

Main Rectangular Section assumed to resist Torsion

T, V_{tmin} , V_{tu}(mod) , H_{min} , H_{max} , X_1 , Y_1	0.47, 0.40, 3.27, 450, 450, 360, 360(V_{tu} modified to Cl 2.4.5)		
V_t = 2•T/(H_{min} ² (H_{max} - H_{min} /3))	2 x 0.47 / (450² x (450- 450/3)	0.02 N/mm²	OK
Combined (V + V_t) / V_{tu}(mod) <= 1	(0.076 + 0.015) / 3.273	0.028	OK
V_t < V_{tmin}	No Special torsional reinforcement required		

Bending Moments

In-Span Steel @ 1181 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	4.7 / 73.7	0.064	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 30 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	8.4 / 73.7	0.115	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 53	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	13 • 1000 / (394 • 450)	0.076 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	8.0/ 298.7	0.027	OK

Nominal Shear Zone at 3149 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	13.4/ 298.7	0.045	OK

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Job ref	: 21187
Sheet	: **Sheet Ref / 21 -**
Made By	:
Date	**:08 June 2022**
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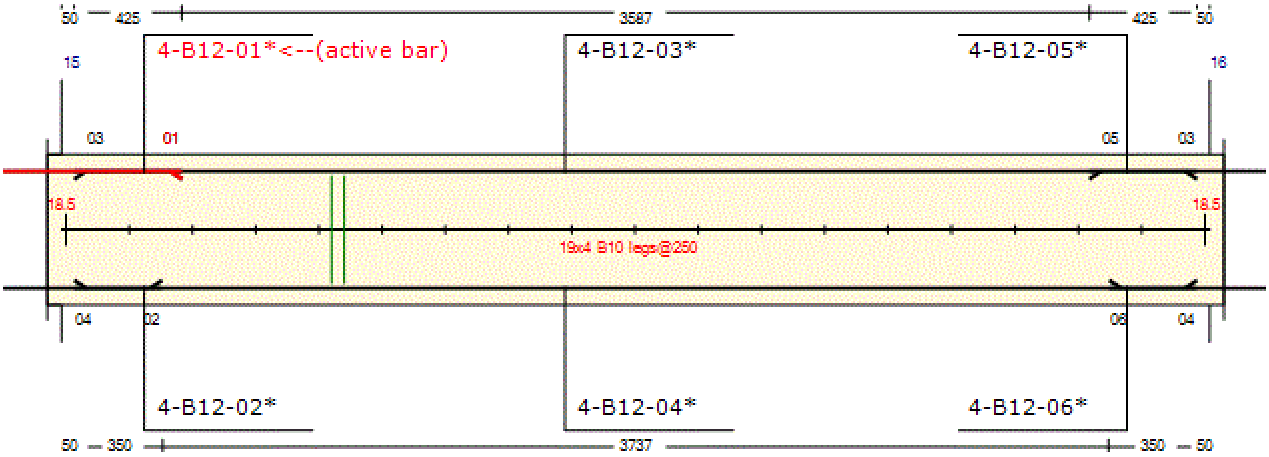

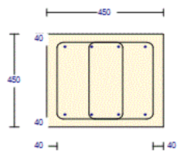

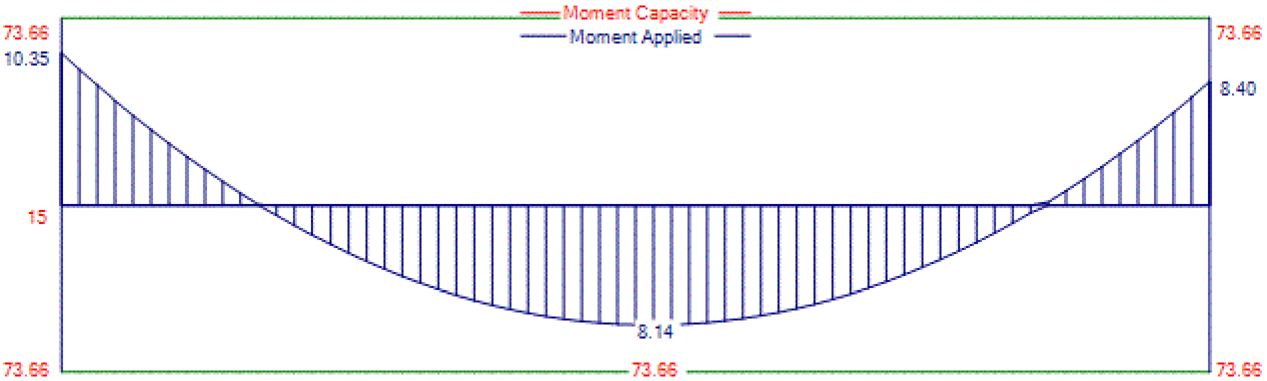

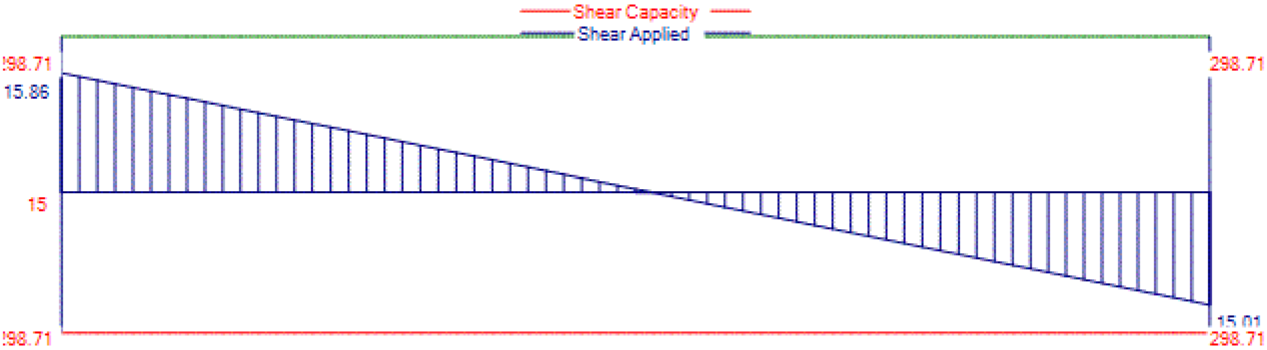

Bas

ic Data

Design to	BS 8110: 1997
f_{cu} , f_y , f_yv , v crit, K1, K2	40, 500, 500, 5.0, 0.4, 0.44

Minor Axis Moments

My max = 19.2 kN.m	Minor axis moments ignored by user

Bending Moments

Left Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	10.3 / 73.7	0.140	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 65	

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Job ref	: 21187
Sheet	: **Sheet Ref / 22 -**
Made By	:
Date	**:08 June 2022**
Checked	:
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In-Span Steel @ 2339 mm. Sagging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	8.1 / 73.7	0.111	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	bottom 51 mm²	

Right Support Steel Hogging

X/d=Fn(A_s, f_y , K1, Beff, d, f_{cu}, γ_m)	452, 500, 0.4, 450, 394.0, 40, 0.87	0.07	
Mu =(K_1 •f_{cu} •B•X)•min(d-k_2 •X,0.95•d)	(0.4•40•450•27.6)•(0.95•394.0)	74 kN.m	
Mapp/Mu	8.4 / 73.7	0.114	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming d = 386, d' = 64	top 53	

Shear

Max Shear

v_{crit} = min(5, 0.8•sqr(f_{cu})	min(5, 0.8 • sqr(40))	5.000 N/mm²	
v = V_{max} / (d • b)	16 • 1000 / (394 • 450)	0.089 N/mm²	OK

Nominal Shear Zone at 1 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	15.9/ 298.7	0.053	OK

Nominal Shear Zone at 4536 mm

vc=Fn(A_s , b_v , d, f_{cu})	452, 450, 394, 40	0.47 N/mm²	Table 3.8
Vcap=Fn(A_sv , S_v , b_v , d, f_{yv} , v_c)	314, 250, 450, 394, 500, 0.47	298.7 kN	Table 3.7
V/Vcap	15.0/ 298.7	0.050	OK

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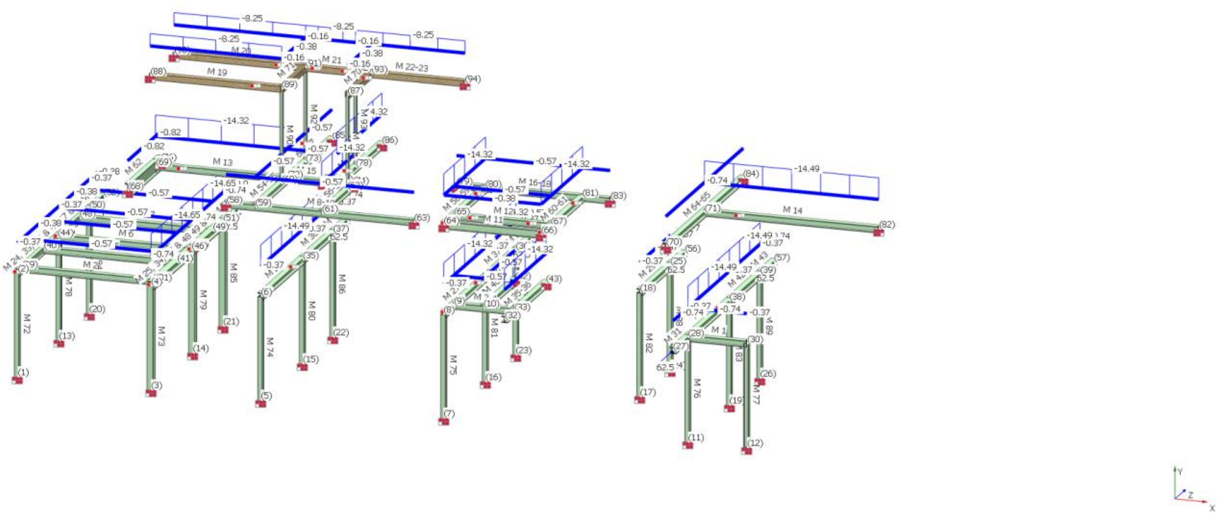
MasterFrame : Graphics



Load Diagram - 001 : Dead plus Live b (Ultimate) - All Groups
Frame Geometry - Full Frame - X+017 Y+018 Z+000

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MASTERFRAME DATA FILE

LOADING CASES AND LOAD COMBINATION

Load Group Labels

Load Group UT	Unity Load Factor (All Cases)
Load Group D1	Dead Load
Load Group L1	Live Load

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Job ref	: 21187
Sheet	: **Sheet Ref / 23 -**
Made By	:
Date	**:08 June 2022**
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Load Case 001 : Dead plus Live b (Ultimate)
Load Combination + 1.00 UT + 1.25 D1 + 1.50 L1
Load Duration Long Term

Load Case 002 : Dead plus Live a (Ultimate)
Load Combination + 1.00 UT + 1.35 D1 + 1.05 L1
Load Duration Long Term

Load Case 003 : Live Only (Serviceability)
Load Combination + 1.00 UT + 1.00 L1
Load Duration Long Term

THE NODAL CO-ORDINATES

Node	X (m)	Y (m)	Z (m)	Node	X (m)	Y (m)	Z (m)
1	-15.791	-6.500	0.000	2	-15.791	-3.000	0.000
3	-11.254	-6.500	0.000	4	-11.254	-3.000	0.000
5	-7.531	-6.500	0.000	6	-7.531	-3.000	0.000
7	-1.319	-6.500	0.000	8	-1.319	-3.000	0.000
9	-1.319	-3.000	1.000	10	-0.319	-3.000	1.010
11	6.962	-6.500	0.000	12	8.962	-6.500	0.000
13	-15.791	-6.500	4.260	14	-11.254	-6.500	4.260
15	-7.531	-6.500	4.260	16	-1.319	-6.500	4.260
17	3.918	-6.500	4.260	18	3.918	-3.000	4.260
19	6.962	-6.500	4.260	20	-15.791	-6.500	7.370
21	-11.254	-6.500	7.370	22	-7.531	-6.500	7.370
23	-1.319	-6.500	7.370	24	3.918	-6.500	7.370
25	3.918	-3.000	7.370	26	6.962	-6.500	7.370
27	6.962	-3.000	-1.500	28	6.962	-3.000	0.000
29	-15.791	-3.000	0.478	30	8.962	-3.000	0.000
31	-11.254	-3.000	0.478	32	0.734	-3.000	0.021
33	0.734	-3.000	1.021	34	-1.319	-3.000	4.260
35	-7.531	-3.000	4.260	36	-1.319	-3.000	7.370
37	-7.531	-3.000	7.370	38	6.962	-3.000	4.260
39	6.962	-3.000	7.370	40	-15.791	-3.000	2.678
41	-11.254	-3.000	2.678	42	-0.319	-3.000	4.260
43	0.734	-3.000	4.281	44	-15.791	-3.000	4.133
45	-15.791	-3.000	4.260	46	-11.254	-3.000	4.133
47	-11.254	-3.000	4.260	48	-15.791	-3.000	6.333
49	-11.254	-3.000	6.333	50	-15.791	-3.000	7.370
51	-11.254	-3.000	7.370	52	-15.791	-3.000	8.811
53	-11.254	-3.000	8.811	54	-7.531	-3.000	8.811
55	-1.319	-3.000	8.811	56	3.918	-3.000	8.811
57	6.962	-3.000	8.811	58	-8.689	0.000	-0.047
59	-7.708	0.000	-0.041	60	-7.708	0.000	2.676
61	-5.453	0.000	-0.026	62	-5.470	0.000	2.680
63	-2.326	0.000	-0.006	64	-1.319	0.000	0.000
65	-1.319	0.000	1.021	66	1.977	0.000	0.021
67	1.977	0.000	1.021	68	-12.173	0.000	0.372
69	-12.173	0.000	3.223	70	6.212	0.000	0.000
71	6.212	0.000	3.962	72	-7.708	0.000	3.223
73	-7.708	0.000	5.123	74	-5.474	0.000	3.238
75	-6.479	0.000	3.223	76	-12.173	0.000	3.712
77	-6.013	0.000	3.223	78	-6.013	0.000	5.123
79	-2.296	0.000	4.260	80	-1.319	0.000	4.260
81	1.977	0.000	4.260	82	12.127	0.000	3.962
83	2.912	0.000	4.260	84	6.212	0.000	7.924
85	-7.708	0.000	7.814	86	-6.013	0.000	7.814
87	-5.470	3.200	2.680	88	-12.173	3.200	2.676
89	-7.708	3.200	2.676	90	-12.173	3.200	5.123
91	-7.708	3.200	5.123	92	-6.013	3.200	5.123
93	-5.470	3.200	5.123	94	-2.296	3.200	5.123

MEMBER PROPERTIES

Members 1, 14, 26, 31-32, 38, 41-43, 64-65, 73, 79 & 85
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 M  ...  ...         203x203 UC 60 [S 275]
  A 76.37E-4         Iy 6127E-8        Iz 2068E-8         It 47.23E-8
  E 210.0E6          G 80.77E6
```
Members 2-10, 12-13, 15-18, 27-30, 35-37, 39-40, 54-61 & 66-69

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```
  M  ...  ...          203x203 UC 46 [S 275]
   A 58.73E-4           Iy 4571E-8          Iz 1551E-8          It 22.15E-8
   E 210.0E6           G 80.77E6
```
Members 11, 24, 33, 44, 46-47, 50 & 52
```
  M  ...  ...          254x146 UB 31 [S 275]
   A 39.67E-4           Iy 4414E-8          Iz 448.4E-8         It 8.55E-8
   E 210.0E6           G 80.77E6
```
Member 19
```
  M  ...  ...          225x200 C24 E 11.00E6 G .688E6 TG C24  1201000
   A 450.0E-4           Iy 15000E-8         Iz 18984E-8         It 60000E-8
```
Members 20 & 22-23
```
  M  ...  ...          225x200 C24 E 11.00E6 G .688E6 TG C24  1001000
   A 450.0E-4           Iy 15000E-8         Iz 18984E-8         It 60000E-8
```
Member 21
```
  M  ...  ...          225x200 C24 E 11.00E6 G .688E6 TG C24  1000000
   A 450.0E-4           Iy 15000E-8         Iz 18984E-8         It 60000E-8
```
Members 25, 34, 45, 48-49, 51 &
53
```
  M  ...  ...          254x254 UC 73 [S 275]
   A 93.1E-4            Iy 11414E-8         Iz 3915E-8          It 57.62E-8
   E 210.0E6           G 80.77E6
```
Members 62-63
```
  M  ...  ...          457x191 UB 67 [S 275]
   A 85.5E-4            Iy 29383E-8         Iz 1455E-8          It 37.14E-8
   E 210.0E6           G 80.77E6
```
Member 70
```
  M  ...  ...          2No. 75x200 C24 + 1No. 10x190 int. vert. plate E 11.00E6 G .688E6 TG C24
 1000000021281+
   A 300.0E-4           Iy 20652E-8         Iz 6855E-8          It 4298E-8
```
Member 71
```
  M  ...  ...          2No. 75x200 C20 + 1No. 10x190 int. vert. plate E 9.500E6 G .594E6 TG C20
 1000000021281+
   A 300.0E-4           Iy 22334E-8         Iz 6859E-8          It 4298E-8
```
Members 72, 74-78, 80-84 & 86-
89
```
  M  ...  ...          152x152 UC 30 [S 275]
   A 38.26E-4           Iy 1749E-8          Iz 561.4E-8         It 10.52E-8
   E 210.0E6           G 80.77E6
```
Members 90-93
```
  M  ...  ...          90x90x5 SHS 13.1 [S 275]
   A 16.73E-4           Iy 199.6E-8         Iz 199.6E-8         It 315.5E-8
   E 210.0E6           G 80.77E6
```

MEMBER LOADING

Member Self Weight Density Load Included in Load Group D1, defined by Modulus of Elasticity

E kN/mm^2	Density kN/m^3
>= 200.00	77.01
>= 20.00	24.00
>= 2.00	10.00

Members 1-18, 24-69 & 72-93 - MasterFrame Pro Loads
```
   D1 D     077.010             ( kN/m³)
```
Members 13-14, 25-28, 32, 34-38, 42, 45, 48-49, 51, 56-61 & 68-69
```
   D1 UDLY -005.000             ( kN/m )
   D1 UDLY -006.000             ( kN/m )
```
Members 19-23
```
   D1 UDLY -003.450             ( kN/m )
   L1 UDLY -002.250             ( kN/m )
```
Members 19-23 & 70-71 -
MasterFrame Pro Loads
```
   D1 D     010.000             ( kN/m³)
```

MEMBER ORIENTATION

Members 72-76 & 78-89 ß +090.00Member 77 ß +180.00

MEMBER END RELEASES

Symbols End 1 torsion-minor-major End 2 torsion-minor-major O Released ® Fixed

```
     12 ®OO ®OO          13 ®OO ®®®          14 ®OO ®®®          19 ®®® ®OO
     20 ®®® ®OO          21 ®OO ®OO          24 ®OO ®®®          25 ®OO ®®®
```

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875


```
26 ®OO ®OO      27 ®OO ®®®      28 ®®® ®OO      32 ®OO ®OO
46 ®®® ®OO      48 ®®® ®OO      54 ®OO ®®®      55 ®®® ®OO
56 ®OO ®®®      58 ®OO ®®®      59 ®®® ®OO      60 ®OO ®®®
61 ®®® ®OO      66 ®OO ®®®      70 ®®® ®OO      90 ®OO ®®®
91 ®OO ®®®      92 ®OO ®®®      93 ®OO ®®®
```

NODAL LOADING AND SUPPORT CONDITIONS

NODES 27 & 52-57

```
D1 Ls +0000.000 +0000.000 +0050.000 +0000.000 +0000.000 +0000.000
```

NODES 42-43, 68, 70, 74, 76-77 &
84-86

```
UT Rs 1 1 1 0 1 1
```

NODES 58, 63-64, 66, 75, 79, 82-83, 88, 90 & 94

```
UT Rs 1 1 1 1 1 0
```

NODES 1, 3, 5, 7, 11-17, 19-24 & 26

```
UT Rs 1 1 1 0 1 1
```

🗁 Z:\Shared\Projects\2021 Projects\21187 Old Orchard Lodge Cottage Park Lane Harefield UB9 6HJ\21187-MS\21187.$5

Nodal Deflections (001 : Dead plus Live b (Ultimate))

Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	1.72	0.00	0.00	1.72
2	-29.27	-0.01	104.93	108.93	1.72	0.00	0.71	1.86
3	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.90
4	-28.18	-0.07	54.93	61.74	0.90	0.00	0.68	1.13
5	0.00	0.00	0.00	0.00	2.25	0.00	0.00	2.25
6	0.00	-0.14	137.60	137.60	2.25	0.00	0.00	2.25
7	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.12
8	0.20	-0.27	7.48	7.49	0.12	0.00	-1.68	1.68
9	7.04	-7.19	7.48	12.54	0.28	0.49	-127.65	127.66
10	7.10	-2237.24	0.20	2237.25	-39.44	0.17	-128.25	134.18
11	0.00	0.00	0.00	0.00	4.51	0.00	0.00	4.51
12	0.00	0.00	0.00	0.00	4.49	0.00	0.00	4.49
13	0.00	0.00	0.00	0.00	2.44	0.00	0.00	2.44
14	0.00	0.00	0.00	0.00	1.25	0.00	0.00	1.25
15	0.00	0.00	0.00	0.00	3.22	0.00	0.00	3.22
16	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.14
17	0.00	0.00	0.00	0.00	3.34	0.00	0.00	3.34
18	0.00	0.30	142.99	142.99	0.35	0.00	0.00	0.35
19	0.00	0.00	0.00	0.00	6.46	0.00	0.00	6.46
20	0.00	0.00	0.00	0.00	2.45	0.00	0.00	2.45
21	0.00	0.00	0.00	0.00	1.27	0.00	0.00	1.27
22	0.00	0.00	0.00	0.00	3.28	0.00	0.00	3.28
23	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.22
24	0.00	0.00	0.00	0.00	3.34	0.00	0.00	3.34
25	0.00	-0.32	143.07	143.07	0.35	0.00	0.00	0.35
26	0.00	0.00	0.00	0.00	6.51	0.00	0.00	6.51
27	-0.52	117.28	275.04	299.00	4.48	0.01	0.00	4.48
28	-0.13	-0.14	274.98	274.98	4.49	0.01	0.00	4.49
29	-24.46	-0.16	104.93	107.74	0.02	0.59	-0.03	0.59
30	-0.13	-0.01	274.47	274.47	4.49	0.01	0.00	4.49
31	-24.45	-1.01	54.93	60.14	0.11	0.45	0.01	0.46
32	8.77	-5993.50	-0.04	5993.50	-80.50	-0.10	-128.72	151.82
33	7.10	-4588.52	-0.04	4588.53	-80.49	-0.10	-128.72	151.81
34	41.04	-0.24	7.64	41.75	0.09	-0.74	-1.52	1.69
35	0.00	0.07	137.60	137.60	0.32	0.00	0.00	0.32
36	1.02	-0.12	7.79	7.86	-0.05	-0.74	-0.03	0.74
37	0.00	-0.41	137.65	137.65	0.21	0.00	0.00	0.21
38	0.00	0.38	274.82	274.82	0.58	0.00	0.00	0.58
39	0.00	-0.72	274.82	274.82	0.47	0.00	0.00	0.47
40	-7.36	-0.33	104.94	105.20	-0.01	0.53	-0.04	0.53
41	-7.35	-2.50	54.93	55.48	-0.05	0.48	-0.01	0.48
42	0.00	0.00	0.00	0.00	-39.45	0.00	0.00	39.45
43	0.00	0.00	0.00	0.00	-80.79	0.00	0.00	80.79
44	5.01	0.15	104.95	105.07	-0.02	0.58	-0.01	0.58
45	6.29	0.21	104.95	105.14	0.27	0.09	-0.15	0.32
46	5.00	-0.20	54.92	55.15	-0.12	0.51	0.00	0.52

RM DMS
85-90 Paul Street
London
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Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 26 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Nodal Deflections (001 : Dead plus Live b (Ultimate))								
Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	1.72	0.00	0.00	1.72
47	6.12	0.07	54.92	55.26	0.20	0.24	-0.14	0.34
48	15.67	0.89	105.04	106.21	-0.08	0.59	-0.02	0.60
49	15.67	0.12	54.95	57.14	-0.07	0.31	0.00	0.32
50	25.51	-0.24	105.09	108.14	0.26	0.52	-0.62	0.85
51	21.03	-0.25	54.96	58.85	0.15	0.29	-0.51	0.61
52	38.57	-6.84	105.20	112.25	0.26	0.52	-0.62	0.85
53	28.28	-4.12	55.01	61.99	0.15	0.29	-0.51	0.61
54	0.00	-5.62	137.71	137.82	0.21	0.00	0.00	0.21
55	-17.52	1.14	7.86	19.24	-0.05	-0.74	-0.03	0.74
56	0.00	-9.15	143.14	143.43	0.35	0.00	0.00	0.35
57	0.00	-12.53	274.87	275.16	0.47	0.00	0.00	0.47
58	0.00	0.00	0.00	0.00	0.00	0.00	-0.43	0.43
59	0.00	-7.10	0.00	7.10	0.00	0.00	-0.38	0.38
60	0.00	-16.25	0.00	16.25	0.14	0.00	0.48	0.50
61	0.00	-15.48	0.00	15.48	-0.01	0.00	0.02	0.02
62	0.00	-3.83	0.00	3.83	-0.38	0.00	0.00	0.38
63	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.42
64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	0.00	-5.97	0.00	5.97	0.28	0.00	-0.08	0.29
66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
67	0.00	-5.75	0.00	5.75	0.28	0.00	0.08	0.29
68	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
69	0.00	-0.15	0.00	0.15	-0.02	0.00	0.00	0.02
70	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.82
71	0.00	-37.44	0.00	37.44	0.00	0.00	0.00	0.00
72	0.00	-17.50	0.00	17.50	0.00	0.00	0.66	0.66
73	0.00	-15.82	0.00	15.82	-0.17	0.00	0.39	0.42
74	0.00	0.00	0.00	0.00	-0.40	0.00	0.00	0.40
75	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.89
76	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.02
77	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.53
78	-0.09	-12.92	0.00	12.93	0.13	0.00	0.00	0.13
79	0.00	0.00	0.00	0.00	0.00	0.00	-0.39	0.39
80	0.00	-6.17	0.00	6.17	0.00	0.00	-0.30	0.30
81	0.00	-5.92	0.00	5.92	0.00	0.00	0.31	0.31
82	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.92
83	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.39
84	0.00	0.00	0.00	0.00	-0.82	0.00	0.00	0.82
85	0.00	0.00	0.00	0.00	-0.42	0.00	0.00	0.42
86	0.00	0.00	0.00	0.00	-0.51	0.00	0.00	0.51
87	1.35	-3.84	1.97	4.52	0.26	-0.03	-0.03	0.26
88	0.00	0.00	0.00	0.00	0.00	0.00	-1.27	1.27
89	0.00	-16.42	-0.15	16.42	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	-1.27	1.27
91	0.00	-16.06	-0.15	16.06	-0.01	0.00	0.00	0.01
92	0.00	-13.13	2.44	13.36	0.02	0.05	-0.31	0.32
93	0.00	-16.06	1.96	16.18	0.02	0.05	-0.28	0.29
94	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.77

Nodal Deflections (002 : Dead plus Live a (Ultimate))								
Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	1.86	0.00	0.00	1.86
2	-31.61	-0.02	113.32	117.65	1.86	0.00	0.77	2.01
3	0.00	0.00	0.00	0.00	0.97	0.00	0.00	0.97
4	-30.43	-0.08	59.33	66.68	0.97	0.00	0.73	1.22
5	0.00	0.00	0.00	0.00	2.43	0.00	0.00	2.43
6	0.00	-0.15	148.60	148.60	2.43	0.00	0.00	2.43
7	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.13
8	0.21	-0.30	8.08	8.09	0.13	0.00	-1.81	1.82
9	7.61	-7.76	8.08	13.54	0.31	0.53	-137.87	137.87
10	7.67	-2416.22	0.21	2416.23	-42.59	0.19	-138.51	144.91
11	0.00	0.00	0.00	0.00	4.87	0.00	0.00	4.87

RM DMS
85-90 Paul Street
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EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 27 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Nodal Deflections (002 : Dead plus Live a (Ultimate))								
Load Case	**Nodal Displacements (mm)**				**Nodal Rotation (degrees)**			
	δX →	**δY ↑**	**δZ ↗**	**δXYZ**	**θX →**	**θY ↑**	**θZ ↗**	**θXYZ**
1	0.00	0.00	0.00	0.00	1.86	0.00	0.00	1.86
12	0.00	0.00	0.00	0.00	4.85	0.00	0.00	4.85
13	0.00	0.00	0.00	0.00	2.64	0.00	0.00	2.64
14	0.00	0.00	0.00	0.00	1.35	0.00	0.00	1.35
15	0.00	0.00	0.00	0.00	3.48	0.00	0.00	3.48
16	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.16
17	0.00	0.00	0.00	0.00	3.60	0.00	0.00	3.60
18	0.00	0.32	154.43	154.43	0.38	0.00	0.00	0.38
19	0.00	0.00	0.00	0.00	6.97	0.00	0.00	6.97
20	0.00	0.00	0.00	0.00	2.65	0.00	0.00	2.65
21	0.00	0.00	0.00	0.00	1.38	0.00	0.00	1.38
22	0.00	0.00	0.00	0.00	3.54	0.00	0.00	3.54
23	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.23
24	0.00	0.00	0.00	0.00	3.61	0.00	0.00	3.61
25	0.00	-0.34	154.51	154.51	0.38	0.00	0.00	0.38
26	0.00	0.00	0.00	0.00	7.04	0.00	0.00	7.04
27	-0.56	126.66	297.05	322.92	4.84	0.02	0.00	4.84
28	-0.14	-0.16	296.98	296.98	4.85	0.02	0.00	4.85
29	-26.42	-0.18	113.32	116.36	0.02	0.63	-0.03	0.64
30	-0.14	-0.01	296.43	296.43	4.85	0.02	0.01	4.85
31	-26.41	-1.10	59.33	64.95	0.12	0.49	0.01	0.50
32	9.48	-6472.98	-0.04	6472.99	-86.94	-0.10	-139.01	163.96
33	7.67	-4955.61	-0.04	4955.61	-86.93	-0.10	-139.01	163.95
34	44.32	-0.26	8.25	45.09	0.09	-0.80	-1.64	1.82
35	0.00	0.08	148.60	148.60	0.34	0.00	0.00	0.34
36	1.10	-0.13	8.41	8.49	-0.06	-0.80	-0.03	0.80
37	0.00	-0.45	148.67	148.67	0.22	0.00	0.00	0.22
38	0.00	0.41	296.80	296.80	0.63	0.00	0.00	0.63
39	0.00	-0.78	296.80	296.80	0.51	0.00	0.00	0.51
40	-7.95	-0.36	113.33	113.61	-0.01	0.57	-0.04	0.58
41	-7.94	-2.70	59.32	59.91	-0.05	0.52	-0.02	0.52
42	0.00	0.00	0.00	0.00	-42.61	0.00	0.00	42.61
43	0.00	0.00	0.00	0.00	-87.25	0.00	0.00	87.25
44	5.41	0.16	113.35	113.48	-0.03	0.63	-0.02	0.63
45	6.79	0.22	113.35	113.55	0.29	0.10	-0.16	0.35
46	5.40	-0.21	59.32	59.56	-0.13	0.55	0.00	0.56
47	6.61	0.07	59.32	59.68	0.22	0.26	-0.15	0.37
48	16.93	0.96	113.44	114.70	-0.09	0.64	-0.02	0.64
49	16.92	0.13	59.35	61.71	-0.07	0.34	0.00	0.35
50	27.55	-0.25	113.49	116.79	0.28	0.56	-0.67	0.92
51	22.72	-0.27	59.36	63.56	0.17	0.31	-0.55	0.66
52	41.66	-7.38	113.61	121.23	0.28	0.56	-0.67	0.92
53	30.54	-4.45	59.41	66.95	0.17	0.31	-0.55	0.66
54	0.00	-6.07	148.73	148.85	0.22	0.00	0.00	0.22
55	-18.92	1.23	8.49	20.78	-0.05	-0.80	-0.03	0.80
56	0.00	-9.88	154.59	154.91	0.38	0.00	0.00	0.38
57	0.00	-13.53	296.86	297.17	0.51	0.00	0.00	0.51
58	0.00	0.00	0.00	0.00	0.00	0.00	-0.46	0.46
59	0.00	-7.59	0.00	7.59	0.00	0.00	-0.41	0.41
60	0.00	-16.75	0.00	16.75	0.14	0.00	0.50	0.52
61	0.00	-16.59	0.00	16.59	-0.01	0.00	0.02	0.02
62	0.00	-4.11	0.00	4.11	-0.41	0.00	0.00	0.41
63	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.45
64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	0.00	-6.45	0.00	6.45	0.30	0.00	-0.08	0.31
66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
67	0.00	-6.21	0.00	6.21	0.30	0.00	0.08	0.31
68	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
69	0.00	-0.16	0.00	0.16	-0.02	0.00	0.00	0.02
70	0.00	0.00	0.00	0.00	0.88	0.00	0.00	0.88
71	0.00	-40.44	0.00	40.44	0.00	0.00	0.00	0.00
72	0.00	-18.03	0.00	18.03	0.00	0.00	0.68	0.68
73	0.00	-15.81	0.00	15.81	-0.18	0.00	0.40	0.44
74	0.00	0.00	0.00	0.00	-0.43	0.00	0.00	0.43

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 28 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

Nodal Deflections (002 : Dead plus Live a (Ultimate))

Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	1.86	0.00	0.00	1.86
75	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.92
76	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.02
77	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.55
78	-0.08	-13.26	0.00	13.26	0.13	0.00	0.00	0.13
79	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	0.42
80	0.00	-6.66	0.00	6.66	0.00	0.00	-0.33	0.33
81	0.00	-6.39	0.00	6.39	0.00	0.00	0.33	0.33
82	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.99
83	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.42
84	0.00	0.00	0.00	0.00	-0.88	0.00	0.00	0.88
85	0.00	0.00	0.00	0.00	-0.42	0.00	0.00	0.42
86	0.00	0.00	0.00	0.00	-0.53	0.00	0.00	0.53
87	1.17	-4.12	1.88	4.68	0.25	-0.03	-0.03	0.26
88	0.00	0.00	0.00	0.00	0.00	0.00	-1.20	1.20
89	0.00	-16.91	-0.36	16.91	-0.02	0.00	0.00	0.02
90	0.00	0.00	0.00	0.00	0.00	0.00	-1.19	1.19
91	0.00	-16.03	-0.36	16.03	-0.02	0.00	0.00	0.02
92	0.00	-13.45	2.33	13.66	0.01	0.05	-0.28	0.28
93	0.00	-16.01	1.88	16.12	0.01	0.05	-0.24	0.25
94	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.73

Nodal Deflections (003 : Live Only (Serviceability))

Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 29 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Nodal Deflections (003 : Live Only (Serviceability))

Load Case	Nodal Displacements (mm)				Nodal Rotation (degrees)			
	δX →	δY ↑	δZ ↗	δXYZ	θX →	θY ↑	θZ ↗	θXYZ
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
59	0.00	-0.13	0.00	0.13	0.00	0.00	-0.01	0.01
60	0.00	-1.41	0.00	1.41	0.01	0.00	0.04	0.04
61	0.00	-0.22	0.00	0.22	0.00	0.00	0.00	0.00
62	0.00	-0.04	0.00	0.04	0.00	0.00	0.00	0.00
63	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69	0.00	-0.01	0.00	0.01	0.00	0.00	0.00	0.00
70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72	0.00	-1.52	0.00	1.52	0.00	0.00	0.05	0.05
73	0.00	-2.24	0.00	2.24	-0.01	0.00	0.03	0.03
74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.05
78	-0.03	-1.23	0.00	1.23	0.01	0.00	0.00	0.01
79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85	0.00	0.00	0.00	0.00	-0.07	0.00	0.00	0.07
86	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	0.04
87	0.51	-0.04	0.43	0.67	0.05	-0.01	-0.01	0.05
88	0.00	0.00	0.00	0.00	0.00	0.00	-0.31	0.31
89	0.00	-1.45	0.36	1.50	0.02	0.00	0.00	0.02
90	0.00	0.00	0.00	0.00	0.00	0.00	-0.32	0.32
91	0.00	-2.30	0.36	2.33	0.02	0.00	0.00	0.02
92	0.00	-1.28	0.53	1.39	0.01	0.01	-0.11	0.11
93	0.00	-2.35	0.43	2.39	0.01	0.01	-0.11	0.11
94	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.17

Member Forces (001 : Dead plus Live b (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
1	28	0.01C	0.00	0.68	0.00	0.00	0.00	0.31	0.00	0.00
	30	0.01C	0.00	-0.79	0.00	-0.11	0.00	@ 0.900	@ 0.000	@ 0.000

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref : 21187
Sheet : **Sheet Ref / 30 -**
Made By :
Date **:08 June 2022**
Checked **:**
Approved :

Member Forces (001 : Dead plus Live b (Ultimate))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				y-y	**z-z**	**y-y**	**z-z**	**y-y**	**z-z**	
2	29	2.16T	-0.01	1.57	3.72	-0.19	-6.73	2.00		1.92
	31	2.16T	0.01	-0.99	3.72	1.12	10.14	@ 2.768		@ 3.176
3	9	19.16C	12.40	38.04	58.88	-51.29	-11.27		47.03	3.79
	10	19.16C	-12.40	37.48	58.88	-13.54	47.61		@ 0.990	@ 0.950
4	10	4.78C	12.17	36.66	-15.30	-25.85	22.48		47.03	3.79
	33	4.78C	-12.17	36.07	-15.30	12.45	6.37		@ 0.990	@ 0.950
5	40	1.74T	0.00	1.29	4.19	0.00	-8.83	1.46		1.36
	41	1.74T	0.00	-1.28	4.19	0.02	10.18	@ 2.269		@ 3.403
6	44	2.03C	0.01	1.05	2.93	0.13	-5.74	1.11		1.20
	46	2.03C	-0.01	-1.51	2.93	-0.91	7.54	@ 1.860		@ 3.312
7	48	1.66C	0.00	1.17	5.99	0.08	-10.11	1.28		3.52
	49	1.66C	0.00	-1.40	5.99	-0.46	17.06	@ 2.042		@ 3.131
8	58	0.00T	0.00	16.95	0.00	0.00	0.00	42.41	0.00	15.49
	59	0.00T	0.00	16.39	0.00	16.35	0.00	@ 3.236	@ 0.000	@ 3.168
9	59	0.00T	0.00	12.23	0.00	16.25	0.00	42.41	0.00	15.49
	61	0.00T	0.00	10.96	0.00	42.41	0.00	@ 3.236	@ 0.000	@ 3.168
10	61	0.00C	0.00	-12.68	0.00	42.41	0.00	42.41	0.00	15.49
	63	0.00C	0.00	-14.45	0.00	0.00	0.00	@ 3.236	@ 0.000	@ 3.168
11	64	0.00C	0.00	0.63	0.00	0.02	0.00	0.54		0.07
	66	0.00C	0.00	-0.63	0.00	0.02	0.00	@ 1.615		@ 1.648
12	65	0.00C	0.00	0.93	0.00	0.00	0.00	0.77		0.09
	67	0.00C	0.00	-0.93	0.00	0.00	0.00	@ 1.615		@ 1.648
13	69	0.00C	0.00	46.20	0.00	0.00	0.00	74.56	0.00	16.08
	72	0.00C	0.00	-17.71	0.00	63.60	0.00	@ 3.215	@ 0.000	@ 2.411
14	71	0.00C	0.00	42.84	0.00	0.00	0.00	63.35		17.94
	82	0.00C	0.00	-42.84	0.00	0.00	0.00	@ 2.958		@ 2.958
15	72	0.00C	0.00	-51.52	0.00	63.75	0.00		0.00	0.65
	75	0.00C	0.00	-52.22	0.00	0.00	0.00		@ 0.000	@ 0.516
16	79	0.00C	0.00	31.91	0.00	0.00	0.00	31.25		10.44
	80	0.00C	0.00	31.36	0.00	30.91	0.00	@ 2.098		@ 2.592
17	80	0.00C	0.00	0.64	0.00	30.89	0.00	31.25		10.44
	81	0.00C	0.00	-1.22	0.00	29.94	0.00	@ 2.098		@ 2.592
18	81	0.00C	0.00	-31.78	0.00	29.96	0.00	31.25		10.44
	83	0.00C	0.00	-32.31	0.00	0.00	0.00	@ 2.098		@ 2.592
19	88	0.00C	0.01	18.42	0.01	0.00	-0.05	20.56		25.87
	89	0.00C	-0.01	-18.42	0.01	0.00	0.00	@ 2.233		@ 2.233
20	90	0.26T	0.02	18.42	0.01	0.00	-0.05	20.56		25.87
	91	0.26T	-0.02	-18.42	0.01	0.00	0.00	@ 2.233		@ 2.233
21	91	0.26T	-0.13	6.99	0.00	0.00	0.00	2.96		0.54
	92	0.26T	0.13	-6.99	0.00	0.00	0.00	@ 0.847		@ 0.847
22	92	0.41C	0.04	15.77	-0.05	-2.14	-0.07	13.13	-0.10	11.24

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref : 21187
Sheet : **Sheet Ref / 31 -**
Made By :
Date : **08 June 2022**
Checked :
Approved :

Member Forces (001 : Dead plus Live b (Ultimate))										
Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	93	0.41C	-0.04	11.30	-0.05	5.20	-0.10	@ 1.939	@ 0.543	@ 1.876
23	93	0.43C	0.04	11.47	0.43	5.15	-0.10	13.13	-0.10	11.24
	94	0.43C	-0.04	-14.72	0.43	0.00	1.27	@ 1.939	@ 0.543	@ 1.876
24	2	0.00C	0.19	2.72	-2.49	0.00	0.00	2.46	5.54	1.20
	29	0.00C	-0.19	2.54	-2.49	1.26	-1.19	@ 2.656	@ 0.478	@ 0.874
25	4	0.00C	1.13	32.60	-9.05	0.00	0.00	34.57	-9.18	2.83
	31	0.00C	-1.13	25.59	-9.05	13.92	-4.33	@ 2.150	@ 2.656	@ 2.172
26	6	0.00C	0.00	30.85	0.00	0.00	0.00	32.86		4.83
	35	0.00C	0.00	-30.85	0.00	0.00	0.00	@ 2.130		@ 2.130
27	8	0.00C	39.34	62.39	-16.84	0.00	0.00	54.75	-16.68	9.95
	9	0.00C	-39.34	48.08	-16.84	55.23	-16.84	@ 0.990	@ 0.990	@ 2.011
28	9	59.08T	-12.08	10.04	1.71	43.35	-5.57	54.75	-16.68	9.95
	34	59.08T	12.08	-36.63	1.71	0.00	0.00	@ 0.990	@ 0.990	@ 2.011
29	18	31.23T	0.00	-69.65	0.00	109.30	0.00			1.79
	25	31.23T	0.00	-71.41	0.00	-110.04	0.00			@ 0.653
30	25	62.50T	0.00	0.81	0.00	-0.59	0.00			0.00
	56	62.50T	0.00	0.00	0.00	0.00	0.00			@ 0.000
31	27	62.50C	0.00	0.00	0.00	0.00	0.00		0.00	0.00
	28	62.50C	0.00	-1.10	0.00	-0.83	0.00		@ 0.000	@ 0.000
32	28	62.26C	0.00	30.85	0.00	0.00	0.00	32.86	0.00	4.83
	38	62.26C	0.00	-30.85	0.00	0.00	0.00	@ 2.130	@ 0.000	@ 2.130
33	29	3.72T	0.00	0.96	-4.66	1.26	5.54	2.46	5.54	1.20
	40	3.72T	0.00	0.12	-4.66	2.46	-4.71	@ 2.656	@ 0.478	@ 0.874
34	31	3.72C	0.01	24.60	-6.88	13.91	5.81	34.57	-9.18	2.83
	41	3.72C	-0.01	-7.62	-6.88	32.58	-9.33	@ 2.150	@ 2.656	@ 2.172
35	32	0.00C	0.00	0.00	0.00	0.00	0.00	21.67	6.37	3.63
	33	0.00C	0.00	-14.32	0.00	-7.16	0.00	@ 2.532	@ 1.000	@ 2.369
36	33	15.25T	-12.33	21.76	-4.93	5.14	6.37	21.67	6.37	3.63
	43	15.25T	12.33	-24.91	-4.93	0.00	-9.71	@ 2.532	@ 1.000	@ 2.369
37	34	59.69T	-0.15	18.22	-0.02	2.15	0.03	13.74		1.31
	36	59.69T	0.15	-26.30	-0.02	-10.42	-0.03	@ 1.275		@ 1.431
38	35	30.36T	0.00	-48.06	0.00	106.24	0.00			2.02
	37	30.36T	0.00	-93.11	0.00	-113.27	0.00			@ 0.809
39	36	62.50T	0.00	0.81	0.00	-0.59	0.00		0.00	0.00
	55	62.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
40	10	74.32C	-12.32	0.81	-13.62	0.36	25.13	0.94		2.04
	42	74.32C	12.32	-1.03	-13.62	0.00	-19.14	@ 1.397		@ 0.877
41	37	62.50T	0.00	1.06	0.00	-0.76	0.00			0.00
	54	62.50T	0.00	0.00	0.00	0.00	0.00			@ 0.000
42	38	0.77C	0.00	-118.13	0.00	215.22	0.00		0.00	3.31
	39	0.77C	0.00	-163.18	0.00	-222.21	0.00		@ 0.000	@ 0.746

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 32 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

Member Forces (001 : Dead plus Live b (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
43	39	62.50T	0.00	1.06	0.00	-0.76	0.00		0.00	0.00
	57	62.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
44	40	7.91T	0.00	-1.16	-6.40	2.46	4.12	2.46	5.54	1.20
	44	7.91T	0.00	-1.72	-6.40	0.36	-5.19	@ 2.656	@ 0.478	@ 0.874
45	41	7.91C	-0.01	-8.90	-5.14	32.58	0.85	34.57	-9.18	2.83
	46	7.91C	0.01	-30.21	-5.14	4.13	-6.64	@ 2.150	@ 2.656	@ 2.172
46	44	10.84T	0.13	-2.77	-4.37	0.35	0.55	2.46	5.54	1.20
	45	10.84T	-0.13	-2.82	-4.37	0.00	0.00	@ 2.656	@ 0.478	@ 0.874
47	45	33.61T	-0.01	-50.55	-3.80	79.72	0.00		-7.79	4.55
	48	33.61T	0.01	-51.34	-3.80	-25.91	-7.87		@ 2.053	@ 1.472
48	46	10.84C	0.90	-31.72	-7.17	4.14	0.91	34.57	-9.18	2.83
	47	10.84C	-0.90	-33.58	-7.17	0.00	0.00	@ 2.150	@ 2.656	@ 2.172
49	47	27.41T	-0.05	-66.33	-4.90	133.85	-0.05		-10.10	1.30
	49	27.41T	0.05	-96.70	-4.90	-35.15	-10.20		@ 2.053	@ 0.829
50	48	39.60T	0.07	-52.51	-2.13	-25.91	2.23		-7.79	4.55
	50	39.60T	-0.07	-52.90	-2.13	-80.54	0.02		@ 2.053	@ 1.472
51	49	21.42T	0.40	-98.10	-6.56	-35.15	6.86		-10.10	1.30
	51	21.42T	-0.40	-113.28	-6.56	-144.72	0.05		@ 2.053	@ 0.829
52	50	62.50T	0.00	0.55	0.00	-0.40	0.00		0.00	0.00
	52	62.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
53	51	62.50T	0.00	1.29	0.00	-0.93	0.00		0.00	0.00
	53	62.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
54	59	0.00T	-0.10	4.16	0.00	0.00	0.00	9.21		0.81
	60	0.00T	0.10	2.62	0.00	9.21	0.00	@ 2.717		@ 1.820
55	60	0.00C	-0.10	-16.68	0.00	9.21	0.00	9.21		0.81
	72	0.00C	0.10	-16.99	0.00	0.00	0.00	@ 2.717		@ 1.820
56	61	0.00C	0.00	-23.64	0.00	0.00	0.00	-19.52	0.03	2.26
	62	0.00C	0.00	15.10	0.00	-11.55	-0.01	@ 1.651	@ 2.706	@ 1.651
57	62	0.48T	0.00	16.71	-0.02	-11.55	0.03	-19.52	0.03	2.26
	74	0.48T	0.00	24.69	-0.02	0.00	0.01	@ 1.651	@ 2.706	@ 1.651
58	64	0.00C	0.02	31.20	0.00	0.00	0.00	32.95		6.50
	65	0.00C	-0.02	16.58	0.00	24.39	0.00	@ 2.122		@ 2.122
59	65	0.00C	0.02	15.65	0.00	24.39	0.00	32.95		6.50
	80	0.00C	-0.02	-30.71	0.00	0.00	0.00	@ 2.122		@ 2.122
60	66	0.00C	-0.02	31.05	0.00	0.00	0.00	32.62		6.37
	67	0.00C	0.02	16.74	0.00	23.90	0.00	@ 2.101		@ 2.101
61	67	0.00C	-0.02	15.81	0.00	23.90	0.00	32.62		6.37
	81	0.00C	0.02	-30.56	0.00	0.00	0.00	@ 2.101		@ 2.101
62	68	0.00C	0.00	8.14	0.00	0.00	0.00		0.00	0.18
	69	0.00C	0.00	5.79	0.00	19.86	0.00		@ 0.000	@ 1.625
63	69	0.00C	0.00	-40.41	0.00	19.86	0.00		0.00	0.00
	76	0.00C	0.00	-40.81	0.00	0.00	0.00		@ 0.000	@ 0.000

RM DMS
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Member Forces (001 : Dead plus Live b (Ultimate))										
Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
64	70	0.00C	0.00	24.33	0.00	0.00	0.00	90.64		37.44
	71	0.00C	0.00	21.42	0.00	90.64	0.00	@ 3.962		@ 3.962
65	71	0.00C	0.00	-21.42	0.00	90.64	0.00	90.64		37.44
	84	0.00C	0.00	-24.33	0.00	0.00	0.00	@ 3.962		@ 3.962
66	72	0.00C	0.04	16.81	0.00	0.00	0.00	30.93	0.00	5.68
	73	0.00C	-0.04	15.74	0.00	30.93	0.00	@ 1.900	@ 0.000	@ 2.196
67	73	0.02C	0.04	-10.73	0.00	30.93	0.00	30.93	0.00	5.68
	85	0.02C	-0.04	-12.25	0.00	0.00	0.00	@ 1.900	@ 0.000	@ 2.196
68	77	0.03T	0.00	46.51	-0.44	0.00	0.45	62.52	-0.39	13.32
	78	0.03T	0.00	19.31	-0.44	62.52	-0.39	@ 1.900	@ 1.881	@ 2.250
69	78	0.02C	0.00	-3.97	0.23	62.52	-0.32	62.52	-0.39	13.32
	86	0.02C	0.00	-42.50	0.23	0.00	0.29	@ 1.900	@ 1.881	@ 2.250
70	87	0.48C	0.05	1.09	-0.02	-1.55	0.04			0.19
	93	0.48C	-0.05	0.17	-0.02	0.00	0.00			@ 0.953
71	89	0.01C	0.00	0.37	0.00	0.02	0.00	0.20	0.00	0.05
	91	0.01C	0.00	-0.55	0.00	-0.20	0.00	@ 0.979	@ 0.000	@ 1.101
72	1	4.01C	0.00	0.00	2.49	0.00	-8.54	0.00		5.58
	2	2.72C	0.00	0.00	2.49	0.00	0.19	@ 0.000		@ 1.470
73	3	35.17C	0.00	0.00	9.05	0.00	-30.53	0.00		5.34
	4	32.60C	0.00	0.00	9.05	0.00	1.13	@ 0.000		@ 1.470
74	5	32.14C	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	6	30.85C	0.00	0.00	0.00	0.00	0.00	@ 0.000		@ 0.000
75	7	63.68C	0.00	0.00	16.84	0.00	-19.61	0.00		15.17
	8	62.39C	0.00	0.00	16.84	0.00	39.34	@ 0.000		@ 2.345
76	11	33.93C	0.00	-0.24	0.01	0.00	-0.04			0.18
	28	32.64C	0.00	-0.24	0.01	-0.82	0.00			@ 2.030
77	12	2.08C	0.00	-0.01	0.00	-0.06	0.00		0.00	0.04
	30	0.79C	0.00	-0.01	0.00	-0.11	0.00		@ 0.000	@ 1.820
78	13	46.44T	0.00	-22.78	-0.58	0.00	1.88			17.09
	45	47.73T	0.00	-22.78	-0.58	-79.72	-0.13			@ 2.030
79	14	30.18T	-0.05	-38.24	-2.27	0.00	6.99			8.23
	47	32.75T	0.05	-38.24	-2.27	-133.85	-0.95			@ 1.995
80	15	15.92T	0.00	-30.36	0.00	0.00	0.00			22.73
	35	17.21T	0.00	-30.36	0.00	-106.24	0.00			@ 2.030
81	16	56.14C	0.03	-0.61	1.73	0.00	5.88			11.62
	34	54.85C	-0.03	-0.61	1.73	-2.15	11.93			@ 1.855
82	17	68.36T	0.00	-31.23	0.00	0.00	0.00			23.39
	18	69.65T	0.00	-31.23	0.00	-109.30	0.00			@ 2.030
83	19	85.99T	0.00	-61.49	0.00	0.00	0.00		0.00	46.05
	38	87.28T	0.00	-61.49	0.00	-215.22	0.00		@ 0.000	@ 2.030
84	20	54.74C	-0.02	-22.90	-2.13	0.00	7.40			17.71

RM DMS
85-90 Paul Street
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Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 34 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Member Forces (001 : Dead plus Live b (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	50	53.45C	0.02	-22.90	-2.13	-80.15	-0.07			@ 1.995
85	21	117.14C	-0.05	-41.08	-6.56	0.00	22.56			9.52
	51	114.57C	0.05	-41.08	-6.56	-143.79	-0.40			@ 1.925
86	22	95.46C	0.00	-32.14	0.00	0.00	0.00			24.07
	37	94.17C	0.00	-32.14	0.00	-112.51	0.00			@ 2.030
87	23	28.41C	0.03	-2.81	-0.02	0.00	0.22			2.12
	36	27.12C	-0.03	-2.81	-0.02	-9.83	0.15			@ 2.030
88	24	73.51C	0.00	-31.27	0.00	0.00	0.00			23.42
	25	72.22C	0.00	-31.27	0.00	-109.45	0.00			@ 2.030
89	26	165.53C	0.00	-63.27	0.00	0.00	0.00		0.00	47.38
	39	164.24C	0.00	-63.27	0.00	-221.45	0.00		@ 0.000	@ 2.030
90	60	19.30C	0.00	0.00	0.00	0.00	0.00			0.02
	89	18.79C	0.00	0.00	0.00	0.00	-0.01			@ 1.856
91	62	1.61C	0.04	-0.02	0.48	0.00	0.00			2.42
	87	1.09C	-0.04	-0.02	0.48	-0.05	1.55			@ 1.856
92	73	26.47C	0.00	0.00	-0.02	0.00	0.00	0.00		0.09
	91	25.96C	0.00	0.00	-0.02	0.00	-0.05	@ 0.000		@ 1.856
93	78	23.28C	-0.07	-0.67	-0.05	0.00	0.00			3.36
	92	22.77C	0.07	-0.67	-0.05	-2.14	-0.17			@ 1.856

Member Forces (002 : Dead plus Live a (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
1	28	0.01C	0.00	0.74	0.00	0.00	0.00	0.34	0.00	0.01
	30	0.01C	0.00	-0.85	0.00	-0.12	0.00	@ 0.900	@ 0.000	@ 0.980
2	29	2.34T	-0.01	1.70	4.01	-0.20	-7.27	2.16		2.07
	31	2.34T	0.01	-1.07	4.01	1.21	10.95	@ 2.768		@ 3.176
3	9	20.69C	13.40	41.09	63.59	-55.39	-12.17		50.79	4.09
	10	20.69C	-13.40	40.48	63.59	-14.62	51.42		@ 0.990	@ 0.950
4	10	5.16C	13.14	39.59	-16.52	-27.92	24.28		50.79	4.09
	33	5.16C	-13.14	38.95	-16.52	13.45	6.88		@ 0.990	@ 0.950
5	40	1.88T	0.00	1.39	4.53	0.00	-9.54	1.58		1.47
	41	1.88T	0.00	-1.38	4.53	0.02	11.00	@ 2.269		@ 3.403
6	44	2.19C	0.01	1.14	3.16	0.14	-6.20	1.20		1.30
	46	2.19C	-0.01	-1.63	3.16	-0.98	8.15	@ 1.860		@ 3.312
7	48	1.79C	0.00	1.26	6.47	0.08	-10.92	1.38		3.80
	49	1.79C	0.00	-1.51	6.47	-0.49	18.43	@ 2.042		@ 3.131
8	58	0.00T	0.00	17.88	0.00	0.00	0.00	45.55	0.00	16.60
	59	0.00T	0.00	17.28	0.00	17.25	0.00	@ 3.236	@ 0.000	@ 3.168
9	59	0.00T	0.00	13.28	0.00	17.14	0.00	45.55	0.00	16.60
	61	0.00T	0.00	11.91	0.00	45.55	0.00	@ 3.236	@ 0.000	@ 3.168
10	61	0.00C	0.00	-13.61	0.00	45.55	0.00	45.55	0.00	16.60

RM DMS
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Tel: (0203) 701 3875

Job ref : 21187
Sheet : **Sheet Ref / 35 -**
Made By :
Date : **08 June 2022**
Checked :
Approved :

Member Forces (002 : Dead plus Live a (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	63	0.00C	0.00	-15.52	0.00	0.00	0.00	@ 3.236	@ 0.000	@ 3.168
11	64	0.00C	0.00	0.68	0.00	0.02	0.00	0.58		0.07
	66	0.00C	0.00	-0.68	0.00	0.02	0.00	@ 1.615		@ 1.648
12	65	0.00C	0.00	1.01	0.00	0.00	0.00	0.83		0.10
	67	0.00C	0.00	-1.01	0.00	0.00	0.00	@ 1.615		@ 1.648
13	69	0.00C	0.00	48.88	0.00	0.00	0.00	77.28		16.77
	72	0.00C	0.00	-20.15	0.00	64.15	0.00	@ 3.170		@ 2.411
14	71	0.00C	0.00	46.27	0.00	0.00	0.00	68.42		19.37
	82	0.00C	0.00	-46.27	0.00	0.00	0.00	@ 2.958		@ 2.958
15	72	0.00C	0.00	-51.95	0.00	64.30	0.00		0.00	0.65
	75	0.00C	0.00	-52.70	0.00	0.00	0.00		@ 0.000	@ 0.516
16	79	0.00C	0.00	34.46	0.00	0.00	0.00	33.75		11.27
	80	0.00C	0.00	33.87	0.00	33.38	0.00	@ 2.098		@ 2.592
17	80	0.00C	0.00	0.70	0.00	33.36	0.00	33.75		11.27
	81	0.00C	0.00	-1.32	0.00	32.33	0.00	@ 2.098		@ 2.592
18	81	0.00C	0.00	-34.32	0.00	32.36	0.00	33.75		11.27
	83	0.00C	0.00	-34.89	0.00	0.00	0.00	@ 2.098		@ 2.592
19	88	0.00C	0.02	17.03	0.03	0.00	-0.11	19.01		23.92
	89	0.00C	-0.02	-17.03	0.03	0.00	0.00	@ 2.233		@ 2.233
20	90	0.23T	0.04	17.03	0.03	0.00	-0.11	19.01		23.92
	91	0.23T	-0.04	-17.03	0.03	0.00	0.00	@ 2.233		@ 2.233
21	91	0.23T	-0.16	6.46	0.00	0.00	0.00	2.74	0.00	0.50
	92	0.23T	0.16	-6.46	0.00	0.00	0.00	@ 0.847	@ 0.000	@ 0.847
22	92	0.36C	0.03	14.59	-0.06	-1.88	-0.07	12.20	-0.10	10.46
	93	0.36C	-0.03	10.45	-0.06	4.92	-0.10	@ 1.939	@ 0.543	@ 1.876
23	93	0.38C	0.03	10.57	0.41	4.87	-0.10	12.20	-0.10	10.46
	94	0.38C	-0.03	-13.64	0.41	0.00	1.22	@ 1.939	@ 0.543	@ 1.876
24	2	0.00C	0.20	2.94	-2.69	0.00	0.00	2.65	5.98	1.29
	29	0.00C	-0.20	2.74	-2.69	1.36	-1.29	@ 2.656	@ 0.478	@ 0.874
25	4	0.00C	1.22	35.21	-9.77	0.00	0.00	37.33	-9.92	3.06
	31	0.00C	-1.22	27.64	-9.77	15.03	-4.67	@ 2.150	@ 2.656	@ 2.172
26	6	0.00C	0.00	33.32	0.00	0.00	0.00	35.49		5.21
	35	0.00C	0.00	-33.32	0.00	0.00	0.00	@ 2.130		@ 2.130
27	8	0.00C	42.49	67.38	-18.19	0.00	0.00	59.13	-18.01	10.74
	9	0.00C	-42.49	51.92	-18.19	59.65	-18.19	@ 0.990	@ 0.990	@ 2.011
28	9	63.80T	-13.05	10.84	1.85	46.82	-6.02	59.13	-18.01	10.74
	34	63.80T	13.05	-39.56	1.85	0.00	0.00	@ 0.990	@ 0.990	@ 2.011
29	18	33.73T	0.00	-75.22	0.00	118.04	0.00			1.93
	25	33.73T	0.00	-77.12	0.00	-118.84	0.00			@ 0.653
30	25	67.50T	0.00	0.88	0.00	-0.63	0.00			0.00
	56	67.50T	0.00	0.00	0.00	0.00	0.00			@ 0.000

RM DMS
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Tel: (0203) 701 3875

Job ref : 21187
Sheet : **Sheet Ref / 36 -**
Made By :
Date **:08 June 2022**
Checked **:**
Approved :

Member Forces (002 : Dead plus Live a (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
31	27	67.50C	0.00	0.00	0.00	0.00	0.00		0.00	0.00
	28	67.50C	0.00	-1.19	0.00	-0.89	0.00		@ 0.000	@ 0.000
32	28	67.24C	0.00	33.32	0.00	0.00	0.00	35.49		5.21
	38	67.24C	0.00	-33.32	0.00	0.00	0.00	@ 2.130		@ 2.130
33	29	4.01T	0.00	1.04	-5.03	1.36	5.98	2.65	5.98	1.29
	40	4.01T	0.00	0.13	-5.03	2.66	-5.09	@ 2.656	@ 0.478	@ 0.874
34	31	4.01C	0.01	26.57	-7.43	15.02	6.28	37.33	-9.92	3.06
	41	4.01C	-0.01	-8.23	-7.43	35.19	-10.08	@ 2.150	@ 2.656	@ 2.172
35	32	0.00C	0.00	0.00	0.00	0.00	0.00	23.41	6.88	3.92
	33	0.00C	0.00	-15.46	0.00	-7.73	0.00	@ 2.532	@ 1.000	@ 2.337
36	33	16.47T	-13.32	23.50	-5.33	5.55	6.88	23.41	6.88	3.92
	43	16.47T	13.32	-26.90	-5.33	0.00	-10.49	@ 2.532	@ 1.000	@ 2.337
37	34	64.47T	-0.16	19.68	-0.02	2.32	0.03	14.84		1.41
	36	64.47T	0.16	-28.41	-0.02	-11.26	-0.03	@ 1.275		@ 1.431
38	35	32.78T	0.00	-51.90	0.00	114.74	0.00			2.18
	37	32.78T	0.00	-100.56	0.00	-122.33	0.00			@ 0.809
39	36	67.50T	0.00	0.88	0.00	-0.63	0.00		0.00	0.00
	55	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
40	10	80.27C	-13.31	0.87	-14.71	0.39	27.14	1.01		2.21
	42	80.27C	13.31	-1.11	-14.71	0.00	-20.67	@ 1.397		@ 0.877
41	37	67.50T	0.00	1.14	0.00	-0.82	0.00			0.00
	54	67.50T	0.00	0.00	0.00	0.00	0.00			@ 0.000
42	38	0.83C	0.00	-127.58	0.00	232.44	0.00		0.00	3.57
	39	0.83C	0.00	-176.23	0.00	-239.99	0.00		@ 0.000	@ 0.746
43	39	67.50T	0.00	1.14	0.00	-0.82	0.00		0.00	0.00
	57	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
44	40	8.54T	0.00	-1.26	-6.91	2.65	4.45	2.65	5.98	1.29
	44	8.54T	0.00	-1.86	-6.91	0.39	-5.60	@ 2.656	@ 0.478	@ 0.874
45	41	8.54C	-0.01	-9.61	-5.56	35.19	0.92	37.33	-9.92	3.06
	46	8.54C	0.01	-32.63	-5.56	4.46	-7.17	@ 2.150	@ 2.656	@ 2.172
46	44	11.70T	0.14	-2.99	-4.72	0.38	0.60	2.65	5.98	1.29
	45	11.70T	-0.14	-3.05	-4.72	0.00	0.00	@ 2.656	@ 0.478	@ 0.874
47	45	36.30T	-0.01	-54.59	-4.10	86.09	0.00		-8.42	4.91
	48	36.30T	0.01	-55.45	-4.10	-27.98	-8.50		@ 2.053	@ 1.472
48	46	11.70C	0.97	-34.26	-7.74	4.47	0.98	37.33	-9.92	3.06
	47	11.70C	-0.97	-36.27	-7.74	0.00	0.00	@ 2.150	@ 2.656	@ 2.172
49	47	29.60T	-0.06	-71.64	-5.29	144.56	-0.05		-10.91	1.41
	49	29.60T	0.06	-104.43	-5.29	-37.96	-11.02		@ 2.053	@ 0.829
50	48	42.77T	0.08	-56.71	-2.30	-27.98	2.41		-8.42	4.91
	50	42.77T	-0.08	-57.13	-2.30	-86.99	0.02		@ 2.053	@ 1.472
51	49	23.13T	0.43	-105.94	-7.09	-37.96	7.41		-10.91	1.41
	51	23.13T	-0.43	-122.34	-7.09	-156.29	0.06		@ 2.053	@ 0.829

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Member Forces (002 : Dead plus Live a (Ultimate))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
52	50	67.50T	0.00	0.59	0.00	-0.43	0.00		0.00	0.00
	52	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
53	51	67.50T	0.00	1.39	0.00	-1.00	0.00		0.00	0.00
	53	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000
54	59	0.00T	-0.10	4.00	0.00	0.00	0.00	8.62	0.00	0.76
	60	0.00T	0.10	2.34	0.00	8.62	0.00	@ 2.717	@ 0.000	@ 1.820
55	60	0.01C	-0.10	-15.58	0.00	8.62	0.00	8.62	0.00	0.76
	72	0.01C	0.10	-15.92	0.00	0.00	0.00	@ 2.717	@ 0.000	@ 1.820
56	61	0.00C	0.00	-25.52	0.00	0.00	0.00	-21.06	0.02	2.44
	62	0.00C	0.00	16.32	0.00	-12.44	-0.01	@ 1.651	@ 2.706	@ 1.651
57	62	0.47T	0.00	17.99	-0.02	-12.44	0.02	-21.06	0.02	2.44
	74	0.47T	0.00	26.62	-0.02	0.00	0.01	@ 1.651	@ 2.706	@ 1.651
58	64	0.00C	0.02	33.70	0.00	0.00	0.00	35.59		7.02
	65	0.00C	-0.02	17.91	0.00	26.35	0.00	@ 2.122		@ 2.122
59	65	0.00C	0.02	16.90	0.00	26.35	0.00	35.59		7.02
	80	0.00C	-0.02	-33.17	0.00	0.00	0.00	@ 2.122		@ 2.122
60	66	0.00C	-0.02	33.54	0.00	0.00	0.00	35.23		6.88
	67	0.00C	0.02	18.08	0.00	25.81	0.00	@ 2.101		@ 2.101
61	67	0.00C	-0.02	17.07	0.00	25.81	0.00	35.23		6.88
	81	0.00C	0.02	-33.01	0.00	0.00	0.00	@ 2.101		@ 2.101
62	68	0.00C	0.00	8.64	0.00	0.00	0.00		0.00	0.19
	69	0.00C	0.00	6.11	0.00	21.02	0.00		@ 0.000	@ 1.625
63	69	0.00C	0.00	-42.78	0.00	21.02	0.00		0.00	0.00
	76	0.00C	0.00	-43.21	0.00	0.00	0.00		@ 0.000	@ 0.000
64	70	0.00C	0.00	26.28	0.00	0.00	0.00	97.89		40.44
	71	0.00C	0.00	23.13	0.00	97.89	0.00	@ 3.962		@ 3.962
65	71	0.00C	0.00	-23.13	0.00	97.89	0.00	97.89		40.44
	84	0.00C	0.00	-26.28	0.00	0.00	0.00	@ 3.962		@ 3.962
66	72	0.01C	0.05	15.88	0.00	0.00	0.00	29.07		5.35
	73	0.01C	-0.05	14.72	0.00	29.07	0.00	@ 1.900		@ 2.196
67	73	0.05C	0.05	-9.98	0.00	29.07	0.00	29.07		5.35
	85	0.05C	-0.05	-11.62	0.00	0.00	0.00	@ 1.900		@ 2.196
68	77	0.03T	0.00	48.16	-0.39	0.00	0.39	63.59	-0.34	13.67
	78	0.03T	0.00	18.78	-0.39	63.59	-0.35	@ 1.900	@ 1.881	@ 2.250
69	78	0.02C	0.00	-2.83	0.20	63.59	-0.28	63.59	-0.34	13.67
	86	0.02C	0.00	-44.43	0.20	0.00	0.25	@ 1.900	@ 1.881	@ 2.250
70	87	0.47C	0.05	1.11	-0.01	-1.51	0.03			0.18
	93	0.47C	-0.05	0.12	-0.01	0.00	0.00			@ 0.929
71	89	0.01C	0.00	0.34	0.00	0.08	0.00	0.23	0.00	0.05
	91	0.01C	0.00	-0.65	0.00	-0.29	0.00	@ 0.832	@ 0.000	@ 1.028
72	1	4.33C	0.00	0.00	2.69	0.00	-9.23	0.00		6.03

RM DMS
85-90 Paul Street
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EC2A 4NE

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Job ref	: 21187
Sheet	: **Sheet Ref / 38 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Member Forces (002 : Dead plus Live a (Ultimate))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				y-y	**z-z**	**y-y**	**z-z**	**y-y**	**z-z**	
	2	2.94C	0.00	0.00	2.69	0.00	0.20	@ 0.000		@ 1.470
73	3	37.98C	0.00	0.00	9.77	0.00	-32.97	0.00		5.77
	4	35.21C	0.00	0.00	9.77	0.00	1.22	@ 0.000		@ 1.470
74	5	34.71C	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	6	33.32C	0.00	0.00	0.00	0.00	0.00	@ 0.000		@ 0.000
75	7	68.78C	0.00	0.00	18.19	0.00	-21.18	0.00		16.38
	8	67.38C	0.00	0.00	18.19	0.00	42.49	@ 0.000		@ 2.345
76	11	36.64C	0.00	-0.25	0.01	0.00	-0.04			0.19
	28	35.25C	0.00	-0.25	0.01	-0.89	0.00			@ 1.995
77	12	2.24C	0.00	-0.01	0.00	-0.07	0.00		0.00	0.04
	30	0.85C	0.00	-0.01	0.00	-0.12	0.00		@ 0.000	@ 1.820
78	13	50.15T	0.00	-24.60	-0.62	0.00	2.03			18.45
	45	51.55T	0.00	-24.60	-0.62	-86.09	-0.15			@ 2.030
79	14	32.59T	-0.05	-41.30	-2.45	0.00	7.55			8.89
	47	35.37T	0.05	-41.30	-2.45	-144.56	-1.03			@ 1.995
80	15	17.19T	0.00	-32.78	0.00	0.00	0.00			24.55
	35	18.58T	0.00	-32.78	0.00	-114.74	0.00			@ 2.030
81	16	60.63C	0.03	-0.66	1.87	0.00	6.35			12.55
	34	59.24C	-0.03	-0.66	1.87	-2.32	12.89			@ 1.855
82	17	73.83T	0.00	-33.73	0.00	0.00	0.00			25.26
	18	75.22T	0.00	-33.73	0.00	-118.04	0.00			@ 2.030
83	19	92.87T	0.00	-66.41	0.00	0.00	0.00		0.00	49.73
	38	94.26T	0.00	-66.41	0.00	-232.44	0.00		@ 0.000	@ 2.030
84	20	59.12C	-0.02	-24.73	-2.30	0.00	7.99			19.13
	50	57.73C	0.02	-24.73	-2.30	-86.56	-0.08			@ 1.995
85	21	126.51C	-0.06	-44.37	-7.09	0.00	24.37			10.28
	51	123.74C	0.06	-44.37	-7.09	-155.29	-0.43			@ 1.925
86	22	103.09C	0.00	-34.72	0.00	0.00	0.00			26.00
	37	101.70C	0.00	-34.72	0.00	-121.51	0.00			@ 2.030
87	23	30.68C	0.03	-3.03	-0.02	0.00	0.24			2.29
	36	29.29C	-0.03	-3.03	-0.02	-10.62	0.16			@ 2.030
88	24	79.39C	0.00	-33.77	0.00	0.00	0.00			25.29
	25	78.00C	0.00	-33.77	0.00	-118.21	0.00			@ 2.030
89	26	178.77C	0.00	-68.33	0.00	0.00	0.00		0.00	51.17
	39	177.38C	0.00	-68.33	0.00	-239.16	0.00		@ 0.000	@ 2.030
90	60	17.93C	0.00	0.00	-0.02	0.00	0.00			0.09
	89	17.37C	0.00	0.00	-0.02	0.00	-0.06			@ 1.856
91	62	1.67C	0.03	-0.01	0.47	0.00	0.00			2.37
	87	1.11C	-0.03	-0.01	0.47	-0.05	1.51			@ 1.856
92	73	24.70C	0.00	0.00	-0.03	0.00	0.00	0.00		0.16
	91	24.14C	0.00	0.00	-0.03	0.00	-0.10	@ 0.000		@ 1.856

RM DMS
85-90 Paul Street
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Tel: (0203) 701 3875

Job ref : 21187
Sheet : **Sheet Ref / 39 -**
Made By :
Date **:08 June 2022**
Checked **:**
Approved :

Member Forces (002 : Dead plus Live a (Ultimate))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				y-y	**z-z**	**y-y**	**z-z**	**y-y**	**z-z**	
93	78	21.61C	-0.07	-0.59	-0.06	0.00	0.00			2.96
	92	21.05C	0.07	-0.59	-0.06	-1.88	-0.18			@ 1.856

Member Forces (003 : Live Only (Serviceability))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				y-y	**z-z**	**y-y**	**z-z**	**y-y**	**z-z**	
1	28	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	30	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
2	29	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	31	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
3	9	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	10	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
4	10	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	33	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
5	40	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	41	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
6	44	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	46	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
7	48	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	49	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
8	58	0.00T	0.00	0.74	0.00	0.00	0.00	0.72	0.00	0.23
	59	0.00T	0.00	0.74	0.00	0.72	0.00	@ 0.981	@ 0.000	@ 2.763
9	59	0.00T	0.00	-0.12	0.00	0.72	0.00	0.72	0.00	0.23
	61	0.00T	0.00	-0.12	0.00	0.44	0.00	@ 0.981	@ 0.000	@ 2.763
10	61	0.00C	0.00	-0.14	0.00	0.44	0.00	0.72	0.00	0.23
	63	0.00C	0.00	-0.14	0.00	0.00	0.00	@ 0.981	@ 0.000	@ 2.763
11	64	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	66	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
12	65	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	67	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
13	69	0.00C	0.00	1.78	0.00	0.00	0.00			1.06
	72	0.00C	0.00	1.78	0.00	7.96	0.00			@ 2.590
14	71	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	82	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
15	72	0.00C	0.00	-6.49	0.00	7.97	0.00		0.00	0.08
	75	0.00C	0.00	-6.49	0.00	0.00	0.00		@ 0.000	@ 0.516
16	79	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	80	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
17	80	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	81	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
18	81	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	83	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000

RM DMS
85-90 Paul Street
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EC2A 4NE

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Job ref : 21187
Sheet : **Sheet Ref / 40 -**
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Date : **08 June 2022**
Checked :
Approved :

Member Forces (003 : Live Only (Serviceability))										
Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
19	88	0.00C	-0.03	5.02	-0.03	0.00	0.11	5.61		7.06
	89	0.00C	0.03	-5.02	-0.03	0.00	0.00	@ 2.233		@ 2.233
20	90	0.09T	-0.03	5.02	-0.03	0.00	0.11	5.61		7.06
	91	0.09T	0.03	-5.02	-0.03	0.00	0.00	@ 2.233		@ 2.233
21	91	0.09T	0.03	1.91	0.00	0.00	0.00	0.81	0.00	0.15
	92	0.09T	-0.03	-1.91	0.00	0.00	0.00	@ 0.831	@ 0.000	@ 0.847
22	92	0.15C	0.02	4.29	0.00	-0.76	-0.02	3.47		2.95
	93	0.15C	-0.02	3.07	0.00	1.24	-0.01	@ 1.939		@ 1.908
23	93	0.15C	0.02	3.19	0.09	1.22	-0.01	3.47		2.95
	94	0.15C	-0.02	-3.95	0.09	0.00	0.27	@ 1.939		@ 1.908
24	2	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	29	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
25	4	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	31	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
26	6	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	35	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
27	8	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	9	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
28	9	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	34	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
29	18	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	25	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
30	25	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	56	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
31	27	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	28	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
32	28	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	38	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
33	29	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	40	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
34	31	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	41	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
35	32	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	33	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
36	33	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	43	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
37	34	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	36	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
38	35	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	37	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
39	36	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	55	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 41 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Member Forces (003 : Live Only (Serviceability))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
40	10	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	42	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
41	37	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	54	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
42	38	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	39	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
43	39	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	57	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
44	40	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	44	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
45	41	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	46	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
46	44	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	45	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
47	45	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	48	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
48	46	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	47	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
49	47	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	49	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
50	48	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	50	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
51	49	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	51	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
52	50	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	52	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
53	51	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	53	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
54	59	0.00C	-0.01	0.86	0.00	0.00	0.00	2.33	0.00	0.19
	60	0.00C	0.01	0.86	0.00	2.33	0.00	@ 2.717	@ 0.000	@ 1.848
55	60	0.02T	-0.01	-4.27	0.00	2.33	0.00	2.33	0.00	0.19
	72	0.02T	0.01	-4.27	0.00	0.00	0.00	@ 2.717	@ 0.000	@ 1.848
56	61	0.00T	0.00	-0.02	0.00	0.00	0.00	-0.05	0.01	0.00
	62	0.00T	0.00	-0.02	0.00	-0.05	-0.01	@ 2.706	@ 2.706	@ 0.000
57	62	0.09T	0.00	0.09	-0.01	-0.05	0.01	-0.05	0.01	0.00
	74	0.09T	0.00	0.09	-0.01	0.00	0.01	@ 2.706	@ 2.706	@ 0.000
58	64	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	65	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
59	65	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	80	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
60	66	0.00C	0.00	0.00	0.00	0.00	0.00			0.00

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 42 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

Member Forces (003 : Live Only (Serviceability))										
Load Case	**Node End1 End2**	**Axial Force (kN)**	**Torque Moment (kNm)**	**Shear Force (kN)**		**Bending Moment (kNm)**		**Maximum Moment (kNm @ m)**		**Max Def (mm @ m)**
				y-y	**z-z**	**y-y**	**z-z**	**y-y**	**z-z**	
	67	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
61	67	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	81	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
62	68	0.00C	0.00	0.26	0.00	0.00	0.00		0.00	0.00
	69	0.00C	0.00	0.26	0.00	0.74	0.00		@ 0.000	@ 0.000
63	69	0.00C	0.00	-1.52	0.00	0.74	0.00		0.00	0.00
	76	0.00C	0.00	-1.52	0.00	0.00	0.00		@ 0.000	@ 0.000
64	70	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	71	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
65	71	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	84	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
66	72	0.02T	0.00	4.00	0.00	0.00	0.00	7.60		1.38
	73	0.02T	0.00	4.00	0.00	7.60	0.00	@ 1.900		@ 2.169
67	73	0.05T	0.00	-2.83	0.00	7.60	0.00	7.60		1.38
	85	0.05T	0.00	-2.83	0.00	0.00	0.00	@ 1.900		@ 2.169
68	77	0.00C	0.00	3.64	-0.15	0.00	0.16	6.91	-0.13	1.25
	78	0.00C	0.00	3.64	-0.15	6.91	-0.14	@ 1.900	@ 1.881	@ 2.169
69	78	0.00T	0.00	-2.57	0.08	6.91	-0.12	6.91	-0.13	1.25
	86	0.00T	0.00	-2.57	0.08	0.00	0.10	@ 1.900	@ 1.881	@ 2.169
70	87	0.09C	0.02	0.11	-0.01	-0.28	0.02			0.05
	93	0.09C	-0.02	0.11	-0.01	0.00	0.00			@ 1.026
71	89	0.00C	0.00	0.10	0.00	-0.12	0.00		0.00	0.00
	91	0.00C	0.00	0.10	0.00	0.14	0.00		@ 0.000	@ 0.000
72	1	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	2	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
73	3	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	4	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
74	5	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	6	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
75	7	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	8	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
76	11	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	28	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
77	12	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	30	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
78	13	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	45	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
79	14	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	47	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
80	15	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	35	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 43 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Member Forces (003 : Live Only (Serviceability))

Load Case	Node End1 End2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
81	16	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	34	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
82	17	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	18	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
83	19	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	38	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
84	20	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	50	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
85	21	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	51	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
86	22	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	37	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
87	23	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	36	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
88	24	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	25	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
89	26	0.00C	0.00	0.00	0.00	0.00	0.00			0.00
	39	0.00C	0.00	0.00	0.00	0.00	0.00			@ 0.000
90	60	5.13C	0.00	0.00	0.03	0.00	0.00			0.13
	89	5.13C	0.00	0.00	0.03	0.00	0.08			@ 1.856
91	62	0.11C	0.02	-0.01	0.09	0.00	0.00			0.44
	87	0.11C	-0.02	-0.01	0.09	-0.02	0.28			@ 1.856
92	73	6.83C	0.00	0.00	0.02	0.00	0.00			0.12
	91	6.83C	0.00	0.00	0.02	0.00	0.08			@ 1.856
93	78	6.20C	-0.02	-0.24	0.00	0.00	0.00			1.20
	92	6.20C	0.02	-0.24	0.00	-0.76	0.01			@ 1.856

Support Reactions (001 : Dead plus Live b (Ultimate))

Load Case	Directional Reactions (kN)			Moment Reactions (kNm)		
	Rx → (kN)	Ry ↑ (kN)	Rz ↗ (kN)	Mx → (kN)	My ↑ (kN)	Mz ↗ (kN)
1	2.494	4.007	0.000	0.000	0.000	-8.543
3	9.047	35.171	0.000	0.000	0.000	-30.530
5	0.000	32.142	0.000	0.000	0.000	0.000
7	16.845	63.681	0.000	0.000	0.000	-19.614
11	0.013	33.928	-0.236	0.000	0.000	-0.040
12	-0.013	2.077	0.000	0.000	0.000	-0.064
13	-0.576	-46.439	-22.776	0.000	0.000	1.882
14	-2.269	-30.178	-38.243	0.000	-0.045	6.986
15	0.000	-15.916	-30.355	0.000	0.000	0.000
16	1.729	56.140	-0.614	0.000	0.031	5.882
17	0.000	-68.358	-31.228	0.000	0.000	0.000
19	0.000	-85.988	-61.493	0.000	0.000	0.000
20	-2.134	54.741	-22.900	0.000	-0.022	7.399
21	-6.561	117.143	-41.082	0.000	-0.055	22.564
22	0.000	95.456	-32.145	0.000	0.000	0.000
23	-0.020	28.406	-2.810	0.000	0.031	0.219
24	0.000	73.509	-31.272	0.000	0.000	0.000
26	0.000	165.528	-63.271	0.000	0.000	0.000
42	-13.622	1.030	-74.324	0.000	19.137	12.325
43	-4.932	24.911	15.248	0.000	9.711	12.331

RM DMS
85-90 Paul Street
London
EC2A 4NE

Tel: (0203) 701 3875

Job ref	: 21187
Sheet	: **Sheet Ref / 44 -**
Made By	:
Date	**:08 June 2022**
Checked	:
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Support Reactions (001 : Dead plus Live b (Ultimate))

Load Case	Directional Reactions (kN)			Moment Reactions (kNm)		
	Rx → (kN)	Ry ↑ (kN)	Rz ↗ (kN)	Mx → (kN)	My ↑ (kN)	Mz ↗ (kN)
1	2.494	4.007	0.000	0.000	0.000	-8.543
58	0.000	16.947	0.000	0.000	0.000	0.000
63	0.000	14.446	0.000	0.000	0.000	0.000
64	0.000	31.830	0.000	0.000	0.000	0.000
66	0.000	31.682	0.000	0.000	0.000	0.000
68	0.000	8.139	0.000	0.000	0.000	0.000
70	0.000	24.333	0.000	0.000	0.000	0.000
74	0.021	24.695	0.482	0.000	0.013	0.000
75	0.000	52.215	0.000	0.000	0.000	0.000
76	0.000	40.814	0.000	0.000	0.000	0.000
77	0.442	46.507	-0.030	0.000	0.447	0.000
79	0.000	31.912	0.000	0.000	0.000	0.000
82	0.000	42.840	0.000	0.000	0.000	0.000
83	0.000	32.309	0.000	0.000	0.000	0.000
84	0.000	24.333	0.000	0.000	0.000	0.000
85	0.000	12.254	-0.018	0.000	0.000	-0.045
86	0.227	42.496	-0.021	0.000	-0.286	0.000
88	0.000	18.418	0.010	0.000	-0.046	0.000
90	-0.257	18.418	0.010	0.017	-0.046	0.000
94	-0.428	14.717	-0.431	-0.038	-1.270	0.000
Total	0.005	1070.291	-437.498	-0.021	27.600	10.751

Support Reactions (002 : Dead plus Live a (Ultimate))

Load Case	Directional Reactions (kN)			Moment Reactions (kNm)		
	Rx → (kN)	Ry ↑ (kN)	Rz ↗ (kN)	Mx → (kN)	My ↑ (kN)	Mz ↗ (kN)
1	2.694	4.327	0.000	0.000	0.000	-9.227
3	9.770	37.984	0.000	0.000	0.000	-32.972
5	0.000	34.714	0.000	0.000	0.000	0.000
7	18.192	68.775	0.000	0.000	0.000	-21.184
11	0.014	36.642	-0.255	0.000	0.000	-0.044
12	-0.014	2.243	0.000	0.000	0.000	-0.069
13	-0.622	-50.155	-24.598	0.000	0.000	2.033
14	-2.450	-32.592	-41.302	0.000	-0.049	7.545
15	0.000	-17.189	-32.784	0.000	0.000	0.000
16	1.868	60.631	-0.663	0.000	0.034	6.352
17	0.000	-73.827	-33.726	0.000	0.000	0.000
19	0.000	-92.867	-66.412	0.000	0.000	0.000
20	-2.305	59.120	-24.732	0.000	-0.024	7.991
21	-7.086	126.515	-44.368	0.000	-0.059	24.369
22	0.000	103.092	-34.716	0.000	0.000	0.000
23	-0.022	30.679	-3.035	0.000	0.034	0.237
24	0.000	79.390	-33.774	0.000	0.000	0.000
26	0.000	178.770	-68.333	0.000	0.000	0.000
42	-14.712	1.112	-80.269	0.000	20.668	13.311
43	-5.326	26.904	16.468	0.000	10.488	13.317
58	0.000	17.882	0.000	0.000	0.000	0.000
63	0.000	15.521	0.000	0.000	0.000	0.000
64	0.000	34.376	0.000	0.000	0.000	0.000
66	0.000	34.217	0.000	0.000	0.000	0.000
68	0.000	8.641	0.000	0.000	0.000	0.000
70	0.000	26.279	0.000	0.000	0.000	0.000
74	0.019	26.616	0.471	0.000	0.011	0.000
75	0.000	52.696	0.000	0.000	0.000	0.000
76	0.000	43.211	0.000	0.000	0.000	0.000
77	0.389	48.155	-0.034	0.000	0.392	0.000
79	0.000	34.465	0.000	0.000	0.000	0.000
82	0.000	46.267	0.000	0.000	0.000	0.000
83	0.000	34.894	0.000	0.000	0.000	0.000
84	0.000	26.279	0.000	0.000	0.000	0.000
85	0.000	11.624	-0.046	0.000	0.000	-0.046
86	0.197	44.432	-0.024	0.000	-0.249	0.000
88	0.000	17.028	0.026	0.025	-0.115	0.000
90	-0.225	17.028	0.026	0.035	-0.115	0.000

RM DMS
85-90 Paul Street
London
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Tel: (0203) 701 3875

Job ref : 21187
Sheet : **Sheet Ref / 45 -**
Made By :
Date **:08 June 2022**
Checked **:**
Approved :

Support Reactions (002 : Dead plus Live a (Ultimate))						
Load Case	**Directional Reactions (kN)**			**Moment Reactions (kNm)**		
	Rx → (kN)	**Ry ↑ (kN)**	**Rz ↗ (kN)**	**Mx → (kN)**	**My ↑ (kN)**	**Mz ↗ (kN)**
1	2.694	4.327	0.000	0.000	0.000	-9.227
94	-0.375	13.640	-0.414	-0.029	-1.217	0.000
Total	0.004	1137.521	-472.495	0.031	29.800	11.613

Support Reactions (003 : Live Only (Serviceability))						
Load Case	**Directional Reactions (kN)**			**Moment Reactions (kNm)**		
	Rx → (kN)	**Ry ↑ (kN)**	**Rz ↗ (kN)**	**Mx → (kN)**	**My ↑ (kN)**	**Mz ↗ (kN)**
1	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.737	0.000	0.000	0.000	0.000
63	0.000	0.142	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000
66	0.000	0.000	0.000	0.000	0.000	0.000
68	0.000	0.261	0.000	0.000	0.000	0.000
70	0.000	0.000	0.000	0.000	0.000	0.000
74	0.000	0.095	0.088	0.000	0.000	0.000
75	0.000	6.486	0.000	0.000	0.000	0.000
76	0.000	1.522	0.000	0.000	0.000	0.000
77	0.155	3.635	0.000	0.000	0.158	0.000
79	0.000	0.000	0.000	0.000	0.000	0.000
82	0.000	0.000	0.000	0.000	0.000	0.000
83	0.000	0.000	0.000	0.000	0.000	0.000
84	0.000	0.000	0.000	0.000	0.000	0.000
85	0.000	2.825	0.047	0.000	0.000	0.000
86	0.084	2.567	0.000	0.000	-0.105	0.000
88	0.000	5.023	-0.026	-0.030	0.114	0.000
90	-0.092	5.023	-0.026	-0.029	0.114	0.000
94	-0.153	3.954	-0.090	-0.021	-0.272	0.000
Total	-0.006	32.269	-0.007	-0.081	0.010	0.000

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AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 2 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

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Job ref	: 21187
Sheet	: **Sheet Ref / 46 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

D1 D 077.010 (kN/m³)

Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
2	29	2.34T	-0.01	1.70	4.01	-0.20	-7.27	2.16		0.00
	31	2.34T	0.01	-1.07	4.01	1.21	10.95	@ 2.768		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 2.16, 10.95	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	1.074 / 269.498 =	0.004
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	4.015 / 711.169 =	0.006
$M_{c.z.Rd} = f_y.W_{pl.z}/\gamma_{M0}$	275 x 230.9/1	63.498 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	-2.336 / 1615.075 =	0.001
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	497.4, 16.974, 0.001	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	230.9, 44.792, 0.001	230.9 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\gamma_{M0}$	230.9 x 275/1	63.498 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(1.213/136.785)^2+(10.949/63.498)^1=$	0.173

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	-0.2, 1.2, 1.6, -0.163, 1.290	1.122
$C_{mLT}=0.95+0.05\alpha_h$	M_h = 1.22, M_s = 2.08, ~y = -0.163, α_s = 0.585	0.979
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 10.95, ~y = -0.663	0.4
$C_{my}=0.95+0.05\alpha_h$	M_h = 1.21, M_s = 2.08, ~y = -0.165, α_s = 0.584	0.979

Lateral Buckling Check M.b.Rd

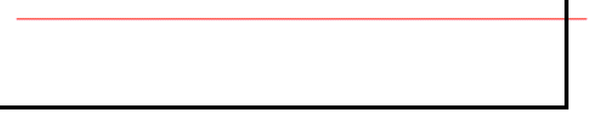
Le = 1.00 L	1 x 4.537 =	4.537 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.122, 4.537, 1551, 22.15, 0.1429, 210000	251.950 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 251.95	0.737
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.737, 0.761, 0.750, 0.400	0.851
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.851, 0.737, 0.944, 0.972	0.875
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	0.875 x 497.4 x 275 ≤ 136.785 =	119.713 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1357.943	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 856.447	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	1.213 / 119.713	0.010
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	10.949 / 63.498	0.172
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.979
$k_zz=C_{mz}\{1+1.4U_{N.z}\}$		0.400
$k_yz=0.6\ k_zz$		0.240
$k_zy= 1- \{0.1\lambda_z/(C_{mLT}-0.25)\}U_{N.z}$		1.000
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.979x0.010+0.240x0.172	0.051
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+1.000x0.010+0.400x0.172	0.079

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 2 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1



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D1 D 077.010 (kN/m^3)

Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
2	29	2.34T	-0.01	1.70	4.01	-0.20	-7.27	2.16		0.00
	31	2.34T	0.01	-1.07	4.01	1.21	10.95	@ 2.768		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 2.16, 10.95	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	1.074 / 269.498 =	0.004
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	4.015 / 711.169 =	0.006
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 230.9/1	63.498 kN.m
$N_{pl.Rd}$ = Ag.fy/γ_{M0}	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
n = $N_{Ed}/N_{pl.Rd}$	-2.336 / 1615.075 =	0.001
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	497.4, 16.974, 0.001	497.4 cm^3
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	230.9, 44.792, 0.001	230.9 cm^3
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	230.9 x 275/1	63.498 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(1.213/136.785)^2+(10.949/63.498)^1=$	0.173

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	-0.2, 1.2, 1.6, -0.163, 1.290	1.122
$C_{mLT}=0.95+0.05\alpha_h$	M_h = 1.22, M_s = 2.08, ~y = -0.163, α_s = 0.585	0.979
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 10.95, ~y = -0.663	0.4
$C_{my}=0.95+0.05\alpha_h$	M_h = 1.21, M_s = 2.08, ~y = -0.165, α_s = 0.584	0.979

Lateral Buckling Check M.b.Rd

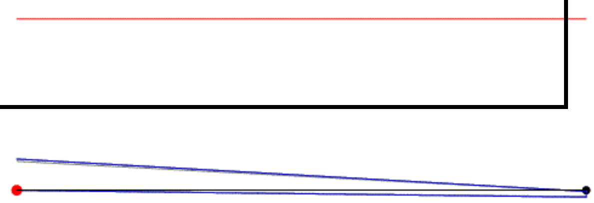
Le = 1.00 L	1 x 4.537 =	4.537 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.122, 4.537, 1551, 22.15, 0.1429, 210000	251.950 kN.m
$\lambda_{LT} = \sqrt{}$ W.f_y/M_{cr}	$\sqrt{}$ 497.4 x 275 / 251.95	0.737
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.737, 0.761, 0.750, 0.400	0.851
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.851, 0.737, 0.944, 0.972	0.875
$M_{b.Rd}$ = c $W_{pl.y}.f_y \leq M_{c.y.Rd}$	0.875 x 497.4 x 275 ≤ 136.785 =	119.713 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1357.943	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 856.447	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	1.213 / 119.713	0.010
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	10.949 / 63.498	0.172
$k_y y=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.979
$k_z z=C_{mz}\{1+1.4U_{N.z}\}$		0.400
$k_y z$=0.6 $k_z z$		0.240
$k_z y$= 1- $\{0.1\lambda_z/(C_{mLT}-0.25)\}U_{N.z}$		1.000
$U_{Ny}+k_y y.U_{M.y}+k_y z.U_{M.z}$	0.000+0.979x0.010+0.240x0.172	0.051
$U_{Nz}+k_z y.U_{M.y}+k_z z.U_{M.z}$	0.000+1.000x0.010+0.400x0.172	0.079

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 50 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1



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Job ref	: 21187
Sheet	: **Sheet Ref / 48 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

D1 D 077.010 (kN/m³)

Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
73	3	37.98C	0.00	0.00	9.77	0.00	-32.97	0.00		0.00
	4	35.21C	0.00	0.00	9.77	0.00	1.22	@ 0.000		@ 0.000

Additional Nominal Moments

M_{yUp}	7.21 kN.m	

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 37.98, 7.21, 32.97	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{z.Ed}/V_{pl.z.Rd}$	9.77 / 927.974 =	0.011
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 305.3/1	83.958 kN.m
$N_{pl.Rd} = A_g.f_y/\ \gamma_{M0}$	76.37 x 275/1 =	2100.175 kN
$n = N_{Ed}/N_{pl.Rd}$	37.984 / 2100.175 =	0.018
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	305.3, 58.447, 0.018	305.3 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	305.3 x 275/1	83.958 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(0)^2+(32.972/83.958)^1=$	0.393

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√76.37x275/10367.14	0.45
$N_{b.y.Rd}$ = Area.c.f_y/ γ_{M1}	76.37x0.906x275/10/1 =	1902.217 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√76.37x275/3498.07	0.775
$N_{b.z.Rd}$ = Area.c.f_y/ γ_{M1}	76.37x0.678x275/10/1 =	1423.219 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√76.37x275/6658.76	0.562
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	76.37x0.808x275/10/1 =	1696.735 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, 7.2, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = 7.21, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = -32.96, ~y = -0.037	0.585
C_{my}=Max(0.6+0.4~y, 0.4)	M = 7.21, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 2068, 47.23, 0.1969, 210000	874.823 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 656.1 x 275 / 874.823	0.454
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.454, 0.587, 0.750, 0.400	0.979
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.979, 0.454, 0.756, 0.907	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 656.1 x 275 ≤ 180.428 =	180.428 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	37.984 / 1902.217	0.020
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	37.984 / 1423.219	0.027
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	0 / 180.428	0.000
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	32.972 / 83.958	0.393
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.603
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.600
k_yz=0.6 k_zz		0.360
k_zy=0.6 k_yy		0.362
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.020+0.603x0.000+0.360x0.393	0.161

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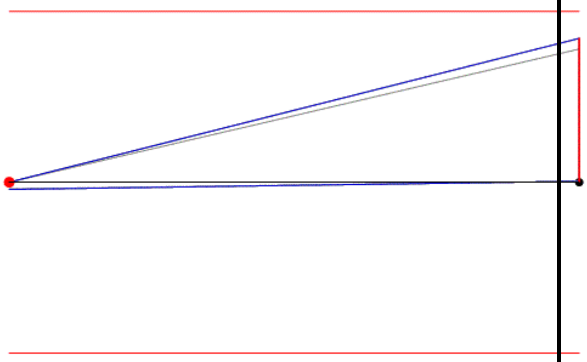
Job ref	: 21187
Sheet	: **Sheet Ref / 49 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

$U_{Nz}+k_{zy}.U_{M.y}+k_{zz}.U_{M.z}$ 0.027+0.362x0.000+0.600x0.393 0.262 OK

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 56 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
79	14	32.59T	-0.05	-41.30	-2.45	0.00	7.55			0.00
	47	35.37T	0.05	-41.30	-2.45	-144.56	-1.03			@ 0.000

Additional Nominal Moments

M_{yUp} -7.427 kN.m

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m) 203x203 UC 60 [S 275]
Class = $Fn(b/T,d/t,f_y,N,M_y,M_z)$ 7.25, 17.11, 275, 0, 151.98, 7.55 (Axial: Non-Slender)

Auto Design Load Cases 1-2

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	41.302 / 351.748 =	0.117
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	2.45 / 927.974 =	0.003
$M_{c.z.Rd} = f_y.W_{pl.z}/\gamma_{M0}$	275 x 305.3/1	83.958 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	76.37x275/1 (No bearing / block tearing design)	2100.175 kN
$n = N_{Ed}/N_{pl.Rd}$	-35.371 / 2100.175 =	0.017
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	656.1, 22.154, 0.017	656.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	656.1 x 275/1	180.428 kN.m
$W_{pl.N.z} = Fn(W_{pl.z}, A_{vz},)$	305.3, 58.447, 0.017	305.3 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\gamma_{M0}$	305.3 x 275/1	83.958 kN.m
$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(151.984/180.428)^2+(1.031/83.958)^1=$	0.722

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -151.9, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -151.94, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 7.54, ~y = -0.136	0.545
C_{my}=Max(0.6+0.4~y, 0.4)	M = -151.98, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	1.750, 3.500, 2068, 47.23, 0.1969, 210000	874.820 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 656.1 x 275 / 874.82	0.454

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Job ref	: 21187
Sheet	: **Sheet Ref / 50 -**
Made By	:
Date	**:08 June 2022**
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c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.454, 0.587, 0.750, 0.400	0.979	Curve b
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.979, 0.454, 0.756, 0.907	1.000	6.3.2.3
$M_{b.Rd}$ = c $W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 656.1 x 275 ≤ 180.428 =	180.428 kN.m	

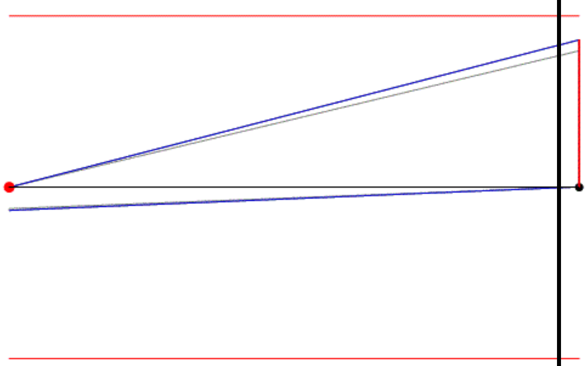
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1902.217	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1423.219	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	151.984 / 180.428	0.842
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	1.031 / 83.958	0.012
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.600
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.545
k_yz=0.6 k_zz		0.327
k_zy=0.6 k_yy		0.360
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.600x0.842+0.327x0.012	0.509
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.360x0.842+0.545x0.012	0.310

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 62 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
85	21	126.51C	-0.06	-44.37	-7.09	0.00	24.37			0.00
	51	123.74C	0.06	-44.37	-7.09	-155.29	-0.43			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 126.51, 155.29, 24.37	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	44.368 / 351.748 =	0.126
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	7.086 / 927.974 =	0.008
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 305.3/1	83.958 kN.m
$N_{pl.Rd} = A_g.f_y/\ \gamma_{M0}$	76.37 x 275/1 =	2100.175 kN
n = $N_{Ed}/N_{pl.Rd}$	126.515 / 2100.175 =	0.060
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	656.1, 22.154, 0.06	656.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	656.1 x 275/1	180.428 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	305.3, 58.447, 0.06	305.3 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	305.3 x 275/1	83.958 kN.m

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$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(155.289/180.428)^2+(0.433/83.958)^1=$	0.746	OK

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
$\lambda y = \sqrt{A.fy/Ncr}$	$\sqrt{76.37x275/10367.14}$	0.45
$N_{b.y.Rd}$ = Area.c.f_y/ γ_{M1}	76.37x0.906x275/10/1 =	1902.217 kN
Lez = Kz.Lz	1x3.5 =	3.5
$\lambda z = \sqrt{A.fy/Ncrz}$	$\sqrt{76.37x275/3498.07}$	0.775
$N_{b.z.Rd}$ = Area.c.f_y/ γ_{M1}	76.37x0.678x275/10/1 =	1423.219 kN
Let = Kt.Lx	1x3.5 =	3.5
$\lambda T = \sqrt{A.fy/NcrT}$	$\sqrt{76.37x275/6658.76}$	0.562
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	76.37x0.808x275/10/1 =	1696.735 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -155.2, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -155.24, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 24.36, ~y = -0.017	0.593
C_{my}=Max(0.6+0.4~y, 0.4)	M = -155.29, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 2068, 47.23, 0.1969, 210000	874.820 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{656.1 \times 275 / 874.82}$	0.454
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.454, 0.587, 0.750, 0.400	0.979
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.979, 0.454, 0.756, 0.907	1.000
$M_{b.Rd}$ = c $W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 656.1 x 275 ≤ 180.428 =	180.428 kN.m

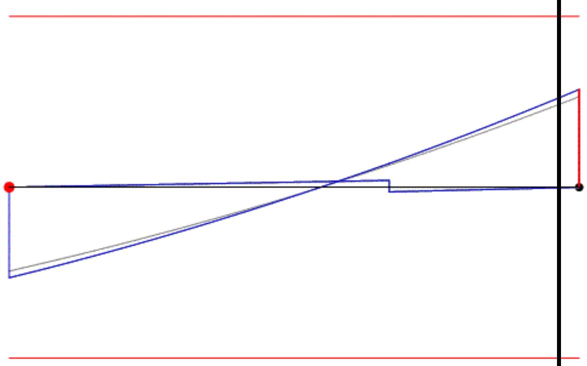
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	126.515 / 1902.217	0.067
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	126.515 / 1423.219	0.089
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	155.289 / 180.428	0.861
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0.433 / 83.958	0.005
$k_y y=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.610
$k_z z=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.643
$k_y z$=0.6 $k_z z$		0.386
$k_z y$=0.6 $k_y y$		0.366
$U_{Ny}+k_y y.U_{M.y}+k_y z.U_{M.z}$	0.067+0.610x0.861+0.386x0.005	0.593
$U_{Nz}+k_z y.U_{M.y}+k_z z.U_{M.z}$	0.089+0.366x0.861+0.643x0.005	0.407

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 35 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	47	29.60T	-0.06	-71.64	-5.29	144.56	-0.05		-10.91	0.00

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Job ref	: 21187
Sheet	: **Sheet Ref / 52 -**
Made By	:
Date	**:08 June 2022**
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	51	23.13T	-0.43	-122.34	-7.09	-156.29	0.06		@ 2.053	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (73.08 kg/m)	254x254 UC 73 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.96, 23.29, 275, 0, 156.29, 11.02	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	122.341 / 406.798 =	0.301
$M_{c.y.Rd}$ = $f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 992.1/1	272.828 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	7.086 / 1148.018 =	0.006
$M_{c.z.Rd}$ = $f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 465.4/1	127.985 kN.m
$N_{pl.Rd}$ = Ag.fy/γ_{M0}	93.1x275/1 (No bearing / block tearing design)	2560.25 kN
n = $N_{Ed}/N_{pl.Rd}$	-29.599 / 2560.25 =	0.012
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	992.1, 25.622, 0.012	992.1 cm^3
$M_{N.y.Rd}$ = $W_{pl.N.y}.f_y/\ \gamma_{M0}$	992.1 x 275/1	272.828 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	465.4, 72.306, 0.012	465.4 cm^3
$M_{N.z.Rd}$ = $W_{pl.N.z}.f_y/\ \gamma_{M0}$	465.4 x 275/1	127.985 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(156.294/272.828)^2+(0.059/127.985)^1=$	0.329

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	144.5, -156.2, 19.9, -0.925, -0.127	2.558
C_{mLT}=Max(0.1(1-~y) -0.8α_s, 0.4)	M_h = -156.17, M_s = 14.03, ~y = -0.925, α_s = -0.090	0.4
C_{mz}=0.90-0.10α_h(1+2~y)	M_h = 0.07, M_s = -8.28, ~y = -0.818, α_s = -0.008	0.899
C_{my}=Max(0.1(1-~y) -0.8α_s, 0.4)	M_h = -156.29, M_s = 14.04, ~y = -0.925, α_s = -0.090	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.11 =	3.11 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	2.558, 3.110, 3915, 57.62, 0.5620, 210000	3026.863 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 992.1 x 275 / 3026.863	0.300
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.300, 0.587, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.300, 0.756, 0.907	1.000
$M_{b.Rd}$ = c $W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 992.1 x 275 ≤ 272.828 =	272.828 kN.m

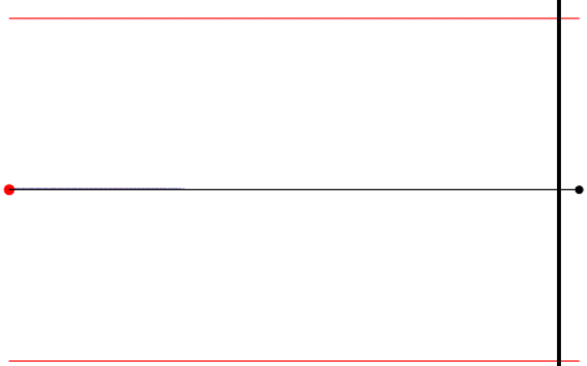
Buckling Resistance

$U_{N.y}$ = $N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 2446.023	0.000
$U_{N.z}$ = $N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 2081.428	0.000
$U_{M.y}$ = $M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	156.294 / 272.828	0.573
$U_{M.z}$ = $M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0.059 / 127.985	0.000
k_yy=C_{my}{1+(λ_y-0.2)$U_{N.y}$}		0.400
k_zz=C_{mz}{1+(2λ_z-0.6)$U_{N.z}$}		0.899
k_yz=0.6 k_zz		0.540
k_zy=0.6 k_yy		0.240
U_{Ny}+k_yy.$U_{M.y}$+k_yz.$U_{M.z}$	0.000+0.400x0.573+0.540x0.000	0.229
U_{Nz}+k_zy.$U_{M.y}$+k_zz.$U_{M.z}$	0.000+0.240x0.573+0.899x0.000	0.138

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 37 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m^3)



Member Forces in Load Case 2

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Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
53	51	67.50T	0.00	1.39	0.00	-1.00	0.00		0.00	0.00
	53	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (73.08 kg/m)	254x254 UC 73 [S 275]	
Class = $Fn(b/T,d/t,f_y,N,M_y,M_z)$	8.96, 23.29, 275, 0, 1.01, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	1.395 / 406.798 =	0.003
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 992.1/1	272.828 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	93.1x275/1 (No bearing / block tearing design)	2560.25 kN
$n = N_{Ed}/N_{pl.Rd}$	-67.5 / 2560.25 =	0.026
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	992.1, 25.622, 0.026	992.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	992.1 x 275/1	272.828 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(1.005/272.828)^2+(0)^1=$	0

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

$C_1= fn(M_1, M_2, M_o, \sim y,\sim m)$	-1.0, 0.0, 0.3, 0.000, -0.251	2.546
$C_{mLT}=Max(0.2+0.8\alpha_s, 0.4)$	$M_h = -1, M_s = -0.25, \sim y = 0.000, \alpha_s = 0.249$	0.4
$C_{mz}=Max(0.6+0.4\sim y, 0.4)$	$M = 0, \sim y = 1.000$	1
$C_{my}=Max(0.2+0.8\alpha_s, 0.4)$	$M_h = -1.01, M_s = -0.25, \sim y = 0.000, \alpha_s = 0.249$	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 1.441 =	1.441 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	2.546, 1.441, 3915, 57.62, 0.5620, 210000	12405.270 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 992.1 x 275 / 12405.27	0.148
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.148, 0.587, 0.750, 0.400	1.000
$c_{LT}.mod = Fn(c_{LT},\lambda_{LT},k_c,f)$	1.000, 0.148, 0.756, 0.907	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 992.1 x 275 ≤ 272.828 =	272.828 kN.m

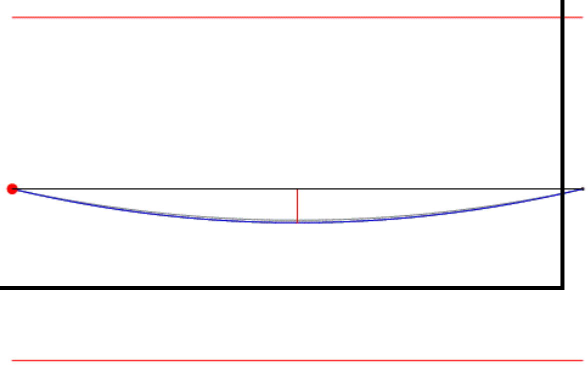
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 2560.25	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 2487.16	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	1.005 / 272.828	0.004
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 127.985	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.400
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
$k_yz=0.6\ k_zz$		0.600
$k_zy=0.6\ k_yy$		0.240
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.400x0.004+0.600x0.000	0.001
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.240x0.004+1.000x0.000	0.001

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 20 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)



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Sheet	: **Sheet Ref / 54 -**
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D1 UDLY -006.000 (kN/m)

Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
26	6	0.00C	0.00	33.32	0.00	0.00	0.00	35.49		0.00
	35	0.00C	0.00	-33.32	0.00	0.00	0.00	@ 2.130		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 0, 35.48, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$	0.003 / 351.748 =	0
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$M_{y.Ed}/M_{c.y.Rd}$	35.484 / 180.428 =	0.197

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 35.5, 0.939, 300.000	1.127

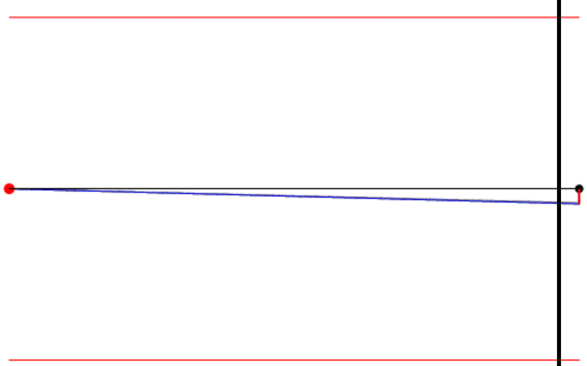
Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 4.26 =	4.26 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 4.260, 2068, 47.23, 0.1969, 210000	426.443 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{656.1 \times 275 / 426.443}$	0.650
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.650, 0.701, 0.750, 0.400	0.894
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.894, 0.650, 0.942, 0.972	0.919
$M_{b.Rd} = c\, W_{pl.y}.f_y \le M_{c.y.Rd}$	0.919 x 656.1 x 275 ≤ 180.428 =	165.856 kN.m
$M_{y.Ed}/M_{b.Rd}$	35.484 / 165.856	0.214

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 51 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	

74	5	34.71C	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	6	33.32C	0.00	0.00	0.00	0.00	0.00	@ 0.000		@ 0.000

Additional Nominal Moments

M_{yUp}	5.958 kN.m	

Classification and Effective Area (EN 1993: 2006)

Section (30.03 kg/m)	152x152 UC 30 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.13, 19.02, 275, 34.71, 5.96, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0 / 183.454 =	0
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 247.7/1	68.118 kN.m
$N_{pl.Rd} = A_g.f_y/\gamma_{M0}$	38.26 x 275/1 =	1052.15 kN
$n = N_{Ed}/N_{pl.Rd}$	34.714 / 1052.15 =	0.033
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	247.7, 11.555, 0.033	247.7 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	247.7 x 275/1	68.118 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(5.958/68.118)^2+(0)^1$=	0.008

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√38.26x275/2959.02	0.596
$N_{b.y.Rd}$ = Area.c.f_y/γ_{M1}	38.26x0.839x275/10/1 =	882.615 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√38.26x275/949.85	1.053
$N_{b.z.Rd}$ = Area.c.f_y/γ_{M1}	38.26x0.51x275/10/1 =	536.619 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√38.26x275/2269.13	0.681
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	38.26x0.736x275/10/1 =	774.857 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, 6.0, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = 5.96, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.6+0.4~y, 0.4)	M = 5.96, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

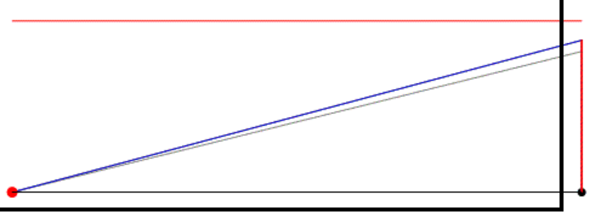
Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 561.4, 10.52, 0.03075, 210000	199.575 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 247.7 x 275 / 199.575	0.584
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.584, 0.659, 0.750, 0.400	0.924
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.924, 0.584, 0.756, 0.889	1.000
$M_{b.Rd}$ = c $W_{pl.y}$.f_y ≤ $M_{c.y.Rd}$	1.000 x 247.7 x 275 ≤ 68.118 =	68.118 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	34.714 / 882.615	0.039
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	34.714 / 536.619	0.065
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	5.958 / 68.118	0.087
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 30.69	0.000
$k_y y=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.609
$k_z z=C_{mz}\{1+1.4U_{N.z}\}$		1.091
$k_y z$=0.6 $k_z z$		0.654
$k_z y$=0.6 $k_y y$		0.366
$U_{Ny}+k_y y.U_{M.y}+k_y z.U_{M.z}$	0.039+0.609x0.087+0.654x0.000	0.093
$U_{Nz}+k_z y.U_{M.y}+k_z z.U_{M.z}$	0.065+0.366x0.087+1.091x0.000	0.097

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 57 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1



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D1 D 077.010 (kN/m³)

Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
80	15	17.19T	0.00	-32.78	0.00	0.00	0.00			0.00
	35	18.58T	0.00	-32.78	0.00	-114.74	0.00			@ 0.000

Additional Nominal Moments

M_{yUp}	-6.718 kN.m	

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 121.46, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	32.784 / 269.498 =	0.122
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	-18.582 / 1615.075 =	0.012
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	497.4, 16.974, 0.012	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$(M_{y.Ed}/M_{N.y.Rd}+(M\_(z.Ed}/M_{N.z.Rd})$	$(121.461/136.785)^2+(0)^1=$	0.788

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -121.4, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -121.43, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.6+0.4~y, 0.4)	M = -121.46, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

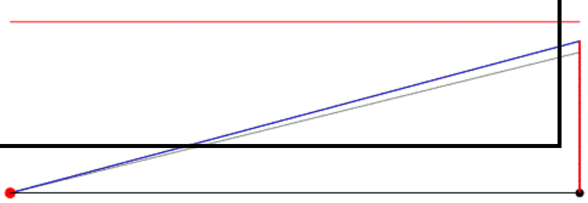
Le = 1.00 L	1 x 3.5 =	3.5 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	1.750, 3.500, 1551, 22.15, 0.1429, 210000	581.388 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 581.388	0.485
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.485, 0.603, 0.750, 0.400	0.966
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.966, 0.485, 0.756, 0.902	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1458.001	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1085.303	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	121.461 / 136.785	0.888
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 63.498	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.600
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.360
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.600x0.888+0.600x0.000	0.533
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.360x0.888+1.000x0.000	0.320

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 63 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1



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D1 D   077.010   (kN/m³)

Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
86	22	103.09 C	0.00	-34.72	0.00	0.00	0.00			0.00
	37	101.70 C	0.00	-34.72	0.00	-121.51	0.00			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn($b/T, d/t, f_y, N, M_y, M_z$)	9.25, 22.33, 275, 103.09, 121.51, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	34.716 / 269.498 =	0.129
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$N_{pl.Rd} = A_g.f_y/\gamma_{M0}$	58.73 x 275/1 =	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	103.092 / 1615.075 =	0.064
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy})$	497.4, 16.974, 0.064	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(121.507/136.785)^2+(0)^1$=	0.789

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√58.73x275/7733.31	0.457
$N_{b.y.Rd}$ = Area.c.f_y/γ_{M1}	58.73x0.903x275/10/1 =	1458.001 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√58.73x275/2624.36	0.784
$N_{b.z.Rd}$ = Area.c.f_y/γ_{M1}	58.73x0.672x275/10/1 =	1085.303 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√58.73x275/4037.02	0.633
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	58.73x0.766x275/10/1 =	1237.072 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -121.5, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -121.47, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.6+0.4~y, 0.4)	M = -121.51, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
$M_{cr} = Fn(C_1, L_e, I_z, I_t, I_w, E)$	1.750, 3.500, 1551, 22.15, 0.1429, 210000	581.388 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 581.388	0.485
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.485, 0.603, 0.750, 0.400	0.966
$c_{LT}.mod = Fn(c_{LT}, \lambda_{LT}, k_c, f)$	0.966, 0.485, 0.756, 0.902	1.000
$M_{b.Rd} = c\, W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	103.092 / 1458.001	0.071
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	103.092 / 1085.303	0.095
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	121.507 / 136.785	0.888
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 63.498	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.611
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.092
$k_yz=0.6\, k_zz$		0.655
$k_zy=0.6\, k_yy$		0.367
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.071+0.611x0.888+0.655x0.000	0.613
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.095+0.367x0.888+1.092x0.000	0.421

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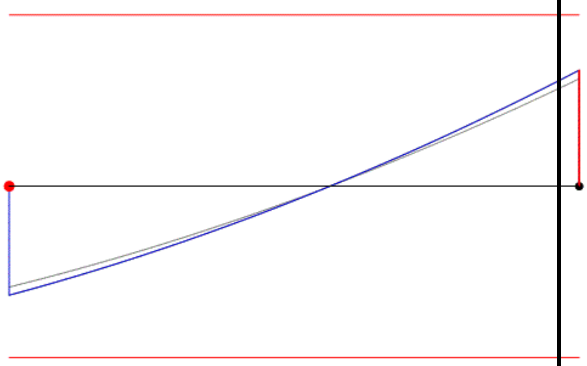
AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 28 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1



D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)

Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
38	35	32.78T	0.00	-51.90	0.00	114.74	0.00			0.00
	37	32.78T	0.00	-100.56	0.00	-122.33	0.00			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 0, 122.33, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	100.556 / 351.748 =	0.286
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	76.37x275/1 (No bearing / block tearing design)	2100.175 kN
$n = N_{Ed}/N_{pl.Rd}$	-32.784 / 2100.175 =	0.016
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	656.1, 22.154, 0.016	656.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	656.1 x 275/1	180.428 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(122.331/180.428)^2+(0)^1=$	0.46

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	114.7, -122.2, 18.9, -0.938, -0.155	2.475
C_{mLT}=Max(0.1(1-~y) -0.8α_s, 0.4)	M_h = -122.23, M_s = 15.12, ~y = -0.938, α_s = -0.124	0.4
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.1(1-~y) -0.8α_s, 0.4)	M_h = -122.33, M_s = 15.12, ~y = -0.938, α_s = -0.124	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.11 =	3.11 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	2.475, 3.110, 2068, 47.23, 0.1969, 210000	1476.379 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 656.1 x 275 / 1476.379	0.350
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.350, 0.603, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.350, 0.756, 0.902	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 656.1 x 275 ≤ 180.428 =	180.428 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1945.07	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1536.364	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	122.331 / 180.428	0.678

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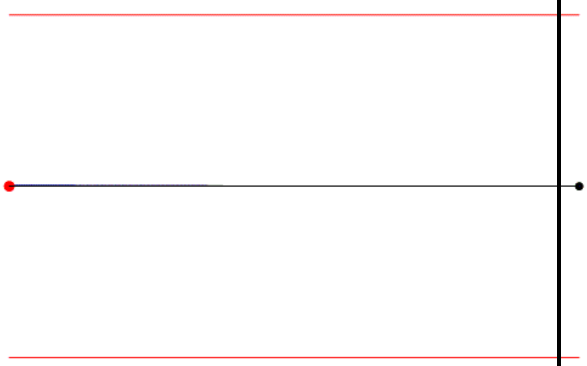
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 83.958	0.000	OK
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.400	
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000	
$k_yz=0.6\ k_zz$		0.600	
$k_zy=0.6\ k_yy$		0.240	
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.400x0.678+0.600x0.000	0.271	OK
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.240x0.678+1.000x0.000	0.163	OK

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 31 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m^3)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
41	37	67.50T	0.00	1.14	0.00	-0.82	0.00			0.00
	54	67.50T	0.00	0.00	0.00	0.00	0.00			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 0, 0.82, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	1.144 / 351.748 =	0.003
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	76.37x275/1 (No bearing / block tearing design)	2100.175 kN
$n = N_{Ed}/N_{pl.Rd}$	-67.5 / 2100.175 =	0.032
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy,})$	656.1, 22.154, 0.032	656.1 cm^3
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	656.1 x 275/1	180.428 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(0.824/180.428)^2+(0)^1=$	0

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	-0.8, 0.0, 0.2, 0.000, -0.251	2.546
C_{mLT}=Max(0.2+0.8α_s, 0.4)	M_h = -0.82, M_s = -0.21, ~y = 0.000, α_s = 0.249	0.4
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.2+0.8α_s, 0.4)	M_h = -0.82, M_s = -0.21, ~y = 0.000, α_s = 0.249	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 1.441 =	1.441 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	2.546, 1.441, 2068, 47.23, 0.1969, 210000	5602.437 kN.m
$\lambda_{LT} = \sqrt{}\ W.f_y/M_{cr}$	$\sqrt{}$ 656.1 x 275 / 5602.437	0.179
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.179, 0.603, 0.750, 0.400	1.000

c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.179, 0.756, 0.902	1.000	6.3.2.3
$M_{b.Rd}$ = c $W_{pl.y}$.f_y ≤ $M_{c.y.Rd}$	1.000 x 656.1 x 275 ≤ 180.428 =	180.428 kN.m	

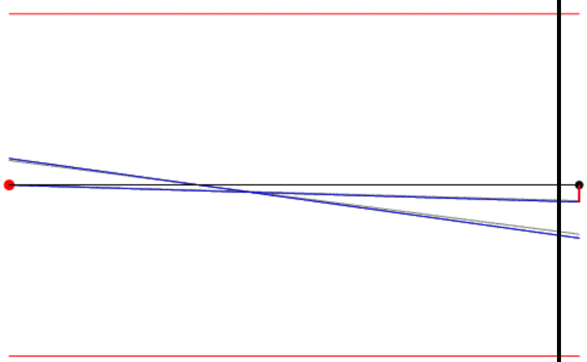
Buckling Resistance

$U_{N.y}$ = N_{Ed}/(c_y.N_{Rk}/γ_{M1})	0 / 2100.175	0.000
$U_{N.z}$ = N_{Ed}/(c_z.N_{Rk}/γ_{M1})	0 / 1972.752	0.000
$U_{M.y}$ = $M_{y.Ed}$/(c_{LT}.$M_{y.Rk}$/γ_{M1})	0.824 / 180.428	0.005
$U_{M.z}$ = $M_{z.Ed}$/($M_{z.Rk}$/γ_{M1})	0 / 83.958	0.000
k_yy=C_{my}{1+(λ_y-0.2)$U_{N.y}$}		0.400
k_zz=C_{mz}{1+(2λ_z-0.6)$U_{N.z}$}		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.240
U_{Ny}+k_yy.$U_{M.y}$+k_yz.$U_{M.z}$	0.000+0.400x0.005+0.600x0.000	0.002
U_{Nz}+k_zy.$U_{M.y}$+k_zz.$U_{M.z}$	0.000+0.240x0.005+1.000x0.000	0.001

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 52 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
75	7	68.78C	0.00	0.00	18.19	0.00	-21.18	0.00		0.00
	8	67.38C	0.00	0.00	18.19	0.00	42.49	@ 0.000		@ 0.000

Additional Nominal Moments

M_{yUp}	13.584 kN.m

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 68.78, 13.58, 42.49	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}$/$V_{pl.y.Rd}$	0 / 269.498 =	0
$M_{c.y.Rd}$ = f_y.$W_{pl.y}$/ γ_{M0}	275 x 497.4/1	136.785 kN.m
$V_{z.Ed}$/$V_{pl.z.Rd}$	18.192 / 711.169 =	0.026
$M_{c.z.Rd}$ = f_y.$W_{pl.z}$/ γ_{M0}	275 x 230.9/1	63.498 kN.m
$N_{pl.Rd}$ = A_g.f_y/ γ_{M0}	58.73 x 275/1 =	1615.075 kN
n = N_{Ed}/$N_{pl.Rd}$	68.775 / 1615.075 =	0.043
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	497.4, 16.974, 0.043	497.4 cm³
$M_{N.y.Rd}$ = $W_{pl.N.y}$.f_y/ γ_{M0}	497.4 x 275/1	136.785 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	230.9, 44.792, 0.043	230.9 cm³

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$M_{N.z.Rd}$ = $W_{pl.N.z}.f_y/\gamma_{M0}$	230.9 x 275/1	63.498 kN.m	
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(13.584/136.785)^2+(42.49/63.498)^1$=	0.679	OK

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√58.73x275/7733.31	0.457
$N_{b.y.Rd}$ = Area.c.f_y/γ_{M1}	58.73x0.903x275/10/1 =	1458.001 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√58.73x275/2624.36	0.784
$N_{b.z.Rd}$ = Area.c.f_y/γ_{M1}	58.73x0.672x275/10/1 =	1085.303 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√58.73x275/4037.02	0.633
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	58.73x0.766x275/10/1 =	1237.072 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, 13.6, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = 13.58, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 42.47, ~y = -0.498	0.401
C_{my}=Max(0.6+0.4~y, 0.4)	M = 13.58, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 1551, 22.15, 0.1429, 210000	581.383 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 497.4 x 275 / 581.383	0.485
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.485, 0.603, 0.750, 0.400	0.966
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.966, 0.485, 0.756, 0.902	1.000
$M_{b.Rd}$ = c $W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

Buckling Resistance

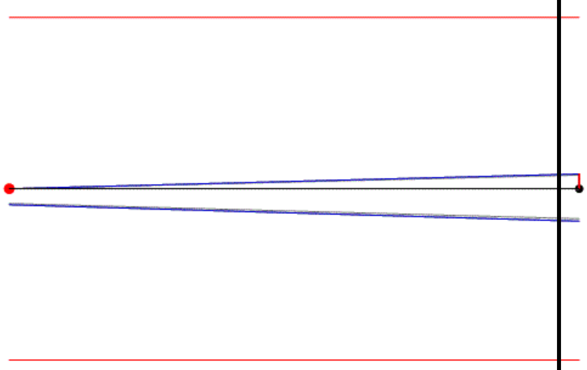
$U_{N.y}$ = $N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	68.775 / 1458.001	0.047
$U_{N.z}$ = $N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	68.775 / 1085.303	0.063
$U_{M.y}$ = $M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	13.584 / 136.785	0.099
$U_{M.z}$ = $M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	42.49 / 63.498	0.669
k_yy=C_{my}{1+(λ_y-0.2)$U_{N.y}$}		0.607
k_zz=C_{mz}{1+(2λ_z-0.6)$U_{N.z}$}		0.425
k_yz=0.6 k_zz		0.255
k_zy=0.6 k_yy		0.364
U_{Ny}+k_yy.$U_{M.y}$+k_yz.$U_{M.z}$	0.047+0.607x0.099+0.255x0.669	0.278
U_{Nz}+k_zy.$U_{M.y}$+k_zz.$U_{M.z}$	0.063+0.364x0.099+0.425x0.669	0.384

AXIAL WITH MOMENTS (MEMBER)

Member SCL1Id 58 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
81	16	60.63C	0.03	-0.6	1.87	0.00	6.35			0.00

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				6						
	34	59. 24C	- 0.0 3	- 0.6 6	1.8 7	- 2.3 2	12. 89			@ 0.0 00

Additional Nominal Moments

M_{yUp}	-3.556 kN.m	

Classification and Effective Area (EN 1993: 2006)

Section (30.03 kg/m)	152x152 UC 30 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.13, 19.02, 275, 60.63, 5.88, 12.89	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0.663 / 183.454 =	0.004
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 247.7/1	68.118 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	1.868 / 456.391 =	0.004
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 111.6/1	30.69 kN.m
$N_{pl.Rd} = A_g.f_y/\ \gamma_{M0}$	38.26 x 275/1 =	1052.15 kN
$n = N_{Ed}/N_{pl.Rd}$	60.631 / 1052.15 =	0.058
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	247.7, 11.555, 0.058	247.7 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	247.7 x 275/1	68.118 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	111.6, 28.745, 0.058	111.6 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	111.6 x 275/1	30.69 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(5.877/68.118)^2+(12.89/30.69)^1=$	0.427

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√38.26x275/2959.02	0.596
$N_{b.y.Rd}$ = Area.c.f_y/ γ_{M1}	38.26x0.839x275/10/1 =	882.615 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√38.26x275/949.85	1.053
$N_{b.z.Rd}$ = Area.c.f_y/ γ_{M1}	38.26x0.51x275/10/1 =	536.619 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√38.26x275/2269.13	0.681
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	38.26x0.736x275/10/1 =	774.857 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -5.9, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -5.88, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 12.89, ~y = 0.493	0.797
C_{my}=Max(0.6+0.4~y, 0.4)	M = -5.88, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 561.4, 10.52, 0.03075, 210000	199.595 kN.m
$\lambda_{LT} = \sqrt{}\ W.f_y/M_{cr}$	√ 247.7 x 275 / 199.595	0.584
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.584, 0.659, 0.750, 0.400	0.924
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.924, 0.584, 0.756, 0.889	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 247.7 x 275 ≤ 68.118 =	68.118 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	60.631 / 882.615	0.069
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	60.631 / 536.619	0.113
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	5.877 / 68.118	0.086
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	12.89 / 30.69	0.420
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.616
$k_zz=C_{mz}\{1+1.4U_{N.z}\}$		0.923
k_yz=0.6 k_zz		0.554
k_zy=0.6 k_yy		0.370
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.069+0.616x0.086+0.554x0.420	0.355
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.113+0.370x0.086+0.923x0.420	0.533

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 64 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

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D1 D 077.010 (kN/m³)

Member Forces in Load Case 2											
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
87	23	30.68C	0.03	-3.03	-0.02	0.00	0.24			0.00
	36	29.29C	-0.03	-3.03	-0.02	-10.62	0.16			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (30.03 kg/m)	152x152 UC 30 [S 275]	
Class = Fn($b/T, d/t, f_y, N, M_y, M_z$)	8.13, 19.02, 275, 30.68, 10.62, 0.24	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	3.035 / 183.454 =	0.017
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 247.7/1	68.118 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	0.022 / 456.391 =	0
$M_{c.z.Rd} = f_y.W_{pl.z}/\gamma_{M0}$	275 x 111.6/1	30.69 kN.m
$N_{pl.Rd} = A_g.f_y/\gamma_{M0}$	38.26 x 275/1 =	1052.15 kN
$n = N_{Ed}/N_{pl.Rd}$	30.679 / 1052.15 =	0.029
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	247.7, 11.555, 0.029	247.7 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	247.7 x 275/1	68.118 kN.m
$W_{pl.N.z} = Fn(W_{pl.z}, A_{vz},)$	111.6, 28.745, 0.029	111.6 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\gamma_{M0}$	111.6 x 275/1	30.69 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(10.622/68.118)^2+(0.161/30.69)^1=$	0.03

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
$\lambda y = \sqrt{A.fy/Ncr}$	$\sqrt{38.26x275/2959.02}$	0.596
$N_{b.y.Rd}$ = Area.c.f_y/γ_{M1}	38.26x0.839x275/10/1 =	882.615 kN
Lez = Kz.Lz	1x3.5 =	3.5
$\lambda z = \sqrt{A.fy/Ncrz}$	$\sqrt{38.26x275/949.85}$	1.053
$N_{b.z.Rd}$ = Area.c.f_y/γ_{M1}	38.26x0.51x275/10/1 =	536.619 kN
Let = Kt.Lx	1x3.5 =	3.5
$\lambda T = \sqrt{A.fy/NcrT}$	$\sqrt{38.26x275/2269.13}$	0.681
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	38.26x0.736x275/10/1 =	774.857 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -10.6, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -10.62, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0.24, ~y = 0.682	0.873
C_{my}=Max(0.6+0.4~y, 0.4)	M = -10.62, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
$M_{cr} = Fn(C_1, L_e, I_z, I_t, I_w, E)$	1.750, 3.500, 561.4, 10.52, 0.03075, 210000	199.581 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{247.7 \times 275 / 199.581}$	0.584
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.584, 0.659, 0.750, 0.400	0.924
c_{LT}.mod = Fn($c_{LT}, \lambda_{LT}, k_c, f$)	0.924, 0.584, 0.756, 0.889	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 247.7 x 275 ≤ 68.118 =	68.118 kN.m

Buckling Resistance

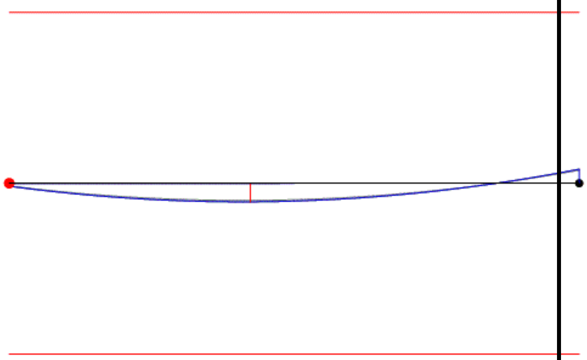
$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	30.679 / 882.615	0.035
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	30.679 / 536.619	0.057
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	10.622 / 68.118	0.156
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0.161 / 30.69	0.005
$k_y y = C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.608
$k_z z = C_{mz}\{1+1.4U_{N.z}\}$		0.943
$k_y z = 0.6\ k_z z$		0.566
$k_z y = 0.6\ k_y y$		0.365

$U_{Ny}+k_{y}y.U_{M.y}+k_{y}z.U_{M.z}$	0.035+0.608x0.156+0.566x0.005	0.133	OK
$U_{Nz}+k_{z}y.U_{M.y}+k_{z}z.U_{M.z}$	0.057+0.365x0.156+0.943x0.005	0.119	OK

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 27 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
37	34	64.47T	-0.16	19.68	-0.02	2.32	0.03	14.84		0.00
	36	64.47T	0.16	-28.41	-0.02	-11.26	-0.03	@ 1.275		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 14.84, 0.03	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0.669 / 269.498 =	0.002
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	0.022 / 711.169 =	0
$M_{c.z.Rd} = f_y.W_{pl.z}/\gamma_{M0}$	275 x 230.9/1	63.498 kN.m
$N_{pl.Rd}$ = Ag.fy/γ_{M0}	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
n = $N_{Ed}/N_{pl.Rd}$	-64.465 / 1615.075 =	0.040
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	497.4, 16.974, 0.04	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	230.9, 44.792, 0.04	230.9 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\gamma_{M0}$	230.9 x 275/1	63.498 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(14.822/136.785)^2+(0.005/63.498)^1=$	0.012

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	2.3, -11.2, 18.7, -0.208, -1.662	1.177
$C_{mLT}=0.95+0.05\alpha_h(1+2\sim y)$	M_h = -11.23, M_s = 14.22, ~y = -0.208, α_s = -0.790	0.927
C_{mz}=Max(0.6+0.4~y, 0.4)	M = -0.03, ~y = -0.971	0.4
$C_{my}=0.95+0.05\alpha_h(1+2\sim y)$	M_h = -11.26, M_s = 14.22, ~y = -0.206, α_s = -0.792	0.927

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.11 =	3.11 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.177, 3.110, 1551, 22.15, 0.1429, 210000	472.443 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 472.443	0.538
χ_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.538, 0.632, 0.750, 0.400	0.944
χ_{LT}.mod = Fn(χ_{LT},λ_{LT},k_c,f)	0.944, 0.538, 0.922, 0.966	0.977

$M_{b.Rd}$ = c $W_{pl.y}.f_y \leq M_{c.y.Rd}$ 0.977 x 497.4 x 275 ≤ 136.785 = 133.659 kN.m

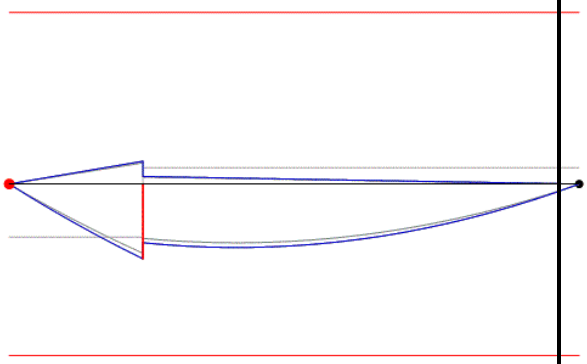
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1491.718	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1173.471	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	14.822 / 133.659	0.111
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0.005 / 63.498	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.927
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.400
$k_yz=0.6\ k_zz$		0.240
$k_zy= 1- \{0.1/(C_{mLT}-0.25)\}U_{N.z}$		1.000
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.927x0.111+0.240x0.000	0.103
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+1.000x0.111+0.400x0.000	0.111

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 21 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)



Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN) y-y	Shear Force (kN) z-z	Bending Moment (kNm) y-y	Bending Moment (kNm) z-z	Maximum Moment (kNm @ m) y-y	Maximum Moment (kNm @ m) z-z	Max Def (mm @ m)
	8	0.00C	42.49	67.38	-18.19	0.00	0.00	59.13	-18.01	0.00
	34	63.80T	13.05	-39.56	1.85	0.00	0.00	@ 0.990	@ 0.990	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 59.65, 18.19	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	51.925 / 269.498 =	0.193
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	18.192 / 711.169 =	0.026
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 230.9/1	63.498 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	-63.802 / 1615.075 =	0.040
$W_{pl.N.y} = Fn(W_{pl.y},\ A_{vy},)$	497.4, 16.974, 0.04	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$W_{pl.N.z} = Fn(W_{pl.z},\ A_{vz},)$	230.9, 44.792, 0.04	230.9 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	230.9 x 275/1	63.498 kN.m
$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(59.653/136.785)^2+(18.192/63.498)^1=$	0.477

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.1, 0.0, 49.1, 0.600, 300.000	1.127	Uniform
C_{mLT}=0.95+0.05α_h	M_h = 0.07, M_s = 49.2, ~y = 0.600, α_s = 0.001	0.95	Table B.3
C_{mz}=0.95+0.05α_h	M_h = -0.02, M_s = -3.93, ~y = 0.056, α_s = 0.005	0.95	Table B.3
C_{my}=0.95+0.05α_h	M_h = 0, M_s = 49.2, ~y = 1.000, α_s = 0.000	0.95	Table B.3

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 4.26 =	4.26 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 4.260, 1551, 22.15, 0.1429, 210000	277.455 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 497.4 x 275 / 277.455	0.702
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.702, 0.736, 0.750, 0.400	0.869
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.869, 0.702, 0.942, 0.972	0.894
$M_{b.Rd}$ = c $W_{pl.y}$.f_y ≤ $M_{c.y.Rd}$	0.894 x 497.4 x 275 ≤ 136.785 =	122.287 kN.m

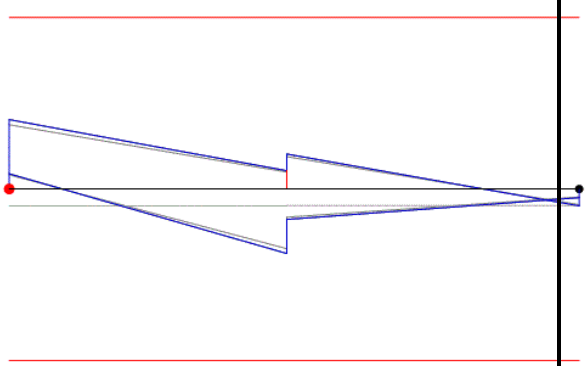
Buckling Resistance

$U_{N.y}$ = N_{Ed}/(c_y.N_{Rk}/γ_{M1})	0 / 1386.335	0.000
$U_{N.z}$ = N_{Ed}/(c_z.N_{Rk}/γ_{M1})	0 / 915.194	0.000
$U_{M.y}$ = $M_{y.Ed}$/(c_{LT}.$M_{y.Rk}$/γ_{M1})	59.653 / 122.287	0.488
$U_{M.z}$ = $M_{z.Ed}$/($M_{z.Rk}$/γ_{M1})	18.192 / 63.498	0.286
k_yy=C_{my}{1+(λ_y-0.2)$U_{N.y}$}		0.950
k_zz=C_{mz}{1+(2λ_z-0.6)$U_{N.z}$}		0.950
k_yz=0.6 k_zz		0.570
k_zy= 1- {0.1/(C_{mLT}-0.25)}$U_{N.z}$		1.000
U_{Ny}+k_yy.$U_{M.y}$+k_yz.$U_{M.z}$	0.000+0.950x0.488+0.570x0.286	0.627
U_{Nz}+k_zy.$U_{M.y}$+k_zz.$U_{M.z}$	0.000+1.000x0.488+0.950x0.286	0.760

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 3 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	9	20.69C	13.40	41.09	63.59	-55.39	-12.17		50.79	0.00
	33	5.16C	-13.14	38.95	-16.52	13.45	6.88		@ 0.990	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 20.69, 55.4, 51.42	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}$/$V_{pl.y.Rd}$	40.477 / 269.498 =	0.15
$M_{c.y.Rd}$ = f_y.$W_{pl.y}$/ γ_{M0}	275 x 497.4/1	136.785 kN.m

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Job ref	: 21187
Sheet	: **Sheet Ref / 67 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

$V_{z.Ed}/V_{pl.z.Rd}$	63.594 / 711.169 =	0.089	Low Shear
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 230.9/1	63.498 kN.m	
$N_{pl.Rd} = A_g.f_y/\ \gamma_{M0}$	58.73 x 275/1 =	1615.075 kN	
$n = N_{Ed}/N_{pl.Rd}$	20.688 / 1615.075 =	0.013	OK
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	497.4, 16.974, 0.013	497.4 cm^3	
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	497.4 x 275/1	136.785 kN.m	
$W_{pl.N.z} = Fn(W_{pl.z}, A_{vz},)$	230.9, 44.792, 0.013	230.9 cm^3	
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	230.9 x 275/1	63.498 kN.m	
$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(14.619/136.785)^2+(51.423/63.498)^1=$	0.821	OK

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x2.054 =	2.054
$\lambda y = \sqrt{A.fy/Ncr}$	$\sqrt{58.73x275/22465.15}$	0.268
$N_{b.y.Rd}$ = Area.c.$f_y/\ \gamma_{M1}$	58.73x0.976x275/10/1 =	1575.787 kN
Lez = Kz.Lz	1x2.054 =	2.054
$\lambda z = \sqrt{A.fy/Ncrz}$	$\sqrt{58.73x275/7623.71}$	0.46
$N_{b.z.Rd}$ = Area.c.$f_y/\ \gamma_{M1}$	58.73x0.865x275/10/1 =	1397.018 kN
Let = Kt.Lx	1x2.054 =	2.054
$\lambda T = \sqrt{A.fy/NcrT}$	$\sqrt{58.73x275/8456.57}$	0.437
$N_{b.T.Rd}$= Area.c.$f_y/\ \gamma_{M1}$	58.73x0.878x275/10/1 =	1417.326 kN

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	-55.4, 13.4, -5.9, -0.242, 0.106	1.818
C_{mLT}=Max(0.2+0.8α_s, 0.4)	M_h = -55.35, M_s = -26.86, ~y = -0.242, α_s = 0.485	0.588
C_{mz}=0.95+0.05α_h(1+2~y)	M_h = -12.11, M_s = 23.84, ~y = -0.569, α_s = -0.508	0.954
C_{my}=Max(0.2+0.8α_s, 0.4)	M_h = -55.4, M_s = -26.85, ~y = -0.243, α_s = 0.485	0.588

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 2.054 =	2.054 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.818, 2.054, 1551, 22.15, 0.1429, 210000	1490.365 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{}$ 497.4 x 275 / 1490.365	0.303
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.303, 0.736, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.303, 0.942, 0.972	1.000
$M_{b.Rd}$ = c $W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

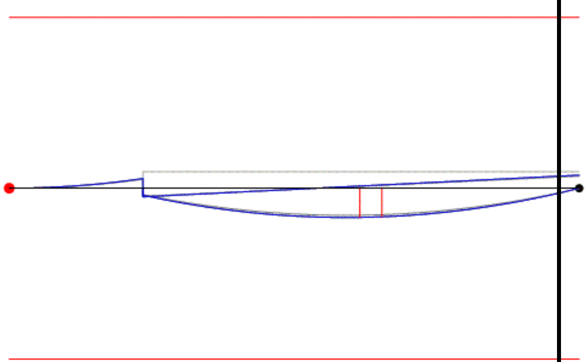
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	20.688 / 1575.787	0.013
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	20.688 / 1397.018	0.015
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	14.619 / 136.785	0.107
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	51.423 / 63.498	0.810
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.588
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.958
k_yz=0.6 k_zz		0.575
k_zy=0.6 k_yy		0.353
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.013+0.588x0.107+0.575x0.810	0.542
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.015+0.353x0.107+0.958x0.810	0.828

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 26 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)



Member Forces in Load Case 2

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Job ref : 21187
Sheet : **Sheet Ref / 68 -**
Made By :
Date **:08 June 2022**
Checked :
Approved :

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	32	0.00C	0.00	0.00	0.00	0.00	0.00	23.41	6.88	0.00
	43	16.47T	13.32	-26.90	-5.33	0.00	-10.49	@ 2.532	@ 1.000	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 23.4, 10.49	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	26.904 / 269.498 =	0.1
$V_{z.Ed}/V_{pl.z.Rd}$	5.326 / 711.169 =	0.007
$M_{c.z.Rd} = f_y.W_{pl.z}/\gamma_{M0}$	275 x 230.9/1	63.498 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	-16.468 / 1615.075 =	0.010
$W_{pl.N.z} = Fn(W_{pl.z}, A_{vz})$	230.9, 44.792, 0.01	230.9 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\gamma_{M0}$	230.9 x 275/1	63.498 kN.m
$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(0)^2+(10.488/63.498)^1=$	0.165

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 22.2, 0.000, 300.000	1.127
C_{mLT}=0.95+0.05α_h	M_h = 0.03, M_s = 22.23, ~y = 0.000, α_s = 0.001	0.95
C_{mz}=Max(0.1-0.8α_s, 0.4)	M_h = -10.48, M_s = 0.86, ~y = 0.000, α_s = -0.082	0.4
C_{my}=0.95+0.05α_h	M_h = 0, M_s = 22.23, ~y = 1.000, α_s = 0.000	0.95

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 4.26 =	4.26 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 4.260, 1551, 22.15, 0.1429, 210000	277.455 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 277.455	0.702
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.702, 0.736, 0.750, 0.400	0.869
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.869, 0.702, 0.942, 0.972	0.894
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	0.894 x 497.4 x 275 ≤ 136.785 =	122.287 kN.m

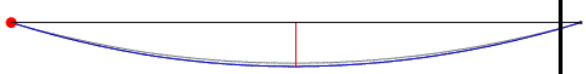
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1386.335	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 915.194	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	23.325 / 122.287	0.191
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	1.761 / 63.498	0.028
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.950
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.400
k_yz=0.6 k_zz		0.240
k_zy= 1- {0.1/(C_{mLT}-0.25)}$U_{N.z}$		1.000
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.950x0.191+0.240x0.028	0.188
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+1.000x0.191+0.400x0.028	0.202

AXIAL WITH MOMENTS (MEMBER)
Member SBL2Id 41 @ Level 2 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)



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D1 UDLY -006.000 (kN/m)

Member Forces in Load Case 2											
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	66	0.00C	-0.02	33.54	0.00	0.00	0.00	35.23		0.00
	81	0.00C	0.02	-33.01	0.00	0.00	0.00	@ 2.101		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 35.23, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$	0.238 / 269.498 =	0.001
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$M_{y.Ed}/M_{c.y.Rd}$	35.227 / 136.785 =	0.258

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 35.2, 0.969, 300.000	1.127

Lateral Buckling Check M.b.Rd

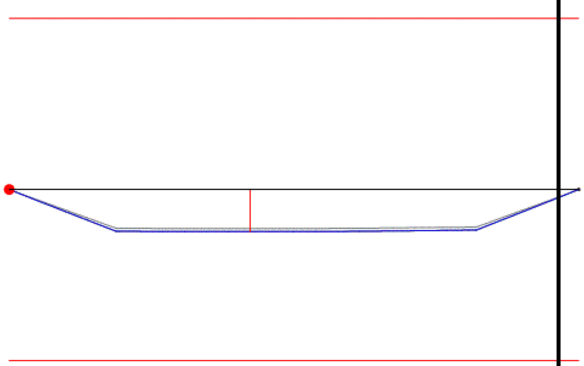
Le = 1.00 L	1 x 4.239 =	4.239 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 4.239, 1551, 22.15, 0.1429, 210000	279.489 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{497.4 \times 275 / 279.489}$	0.700
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.700, 0.734, 0.750, 0.400	0.870
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.870, 0.700, 0.942, 0.972	0.895
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	0.895 x 497.4 x 275 ≤ 136.785 =	122.463 kN.m
$M_{y.Ed}/M_{b.Rd}$	35.227 / 122.463	0.288

AXIAL WITH MOMENTS (MEMBER)

Member SBL2Id 13 @ Level 2 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2								
Member No.	Node End 1 En	Axial Force (k	Torque Mome	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm @ m)	Max Def (mm

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	d 2	N)	nt (kNm)	y-y	z-z	y-y	z-z	y-y	z-z	@ m)
	79	0.00C	0.00	34.46	0.00	0.00	0.00	33.75		0.00
	83	0.00C	0.00	-34.89	0.00	0.00	0.00	@2.098		@0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)   203x203 UC 46 [S 275]
Class = Fn($b/T, d/t, f_y, N, M_y, M_z$)   9.25, 22.33, 275, 0, 33.75, 0   (Axial: Non-Slender)

Auto Design Load Cases   1-2

Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$ 0.052 / 269.498 =   0
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$ 275 x 497.4/1   136.785 kN.m
$M_{y.Ed}/M_{c.y.Rd}$ 33.751 / 136.785 =   0.247

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, M_o, ~y,~m)   0.0, 0.0, 33.6, 0.943, 300.000   1.127

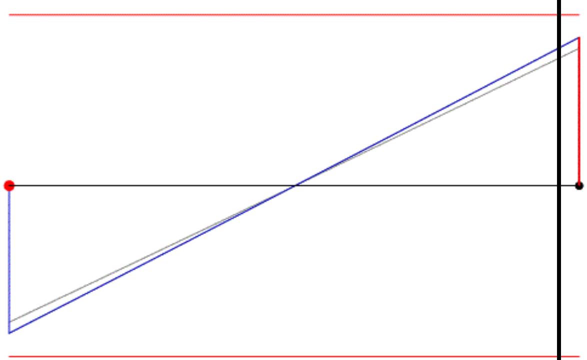
Lateral Buckling Check M.b.Rd

Le = 1.00 L   1 x 5.208 =   5.208 m
M_{cr} = Fn($C_1, L_e, I_z, I_t, I_w, E$)   1.127, 5.208, 1551, 22.15, 0.1429, 210000   208.269 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$ $\sqrt{497.4 \times 275 / 208.269}$ 0.810
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)   0.810, 0.816, 0.750, 0.400   0.811
c_{LT}.mod = Fn($c_{LT}, \lambda_{LT}, k_c, f$)   0.811, 0.810, 0.942, 0.971   0.836
$M_{b.Rd} = c\, W_{pl.y}.f_y \leq M_{c.y.Rd}$ 0.836 x 497.4 x 275 ≤ 136.785 =   114.303 kN.m
$M_{y.Ed}/M_{b.Rd}$ 33.752 / 114.303   0.295

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 22 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D   077.010   (kN/m³)



Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN) y-y	Shear Force (kN) z-z	Bending Moment (kNm) y-y	Bending Moment (kNm) z-z	Maximum Moment (kNm @ m) y-y	Maximum Moment (kNm @ m) z-z	Max Def (mm @ m)
29	18	33.73T	0.00	-75.22	0.00	118.04	0.00			0.00
	25	33.73T	0.00	-77.12	0.00	-118.84	0.00			@0.000

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Job ref	: 21187
Sheet	: **Sheet Ref / 71 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn($b/T,d/t,f_y,N,M_y,M_z$)	9.25, 22.33, 275, 0, 118.84, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	77.118 / 269.498 =	0.286
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	-33.726 / 1615.075 =	0.021
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	497.4, 16.974, 0.021	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	497.4 x 275/1	136.785 kN.m
($M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd}$)	$(118.843/136.785)^2+(0)^1=$	0.755

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	118.0, -118.8, -0.993	2.550
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -118.77, ~y = -0.993	0.4
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.6+0.4~y, 0.4)	M = -118.84, ~y = -0.993	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.11 =	3.11 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	2.550, 3.110, 1551, 22.15, 0.1429, 210000	1023.989 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{497.4 \times 275 / 1023.989}$	0.365
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.365, 0.816, 0.750, 0.400	1.000
c_{LT}.mod = Fn($c_{LT},\lambda_{LT},k_c,f$)	1.000, 0.365, 0.942, 0.971	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

Buckling Resistance

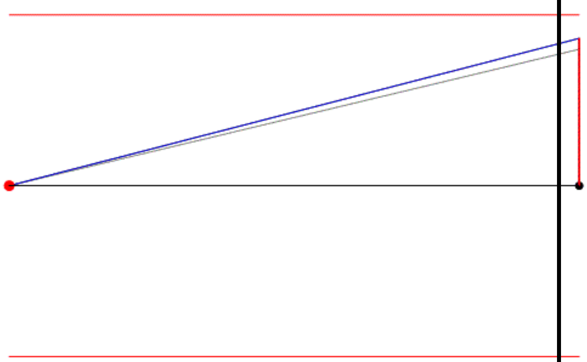
$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1491.718	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1173.471	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	118.843 / 136.785	0.869
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 63.498	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.400
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.240
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.400x0.869+0.600x0.000	0.348
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.240x0.869+1.000x0.000	0.209

AXIAL WITH MOMENTS (MEMBER)

Member SCL1Id 59 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2											
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	

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82	17	73.83T	0.00	-33.73	0.00	0.00	0.00			0.00
	18	75.22T	0.00	-33.73	0.00	-118.04	0.00			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 118.04, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	33.726 / 269.498 =	0.125
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$N_{pl.Rd}$ = Ag.fy/γ_{M0}	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
n = $N_{Ed}/N_{pl.Rd}$	-75.219 / 1615.075 =	0.047
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	497.4, 16.974, 0.047	497.4 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	497.4 x 275/1	136.785 kN.m
($M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd}$)	$(118.041/136.785)^2+(0)^1$=	0.745

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, -118.0, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -118.01, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.6+0.4~y, 0.4)	M = -118.04, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 1551, 22.15, 0.1429, 210000	581.388 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 581.388	0.485
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.485, 0.603, 0.750, 0.400	0.966
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.966, 0.485, 0.756, 0.902	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

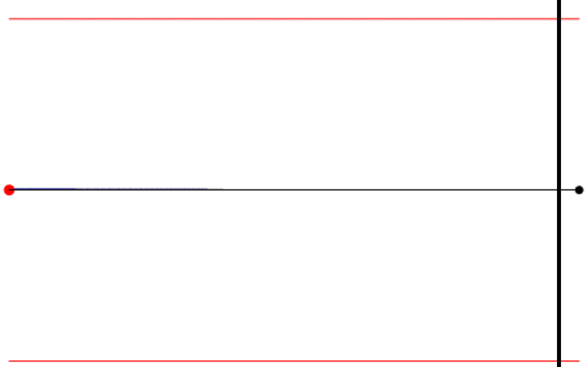
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1458.001	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1085.303	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	118.041 / 136.785	0.863
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 63.498	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.600
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.360
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.600x0.863+0.600x0.000	0.518
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.360x0.863+1.000x0.000	0.311

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 23 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D   077.010   (kN/m³)



Member Forces in Load Case 2

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Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN) y-y	Shear Force (kN) z-z	Bending Moment (kNm) y-y	Bending Moment (kNm) z-z	Maximum Moment (kNm @ m) y-y	Maximum Moment (kNm @ m) z-z	Max Def (mm @ m)
30	25	67.50T	0.00	0.88	0.00	-0.63	0.00			0.00
	56	67.50T	0.00	0.00	0.00	0.00	0.00			@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (46.1 kg/m)	203x203 UC 46 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	9.25, 22.33, 275, 0, 0.63, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0.88 / 269.498 =	0.003
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 497.4/1	136.785 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	58.73x275/1 (No bearing / block tearing design)	1615.075 kN
$n = N_{Ed}/N_{pl.Rd}$	-67.5 / 1615.075 =	0.042
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	497.4, 16.974, 0.042	497.4 cm^3
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	497.4 x 275/1	136.785 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(0.634/136.785)^2+(0)^1=$	0

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	-0.6, 0.0, 0.2, 0.000, -0.250	2.545
C_{mLT}=Max(0.2+0.8α_s, 0.4)	M_h = -0.63, M_s = -0.16, ~y = 0.000, α_s = 0.250	0.4
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.2+0.8α_s, 0.4)	M_h = -0.63, M_s = -0.16, ~y = 0.000, α_s = 0.249	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 1.441 =	1.441 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	2.545, 1.441, 1551, 22.15, 0.1429, 210000	4012.035 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 497.4 x 275 / 4012.035	0.185
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.185, 0.603, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.185, 0.756, 0.902	1.000
$M_{b.Rd} = c\, W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 497.4 x 275 ≤ 136.785 =	136.785 kN.m

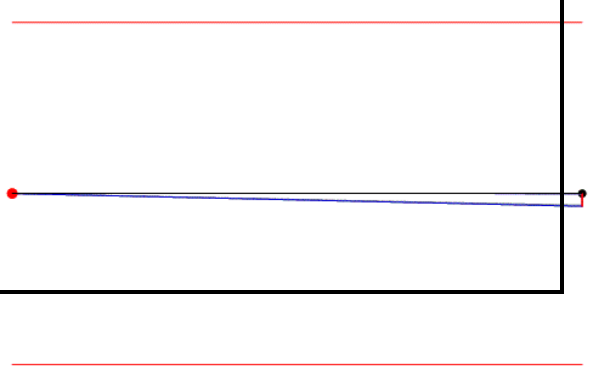
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1615.075	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1513.998	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	0.634 / 136.785	0.005
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 63.498	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.400
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.240
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.400x0.005+0.600x0.000	0.002
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.240x0.005+1.000x0.000	0.001

AXIAL WITH MOMENTS (MEMBER)

Member SCL1Id 53 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1



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D1 D 077.010 (kN/m³)

Member Forces in Load Case 2											
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
76	11	36.64C	0.00	-0.25	0.01	0.00	-0.04			0.00
	28	35.25C	0.00	-0.25	0.01	-0.89	0.00			@ 0.000

Additional Nominal Moments

M_{yUp}	5.958 kN.m	

Classification and Effective Area (EN 1993: 2006)

Section (30.03 kg/m)	152x152 UC 30 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.13, 19.02, 275, 36.64, 5.07, 0.04	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0.255 / 183.454 =	0.001
$M_{c.y.Rd} = f_y.W_{pl.y}/ \gamma_{M0}$	275 x 247.7/1	68.118 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	0.014 / 456.391 =	0
$M_{c.z.Rd} = f_y.W_{pl.z}/ \gamma_{M0}$	275 x 111.6/1	30.69 kN.m
$N_{pl.Rd} = A_g.f_y/ \gamma_{M0}$	38.26 x 275/1 =	1052.15 kN
$n = N_{Ed}/N_{pl.Rd}$	36.642 / 1052.15 =	0.035
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	247.7, 11.555, 0.035	247.7 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/ \gamma_{M0}$	247.7 x 275/1	68.118 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	111.6, 28.745, 0.035	111.6 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/ \gamma_{M0}$	111.6 x 275/1	30.69 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(5.067/68.118)^2+(0.005/30.69)^1$=	0.006

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√38.26x275/2959.02	0.596
$N_{b.y.Rd}$ = Area.c.f_y/ γ_{M1}	38.26x0.839x275/10/1 =	882.615 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√38.26x275/949.85	1.053
$N_{b.z.Rd}$ = Area.c.f_y/ γ_{M1}	38.26x0.51x275/10/1 =	536.619 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√38.26x275/2269.13	0.681
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	38.26x0.736x275/10/1 =	774.857 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, 5.1, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = 5.07, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = -0.04, ~y = -0.116	0.553
C_{my}=Max(0.6+0.4~y, 0.4)	M = 5.07, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 561.4, 10.52, 0.03075, 210000	199.568 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 247.7 x 275 / 199.568	0.584
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.584, 0.659, 0.750, 0.400	0.924
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.924, 0.584, 0.756, 0.889	1.000
$M_{b.Rd}$ = c $W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 247.7 x 275 ≤ 68.118 =	68.118 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	36.642 / 882.615	0.042
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	36.642 / 536.619	0.068
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	5.067 / 68.118	0.074
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0.005 / 30.69	0.000
$k_y y=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.610

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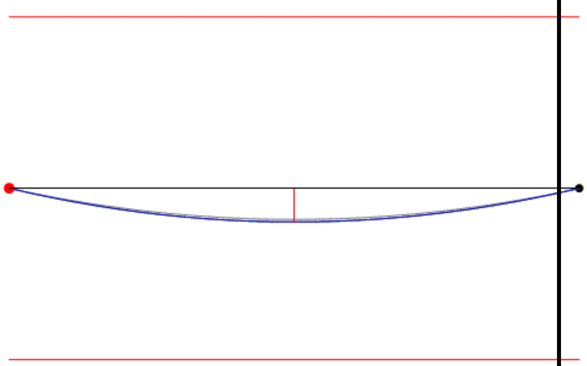
$k_z z = C_{mz}\{1+1.4U_{N.z}\}$		0.606	
$k_y z = 0.6\ k_z z$		0.364	
$k_z y = 0.6\ k_y y$		0.366	
$U_{Ny}+k_y y.U_{M.y}+k_y z.U_{M.z}$	0.042+0.610x0.074+0.364x0.000	0.087	OK
$U_{Nz}+k_z y.U_{M.y}+k_z z.U_{M.z}$	0.068+0.366x0.074+0.606x0.000	0.096	OK

AXIAL WITH MOMENTS (MEMBER)

Member SBL1Id 25 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)



Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
32	28	67.24C	0.00	33.32	0.00	0.00	0.00	35.49		0.00
	38	67.24C	0.00	-33.32	0.00	0.00	0.00	@ 2.130		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 67.24, 35.48, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0.003 / 351.748 =	0
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$N_{pl.Rd} = A_g.f_y/\ \gamma_{M0}$	76.37 x 275/1 =	2100.175 kN
$n = N_{Ed}/N_{pl.Rd}$	67.245 / 2100.175 =	0.032
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	656.1, 22.154, 0.032	656.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	656.1 x 275/1	180.428 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(35.484/180.428)^2+(0)^1$=	0.039

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x4.26 =	4.26
λy = √A.fy/Ncr	√76.37x275/6998.04	0.548
$N_{b.y.Rd}$ = Area.c.f_y/ γ_{M1}	76.37x0.862x275/10/1 =	1811.355 kN
Lez = Kz.Lz	1x4.26 =	4.26
λz = √A.fy/Ncrz	√76.37x275/2361.27	0.944
$N_{b.z.Rd}$ = Area.c.f_y/ γ_{M1}	76.37x0.573x275/10/1 =	1203.959 kN
Let = Kt.Lx	1x4.26 =	4.26
λT = √A.fy/NcrT	√76.37x275/5649.93	0.61
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	76.37x0.78x275/10/1 =	1637.357 kN

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 35.5, 0.939, 300.000	1.127
$C_{mLT}=0.95+0.05\alpha_h$	M_h = 0.03, M_s = 35.48, ~y = 0.939, α_s = 0.001	0.95

C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1	Table B.3
C_{my}=0.95+0.05α_h	M_h = 0, M_s = 35.48, ~y = 1.000, α_s = 0.000	0.95	Table B.3

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 4.26 =	4.26 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 4.260, 2068, 47.23, 0.1969, 210000	426.443 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 656.1 x 275 / 426.443	0.650
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.650, 0.701, 0.750, 0.400	0.894
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.894, 0.650, 0.942, 0.972	0.919
$M_{b.Rd}$ = c $W_{pl.y}$.f_y ≤ $M_{c.y.Rd}$	0.919 x 656.1 x 275 ≤ 180.428 =	165.856 kN.m

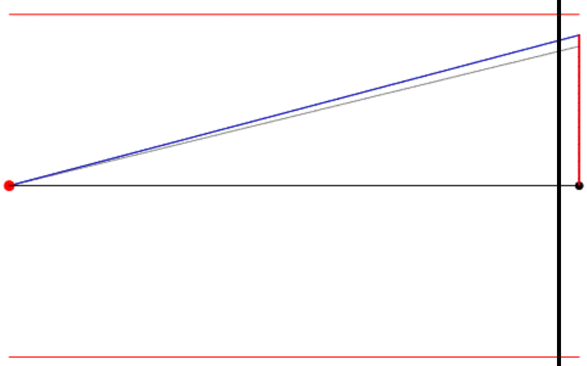
Buckling Resistance

$U_{N.y}$ = N_{Ed}/(c_y.N_{Rk}/γ_{M1})	67.245 / 1811.355	0.037
$U_{N.z}$ = N_{Ed}/(c_z.N_{Rk}/γ_{M1})	67.245 / 1203.959	0.056
$U_{M.y}$ = $M_{y.Ed}$/(c_{LT}.$M_{y.Rk}$/γ_{M1})	35.484 / 165.856	0.214
$U_{M.z}$ = $M_{z.Ed}$/($M_{z.Rk}$/γ_{M1})	0 / 83.958	0.000
k_yy=C_{my}{1+(λ_y-0.2)$U_{N.y}$}		0.962
k_zz=C_{mz}{1+(2λ_z-0.6)$U_{N.z}$}		1.072
k_yz=0.6 k_zz		0.643
k_zy= 1- {0.1/(C_{mLT}-0.25)}$U_{N.z}$		0.992
U_{Ny}+k_yy.$U_{M.y}$+k_yz.$U_{M.z}$	0.037+0.962x0.214+0.643x0.000	0.243
U_{Nz}+k_zy.$U_{M.y}$+k_zz.$U_{M.z}$	0.056+0.992x0.214+1.072x0.000	0.268

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 60 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
83	19	92.87T	0.00	-66.41	0.00	0.00	0.00		0.00	0.00
	38	94.26T	0.00	-66.41	0.00	-232.44	0.00		@ 0.000	@ 0.000

Additional Nominal Moments

M_{yUp}	-7.566 kN.m

Classification and Effective Area (EN 1993: 2006)

Section (73.08 kg/m)	254x254 UC 73 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.96, 23.29, 275, 0, 240.01, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}$/$V_{pl.y.Rd}$	66.412 / 406.798 =	0.163

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$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 992.1/1	272.828 kN.m	
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	93.1x275/1 (No bearing / block tearing design)	2560.25 kN	
$n = N_{Ed}/N_{pl.Rd}$	-94.259 / 2560.25 =	0.037	OK
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	992.1, 25.622, 0.037	992.1 cm³	
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	992.1 x 275/1	272.828 kN.m	
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(240.009/272.828)^2+(0)^1=$	0.774	OK

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	-0.1, -239.9, 0.000	1.750	|
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -239.94, ~y = 0.000	0.6	
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1	
C_{my}=Max(0.6+0.4~y, 0.4)	M = -240.01, ~y = 0.000	0.6	

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	1.750, 3.500, 3915, 57.62, 0.5620, 210000	1694.626 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{992.1 \times 275 / 1694.626}$	0.401
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.401, 0.561, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.401, 0.756, 0.917	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 992.1 x 275 ≤ 272.828 =	272.828 kN.m

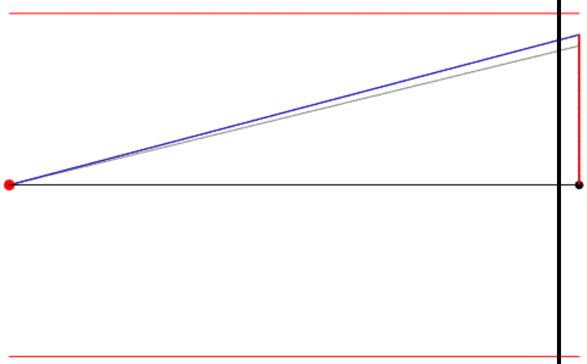
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 2406.757	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1976.961	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	240.009 / 272.828	0.880
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 127.985	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.600
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.360
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.600x0.880+0.600x0.000	0.528
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.360x0.880+1.000x0.000	0.317

AXIAL WITH MOMENTS (MEMBER)
Member SCL1Id 66 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
89	26	178.77 C	0.00	-68.33	0.00	0.00	0.00		0.00	0.00
	39	177.38 C	0.00	-68.33	0.00	-239.16	0.00		@ 0.000	@ 0.000

Classification and Effective Area (EN 1993: 2006)

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Section (73.08 kg/m)	254x254 UC 73 [S 275]	
Class = Fn($b/T,d/t,f_y,N,M_y,M_z$)	8.96, 23.29, 275, 178.77, 239.16, 0	(Axial: Non-Slender) Class 1
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	68.333 / 406.798 =	0.168
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 992.1/1	272.828 kN.m
$N_{pl.Rd} = A_g.f_y/\gamma_{M0}$	93.1 x 275/1 =	2560.25 kN
$n = N_{Ed}/N_{pl.Rd}$	178.77 / 2560.25 =	0.070
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	992.1, 25.622, 0.07	992.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	992.1 x 275/1	272.828 kN.m
($M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$)	$(239.164/272.828)^2+(0)^1=$	0.768

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x3.5 =	3.5
λy = √A.fy/Ncr	√93.1x275/19312.05	0.364
$N_{b.y.Rd}$ = Area.c.f_y/γ_{M1}	93.1x0.94x275/10/1 =	2406.757 kN
Lez = Kz.Lz	1x3.5 =	3.5
λz = √A.fy/Ncrz	√93.1x275/6623.41	0.622
$N_{b.z.Rd}$ = Area.c.f_y/γ_{M1}	93.1x0.772x275/10/1 =	1976.961 kN
Let = Kt.Lx	1x3.5 =	3.5
λT = √A.fy/NcrT	√93.1x275/8607.54	0.545
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	93.1x0.817x275/10/1 =	2092.408 kN

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	-0.1, -239.1, 0.000	1.750
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -239.1, ~y = 0.000	0.6
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1
C_{my}=Max(0.6+0.4~y, 0.4)	M = -239.16, ~y = 0.000	0.6

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.5 =	3.5 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 3.500, 3915, 57.62, 0.5620, 210000	1694.625 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 992.1 x 275 / 1694.625	0.401
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.401, 0.561, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.401, 0.756, 0.917	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 992.1 x 275 ≤ 272.828 =	272.828 kN.m

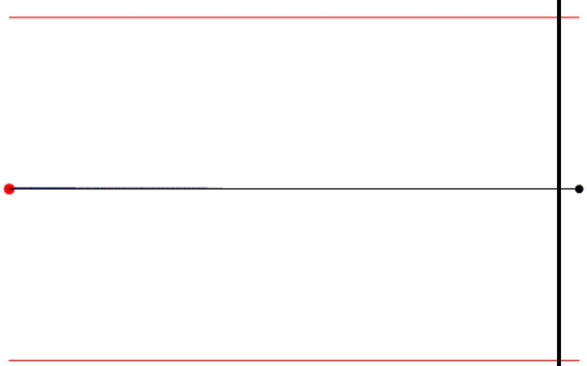
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	178.77 / 2406.757	0.074
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	178.77 / 1976.961	0.090
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	239.164 / 272.828	0.877
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 127.985	0.000
$k_y y = C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.607
$k_z z = C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.058
$k_y z = 0.6\ k_z z$		0.635
$k_z y = 0.6\ k_y y$		0.364
$U_{Ny}+k_y y.U_{M.y}+k_y z.U_{M.z}$	0.074+0.607x0.877+0.635x0.000	0.607
$U_{Nz}+k_z y.U_{M.y}+k_z z.U_{M.z}$	0.090+0.364x0.877+1.058x0.000	0.410

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 33 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2

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Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
43	39	67.50T	0.00	1.14	0.00	-0.82	0.00		0.00	0.00
	57	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = $Fn(b/T,d/t,f_y,N,M_y,M_z)$	7.25, 17.11, 275, 0, 0.82, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	1.144 / 351.748 =	0.003
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	76.37x275/1 (No bearing / block tearing design)	2100.175 kN
$n = N_{Ed}/N_{pl.Rd}$	-67.5 / 2100.175 =	0.032
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	656.1, 22.154, 0.032	656.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	656.1 x 275/1	180.428 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(0.824/180.428)^2+(0)^1=$	0

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

$C_1= fn(M_1, M_2, M_o, \sim y,\sim m)$	-0.8, 0.0, 0.2, 0.000, -0.251	2.546
$C_{mLT}=Max(0.2+0.8\alpha_s, 0.4)$	M_h = -0.82, M_s = -0.21, ~y = 0.000, α_s = 0.249	0.4
$C_{mz}=Max(0.6+0.4\sim y, 0.4)$	M = 0, ~y = 1.000	1
$C_{my}=Max(0.2+0.8\alpha_s, 0.4)$	M_h = -0.82, M_s = -0.21, ~y = 0.000, α_s = 0.249	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 1.441 =	1.441 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	2.546, 1.441, 2068, 47.23, 0.1969, 210000	5602.437 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 656.1 x 275 / 5602.437	0.179
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.179, 0.561, 0.750, 0.400	1.000
$c_{LT}.mod = Fn(c_{LT},\lambda_{LT},k_c,f)$	1.000, 0.179, 0.756, 0.917	1.000
$M_{b.Rd} = c\, W_{pl.y}.f_y \leq M_{c.y.Rd}$	1.000 x 656.1 x 275 ≤ 180.428 =	180.428 kN.m

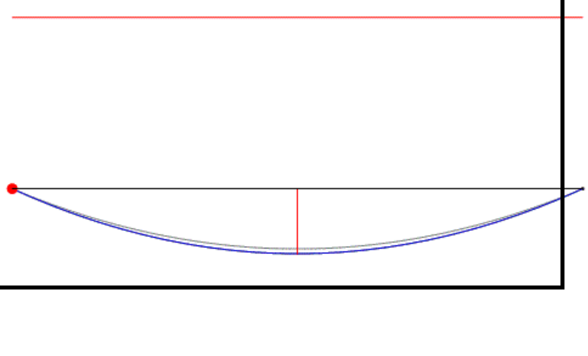
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 2100.175	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 1972.752	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	0.824 / 180.428	0.005
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0 / 83.958	0.000
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.400
$k_zz=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		1.000
$k_yz=0.6\, k_zz$		0.600
$k_zy=0.6\, k_yy$		0.240
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.400x0.005+0.600x0.000	0.002
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.240x0.005+1.000x0.000	0.001

AXIAL WITH MOMENTS (MEMBER)
Member SBL2Id 11 @ Level 2 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)



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Job ref	: 21187
Sheet	: **Sheet Ref / 80 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

D1 UDLY -006.000 (kN/m)

Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
14	71	0.00C	0.00	46.27	0.00	0.00	0.00	68.42		0.00
	82	0.00C	0.00	-46.27	0.00	0.00	0.00	@ 2.958		@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 0, 68.41, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$	0.003 / 351.748 =	0
$M_{c.y.Rd} = f_y.W_{pl.y}/\gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$M_{y.Ed}/M_{c.y.Rd}$	68.408 / 180.428 =	0.379

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 68.4, 0.936, 300.000	1.127

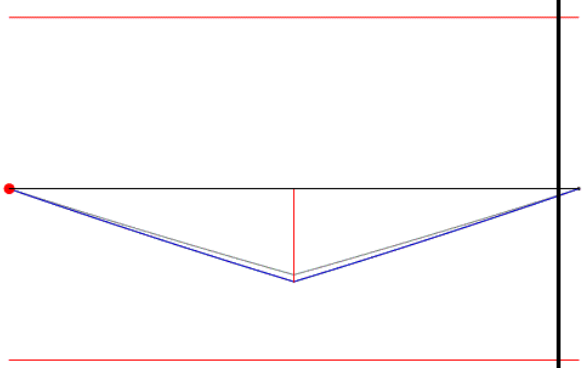
Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 5.915 =	5.915 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 5.915, 2068, 47.23, 0.1969, 210000	278.367 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 656.1 x 275 / 278.367	0.805
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.805, 0.812, 0.750, 0.400	0.814
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.814, 0.805, 0.942, 0.971	0.839
$M_{b.Rd} = c\, W_{pl.y}.f_y \le M_{c.y.Rd}$	0.839 x 656.1 x 275 ≤ 180.428 =	151.320 kN.m
$M_{y.Ed}/M_{b.Rd}$	68.408 / 151.32	0.452

AXIAL WITH MOMENTS (MEMBER)
Member SBL2Id 44 @ Level 2 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	

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	70	0.00C	0.00	26.28	0.00	0.00	0.00	97.89		0.00
	84	0.00C	0.00	-26.28	0.00	0.00	0.00	@3.962		@0.000

Classification and Effective Area (EN 1993: 2006)

Section (59.95 kg/m)	203x203 UC 60 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	7.25, 17.11, 275, 0, 97.9, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$	23.136 / 351.748 =	0.066
$M_{c.y.Rd}$ = $f_y.W_{pl.y}/\gamma_{M0}$	275 x 656.1/1	180.428 kN.m
$M_{y.Ed}/M_{c.y.Rd}$	97.895 / 180.428 =	0.543

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 97.9, 0.926, 300.000	1.348

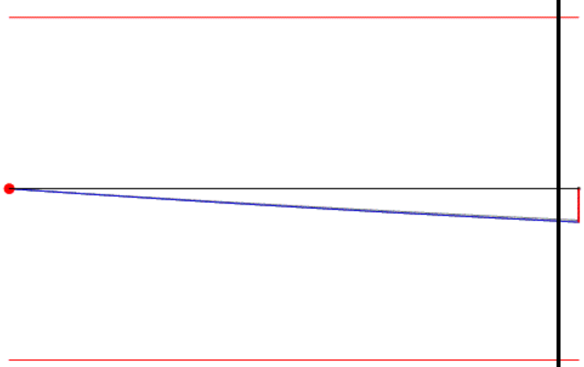
Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 7.924 =	7.924 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.348, 7.924, 2068, 47.23, 0.1969, 210000	235.301 kN.m
λ_{LT} = $\sqrt{}$ W.f_y/M_{cr}	$\sqrt{}$ 656.1 x 275 / 235.301	0.876
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.876, 0.868, 0.750, 0.400	0.774
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.774, 0.876, 0.861, 0.931	0.831
$M_{b.Rd}$ = c $W_{pl.y}.f_y$ ≤ $M_{c.y.Rd}$	0.831 x 656.1 x 275 ≤ 180.428 =	149.981 kN.m
$M_{y.Ed}/M_{b.Rd}$	97.895 / 149.981	0.653

AXIAL WITH MOMENTS (MEMBER)
Member SBL2Id 42 @ Level 2 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
62	68	0.00C	0.00	8.64	0.00	0.00	0.00		0.00	0.00
	69	0.00C	0.00	6.11	0.00	21.02	0.00		@0.000	@0.000

Classification and Effective Area (EN 1993: 2006)

Section (31.14 kg/m)	254x146 UB 31 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.49, 36.5, 275, 0, 21.02, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

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Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$	6.107 / 259.813 =	0.024
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 393.1/1	108.103 kN.m
$M_{y.Ed}/M_{c.y.Rd}$	21.023 / 108.103 =	0.194

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	0.0, 21.0, 0.000	1.750

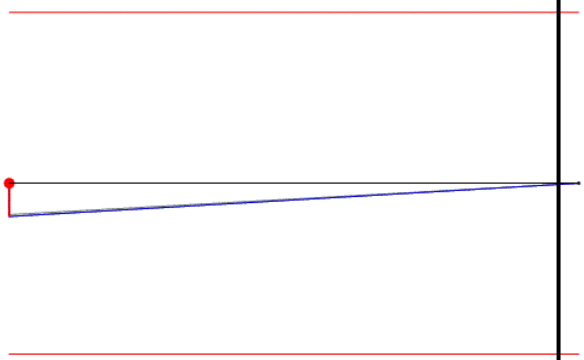
Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 2.851 =	2.851 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.750, 2.851, 448.4, 8.552, 0.06588, 210000	288.050 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{393.1 \times 275 / 288.05}$	0.613
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, $\lambda_{LT}0$)	0.613, 0.677, 0.750, 0.400	0.911
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.911, 0.613, 0.756, 0.887	1.000
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	1.000 x 393.1 x 275 ≤ 108.103 =	108.103 kN.m
$M_{y.Ed}/M_{b.Rd}$	21.023 / 108.103	0.194

AXIAL WITH MOMENTS (MEMBER)
Member SBL2Id 43 @ Level 2 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
63	69	0.00C	0.00	-42.78	0.00	21.02	0.00		0.00	0.00
	76	0.00C	0.00	-43.21	0.00	0.00	0.00		@ 0.000	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (31.14 kg/m)	254x146 UB 31 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.49, 36.5, 275, 0, 21.02, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Moment Capacity Check M.c.y.Rd

$V_{y.Ed}/V_{pl.y.Rd}$	42.776 / 259.813 =	0.165
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 393.1/1	108.103 kN.m
$M_{y.Ed}/M_{c.y.Rd}$	21.024 / 108.103 =	0.194

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	21.0, 0.0, 0.002	1.748

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 0.489 =	0.489 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.748, 0.489, 448.4, 8.552, 0.06588, 210000	8283.558 kN.m

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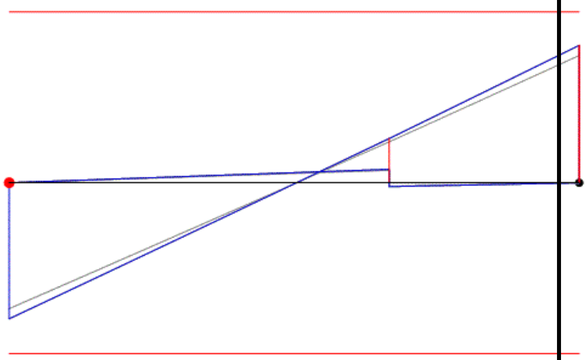
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{393.1 \times 275 / 8283.558}$	0.114	
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.114, 0.677, 0.750, 0.400	1.000	Curve d
$c_{LT}.mod = Fn(c_{LT},\lambda_{LT},k_c,f)$	1.000, 0.114, 0.756, 0.887	1.000	6.3.2.3
$M_{b.Rd} = c\ W_{pl.y}.f_y \leq M_{c.y.Rd}$	$1.000 \times 393.1 \times 275 \leq 108.103 =$	108.103 kN.m	
$M_{y.Ed}/M_{b.Rd}$	21.024 / 108.103	0.194	OK

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 34 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	45	36.30T	-0.01	-54.59	-4.10	86.09	0.00		-8.42	0.00
	50	42.77T	-0.08	-57.13	-2.30	-86.99	0.02		@ 2.053	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (31.14 kg/m)	254x146 UB 31 [S 275]	
Class = Fn($b/T,d/t,f_y,N,M_y,M_z$)	8.49, 36.5, 275, 0, 86.99, 8.5	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	57.134 / 259.813 =	0.22
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 393.1/1	108.103 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	2.305 / 398.98 =	0.006
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 94.1/1	25.878 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	39.67x275/1 (No bearing / block tearing design)	1090.925 kN
$n = N_{Ed}/N_{pl.Rd}$	-42.768 / 1090.925 =	0.039
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy,})$	393.1, 16.364, 0.039	393.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	393.1 x 275/1	108.103 kN.m
$W_{pl.N.z} = Fn(W_{pl.z}, A_{vz,})$	94.1, 25.129, 0.039	94.1 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	94.1 x 275/1	25.878 kN.m
$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(86.989/108.103)^2+(0.024/25.878)^1=$	0.648

Equivalent Uniform Moment Factor C1

C_1= fn(M_1, M_2, ~y)	86.0, -86.9, -0.990	2.550
C_{mLT}=Max(0.6+0.4~y, 0.4)	M = -86.93, ~y = -0.990	0.4
C_{mz}=0.90-0.10α_h(1+2~y)	M_h = 0.03, M_s = -6.38, ~y = -0.296, α_s = -0.004	0.9
C_{my}=Max(0.6+0.4~y, 0.4)	M = -86.99, ~y = -0.990	0.4

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 3.11 =	3.11 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	2.550, 3.110, 448.4, 8.552, 0.06588, 210000	362.433 kN.m

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Job ref	: 21187
Sheet	: **Sheet Ref / 84 -**
Made By	:
Date	**:08 June 2022**
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$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	$\sqrt{393.1 \times 275 / 362.433}$	0.546	
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	0.546, 0.637, 0.750, 0.400	0.941	Curve b
$c_{LT}.mod = Fn(c_{LT}, \lambda_{LT}, k_c, f)$	0.941, 0.546, 0.626, 0.837	1.000	6.3.2.3
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	$1.000 \times 393.1 \times 275 \le 108.103 =$	108.103 kN.m	

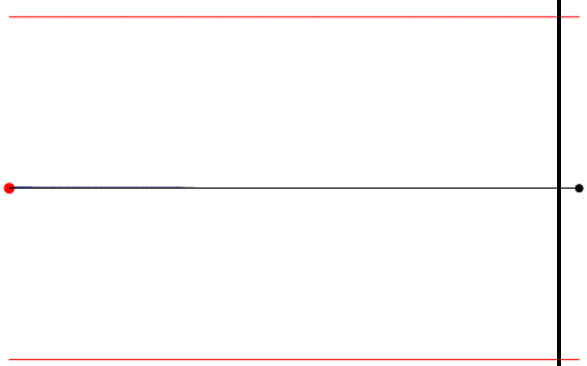
Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1056.085	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 606.22	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	86.989 / 108.103	0.805
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	0.024 / 25.878	0.001
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.400
$k_zz=C_{mz}\{1+1.4U_{N.z}\}$		0.900
$k_yz=0.6\ k_zz$		0.540
$k_zy=0.6\ k_yy$		0.240
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.400x0.805+0.540x0.001	0.322
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+0.240x0.805+0.900x0.001	0.194

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 36 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m^3)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
52	50	67.50T	0.00	0.59	0.00	-0.43	0.00		0.00	0.00
	52	67.50T	0.00	0.00	0.00	0.00	0.00		@ 0.000	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (31.14 kg/m)	254x146 UB 31 [S 275]	
Class = $Fn(b/T, d/t, f_y, N, M_y, M_z)$	8.49, 36.5, 275, 0, 0.43, 0	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	0.594 / 259.813 =	0.002
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 393.1/1	108.103 kN.m
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	39.67x275/1 (No bearing / block tearing design)	1090.925 kN
$n = N_{Ed}/N_{pl.Rd}$	-67.5 / 1090.925 =	0.062
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	393.1, 16.364, 0.062	393.1 cm^3
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	393.1 x 275/1	108.103 kN.m
$(M_{y.Ed}/M_{N.y.Rd+(M\_(z.Ed}/M_{N.z.Rd})$	$(0.428/108.103)^2+(0)^1=$	0

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

$C_1= fn(M_1, M_2, M_o, \sim y, \sim m)$	-0.4, 0.0, 0.1, 0.000, -0.252	2.550

C_{mLT}=Max(0.2+0.8α_s, 0.4)	M_h = -0.43, M_s = -0.11, ~y = 0.000, α_s = 0.248	0.4	Table B.3
C_{mz}=Max(0.6+0.4~y, 0.4)	M = 0, ~y = 1.000	1	Table B.3
C_{my}=Max(0.2+0.8α_s, 0.4)	M_h = -0.43, M_s = -0.11, ~y = 0.000, α_s = 0.248	0.4	Table B.3

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 1.441 =	1.441 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	2.550, 1.441, 448.4, 8.552, 0.06588, 210000	1454.159 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 393.1 x 275 / 1454.159	0.273
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.273, 0.637, 0.750, 0.400	1.000
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	1.000, 0.273, 0.626, 0.837	1.000
$M_{b.Rd}$ = c $W_{pl.y}$.f_y ≤ $M_{c.y.Rd}$	1.000 x 393.1 x 275 ≤ 108.103 =	108.103 kN.m

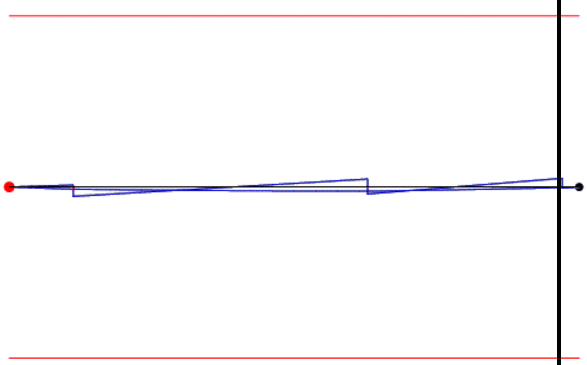
Buckling Resistance

$U_{N.y}$ = N_{Ed}/(c_y.N_{Rk}/γ_{M1})	0 / 1090.925	0.000
$U_{N.z}$ = N_{Ed}/(c_z.N_{Rk}/γ_{M1})	0 / 967.499	0.000
$U_{M.y}$ = $M_{y.Ed}$/(c_{LT}.$M_{y.Rk}$/γ_{M1})	0.428 / 108.103	0.004
$U_{M.z}$ = $M_{z.Ed}$/($M_{z.Rk}$/γ_{M1})	0 / 25.878	0.000
k_yy=C_{my}{1+(λ_y-0.2)$U_{N.y}$}		0.400
k_zz=C_{mz}{1+(2λ_z-0.6)$U_{N.z}$}		1.000
k_yz=0.6 k_zz		0.600
k_zy=0.6 k_yy		0.240
U_{Ny}+k_yy.$U_{M.y}$+k_yz.$U_{M.z}$	0.000+0.400x0.004+0.600x0.000	0.002
U_{Nz}+k_zy.$U_{M.y}$+k_zz.$U_{M.z}$	0.000+0.240x0.004+1.000x0.000	0.001

AXIAL WITH MOMENTS (MEMBER)
Member SBL1Id 18 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)



Member Forces in Load Case 2										
Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm @ m)		Max Def (mm @ m)
				y-y	z-z	y-y	z-z	y-y	z-z	
	2	0.00C	0.20	2.94	-2.69	0.00	0.00	2.65	5.98	0.00
	45	11.70T	-0.14	-3.05	-4.72	0.00	0.00	@ 2.656	@ 0.478	@ 0.000

Classification and Effective Area (EN 1993: 2006)

Section (31.14 kg/m)	254x146 UB 31 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.49, 36.5, 275, 0, 2.66, 5.98	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}$/$V_{pl.y.Rd}$	2.738 / 259.813 =	0.011
$M_{c.y.Rd}$ = f_y.$W_{pl.y}$/ γ_{M0}	275 x 393.1/1	108.103 kN.m
$V_{z.Ed}$/$V_{pl.z.Rd}$	5.03 / 398.98 =	0.013

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Job ref	: 21187
Sheet	: **Sheet Ref / 86 -**
Made By	:
Date	**:08 June 2022**
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$M_{c.z.Rd} = f_y.W_{pl.z}/\gamma_{M0}$	275 x 94.1/1	25.878 kN.m	
$N_{pl.Rd} = Ag.fy/\gamma_{M0}$	39.67x275/1 (No bearing / block tearing design)	1090.925 kN	
$n = N_{Ed}/N_{pl.Rd}$	-11.703 / 1090.925 =	0.011	OK
$W_{pl.N.y} = Fn(W_{pl.y}, A_{vy},)$	393.1, 16.364, 0.011	393.1 cm³	
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\gamma_{M0}$	393.1 x 275/1	108.103 kN.m	
$W_{pl.N.z} = Fn(W_{pl.z}, A_{vz},)$	94.1, 25.129, 0.011	94.1 cm³	
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\gamma_{M0}$	94.1 x 275/1	25.878 kN.m	
$(M_{y.Ed}/M\_(N.y.Rd+(M_{z.Ed}/M_{N.z.Rd})$	$(1.364/108.103)^2+(5.978/25.878)^1=$	0.231	OK

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

$C_1= fn(M_1, M_2, M_o, \sim y,\sim m)$	0.0, 0.0, 2.5, 0.333, 300.000	1.127
$C_{mLT}=0.95+0.05\alpha_h$	M_h = 0, M_s = 2.52, ~y = 0.333, α_s = 0.001	0.95
$C_{mz}=0.90-0.10\alpha_h(1+2\sim y)$	M_h = 0.01, M_s = -2.33, ~y = -0.400, α_s = -0.002	0.9
$C_{my}=0.95+0.05\alpha_h$	M_h = 0, M_s = 2.52, ~y = 1.000, α_s = 0.000	0.95

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 4.26 =	4.26 m
$M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)$	1.127, 4.260, 448.4, 8.552, 0.06588, 210000	96.884 kN.m
$\lambda_{LT} = \sqrt{W.f_y/M_{cr}}$	√ 393.1 x 275 / 96.884	1.056
$c_{LT} = Fn(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT}0)$	1.056, 1.030, 0.750, 0.400	0.665
$c_{LT}.mod = Fn(c_{LT},\lambda_{LT},k_c,f)$	0.665, 1.056, 0.942, 0.975	0.682
$M_{b.Rd} = c\ W_{pl.y}.f_y \le M_{c.y.Rd}$	0.682 x 393.1 x 275 ≤ 108.103 =	73.768 kN.m

Buckling Resistance

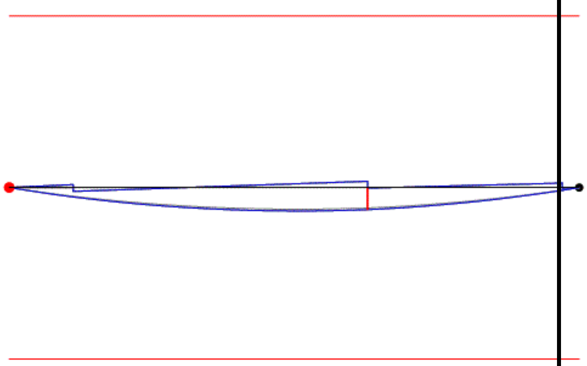
$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	0 / 1019.758	0.000
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	0 / 389.685	0.000
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	1.364 / 73.768	0.018
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	5.978 / 25.878	0.231
$k_yy=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.950
$k_zz=C_{mz}\{1+1.4U_{N.z}\}$		0.900
$k_yz=0.6\ k_zz$		0.540
$k_zy= 1- \{0.1\lambda_z/(C_{mLT}-0.25)\}U_{N.z}$		1.000
$U_{Ny}+k_yy.U_{M.y}+k_yz.U_{M.z}$	0.000+0.950x0.018+0.540x0.231	0.142
$U_{Nz}+k_zy.U_{M.y}+k_zz.U_{M.z}$	0.000+1.000x0.018+0.900x0.231	0.226

AXIAL WITH MOMENTS (MEMBER)

Member SBL1Id 19 @ Level 1 in Load Case 2

Member Loading and Member Forces
Loading Combination : 1 UT + 1.35 D1 + 1.05 L1

D1 D 077.010 (kN/m³)
D1 UDLY -005.000 (kN/m)
D1 UDLY -006.000 (kN/m)



Member Forces in Load Case 2

Member No.	Node End 1 End 2	Axial Force (kN)	Torque Moment (kNm)	Shear Force (kN) y-y	Shear Force (kN) z-z	Bending Moment (kNm) y-y	Bending Moment (kNm) z-z	Maximum Moment (kNm @ m) y-y	Maximum Moment (kNm @ m) z-z	Max Def (mm @ m)
	4	0.00C	1.22	35.21	-9.77	0.00	0.00	37.33	-9.92	0.00
	47	11.70C	-0.97	-36.27	-7.74	0.00	0.00	@ 2.150	@ 2.656	@ 0.000

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Job ref	: 21187
Sheet	: **Sheet Ref / 87 -**
Made By	:
Date	**:08 June 2022**
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Classification and Effective Area (EN 1993: 2006)

Section (73.08 kg/m)	254x254 UC 73 [S 275]	
Class = Fn(b/T,d/t,f_y,N,M_y,M_z)	8.96, 23.29, 275, 11.7, 37.32, 10.08	(Axial: Non-Slender)
Auto Design Load Cases	1-2	

Local Capacity Check

$V_{y.Ed}/V_{pl.y.Rd}$	9.612 / 406.798 =	0.024
$M_{c.y.Rd} = f_y.W_{pl.y}/\ \gamma_{M0}$	275 x 992.1/1	272.828 kN.m
$V_{z.Ed}/V_{pl.z.Rd}$	7.434 / 1148.018 =	0.006
$M_{c.z.Rd} = f_y.W_{pl.z}/\ \gamma_{M0}$	275 x 465.4/1	127.985 kN.m
$N_{pl.Rd} = A_g.f_y/\ \gamma_{M0}$	93.1 x 275/1 =	2560.25 kN
$n = N_{Ed}/N_{pl.Rd}$	11.703 / 2560.25 =	0.005
$W_{pl.N.y}$ = Fn($W_{pl.y}$, A_{vy},)	992.1, 25.622, 0.005	992.1 cm³
$M_{N.y.Rd} = W_{pl.N.y}.f_y/\ \gamma_{M0}$	992.1 x 275/1	272.828 kN.m
$W_{pl.N.z}$ = Fn($W_{pl.z}$, A_{vz},)	465.4, 72.306, 0.005	465.4 cm³
$M_{N.z.Rd} = W_{pl.N.z}.f_y/\ \gamma_{M0}$	465.4 x 275/1	127.985 kN.m
($M_{y.Ed}$/M_(N.y.Rd+($M_{z.Ed}/M_{N.z.Rd}$)	$(35.189/272.828)^2+(10.079/127.985)^1$=	0.095

Compression Resistance N.b.Rd

Ley = Ky.Ly	1x4.26 =	4.26
λy = √A.fy/Ncr	√93.1x275/13036.03	0.443
$N_{b.y.Rd}$ = Area.c.$f_y/\ \gamma_{M1}$	93.1x0.909x275/10/1 =	2326.050 kN
Lez = Kz.Lz	1x4.26 =	4.26
λz = √A.fy/Ncrz	√93.1x275/4470.94	0.757
$N_{b.z.Rd}$ = Area.c.$f_y/\ \gamma_{M1}$	93.1x0.689x275/10/1 =	1763.990 kN
Let = Kt.Lx	1x4.26 =	4.26
λT = √A.fy/NcrT	√93.1x275/6729.55	0.617
$N_{b.T.Rd}$= Area.c.fy/ γ_{M1}	93.1x0.775x275/10/1 =	1985.165 kN

Equivalent Uniform Moment Factors C1, C.mLT, C.mz, and C.my

C_1= fn(M_1, M_2, M_o, ~y,~m)	0.0, 0.0, 37.3, 0.943, 300.000	1.127
$C_{mLT}=0.95+0.05\alpha_h$	M_h = 0.04, M_s = 37.32, ~y = 0.943, α_s = 0.001	0.95
$C_{mz}=0.90+0.10\alpha_h$	M_h = -0.01, M_s = -6, ~y = -0.778, α_s = 0.001	0.9
$C_{my}=0.95+0.05\alpha_h$	M_h = 0, M_s = 37.33, ~y = 1.000, α_s = 0.000	0.95

Lateral Buckling Check M.b.Rd

Le = 1.00 L	1 x 4.26 =	4.26 m
M_{cr} = Fn(C_1,L_e,I_z,I_t,I_w,E)	1.127, 4.260, 3915, 57.62, 0.5620, 210000	792.949 kN.m
λ_{LT} = √ W.f_y/M_{cr}	√ 992.1 x 275 / 792.949	0.587
c_{LT} = Fn(λ_{LT}, Φ_{LT}, β, λ_{LT}0)	0.587, 0.661, 0.750, 0.400	0.923
c_{LT}.mod = Fn(c_{LT},λ_{LT},k_c,f)	0.923, 0.587, 0.942, 0.974	0.948
$M_{b.Rd}$ = c $W_{pl.y}.f_y \le M_{c.y.Rd}$	0.948 x 992.1 x 275 ≤ 272.828 =	258.677 kN.m

Buckling Resistance

$U_{N.y} = N_{Ed}/(c_y.N_{Rk}/\gamma_{M1})$	11.703 / 2326.05	0.005
$U_{N.z} = N_{Ed}/(c_z.N_{Rk}/\gamma_{M1})$	11.703 / 1763.99	0.007
$U_{M.y} = M_{y.Ed}/(c_{LT}.M_{y.Rk}/\gamma_{M1})$	35.189 / 258.677	0.136
$U_{M.z} = M_{z.Ed}/(M_{z.Rk}/\gamma_{M1})$	10.079 / 127.985	0.079
$k_y y=C_{my}\{1+(\lambda_y-0.2)U_{N.y}\}$		0.951
$k_z z=C_{mz}\{1+(2\lambda_z-0.6)U_{N.z}\}$		0.906
$k_y z=0.6\ k_z z$		0.543
$k_z y= 1- \{0.1/(C_{mLT}-0.25)\}U_{N.z}$		0.999
$U_{Ny}+k_y y.U_{M.y}+k_y z.U_{M.z}$	0.005+0.951x0.136+0.543x0.079	0.177
$U_{Nz}+k_z y.U_{M.y}+k_z z.U_{M.z}$	0.007+0.999x0.136+0.906x0.079	0.214

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Job ref	: 21187
Sheet	: **Sheet Ref / 88 -**
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Date	**:08 June 2022**
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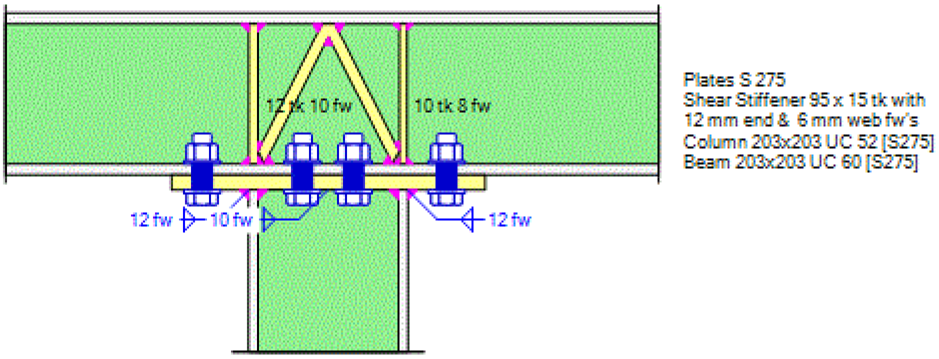
BRIEF 2

COLUMN TO BEAM FLANGE CONNECTION AT : END 2 OF MEMBER SCL1ID 57 - LEVEL 1



Column to Cap Beam Flange End-Plated Connection to EC 3 (UK NAD)

LOADING CASE 001 : DEAD PLUS LIVE B (ULTIMATE)

Basic Data

Integrated Applied Forces at Beam/Bottom Column Interface

Resultant Forces M, Fv, F	100.2 kNm, -29.5 kN, -17.2 kN
Load directions	Left of Connection in Tension, Column moving Left and in Tension.
Design to	EC 3: Part 1-8: 2005 Design of Connections SCI Green Book P398: Joints in steel construction: Moment-Resisting Joints to Eurocode 3
Weld Grades	All weld grades provided to suit minimum connected steel grade

Basic Dimensions

Beam-203x203UC60 [S 275]	D=209.6, B=205.8, T=14.2, t=9.4, r=10.2, py=275		
Column-203x203UC52 [S 275]	D=206.2, B=204.3, T=12.5, t=7.9, r=10.2, py=275		
Bolts 24 mm Ø in 26 mm holes	Grade 8.8 Bolts		
Plates S 275	All weld grades provided to suit minimum connected steel grade		
Beam Forces M, Fv, F	0.97 x 103 = 100 kN.m, -14 kN, 30 kN		
Beam Capacities Mc, Fvc, Fc	180.4 kN.m, 351.8 kN, 2100.2 kN	Mc = 180.4 kN.m	OK

Summary of Results (Unity Ratios)

Tensile Capacity		0.03	OK
Moment Capacity 111.7 kNm (for 3 rows of bolts) (Modified Applied Mom. M_{mod} =101.9 kNm)		0.91	OK
Moment Capacity 104.0 kNm (for the 2 rows of bolts required in the tension zone)		0.98	OK
Shear Capacity		0.04	OK
Shear Capacity (Fv & T)		0.03	OK
Beam Tension Stiffener at row 1	0.38, 0.89, 0.82	0.89	OK
Flange Welds	0.62	0.62	OK
Web Welds	0.54, 0.26	0.54	OK
Beam Compression stiff Web Weld	0.65	0.65	OK
Shear stiff End Welds	0.86	0.86	OK

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Sheet	: **Sheet Ref / 89 -**
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Step 1: Tension Zone

Basics

Bm/Plt b_p , W, t_{wb} , S_w , m_p , e_p , n_p	230.0, 90, 7.9, 10, 33.1, 70.0, 41.3		
Beam B_c , t_wc , r_c , m_c , e_c , n_c	205.8, 9.4, 10.2, 32.1, 57.9, 40.2		
Column extension x, e_x , s_f , m_x , e , n_x	60.0, 40, 12, 50.4, 70.0, 40.0		
$F_{t,Rd}$=k_2 •f_{ub} •A / γ_{m^2}	0.90•800•353/1.25	203.3 kN	
$F_{T,3,Rd}$=Σ $F_{t,Rd}$	2•203.3	406.7 kN	

BOLT ROW 1

Beam Flange row 1 only

m, e, mx, α	32.1, 57.9, 52.3, 6.4		
l_{eff} modes	$l_{eff,cp}$ = 201.9, $l_{eff,ncp}$ = 205.6		T2.2 (c)
Mode 1 $l_{eff,1}$=min($l_{eff,cp}$, $l_{eff,cnp}$)	min(201.9, 205.6)	201.9 mm	
Mode 2 $l_{eff,2}$=$l_{eff,ncp}$	205.6	205.6 mm	
$M_{pl,1}$ =$l_{eff,1}$ •t_f^2•p_y /4/γ_{M0}	201.9•14.2•14.2•275.0/4/1.0	2799.5 kN.mm	
$M_{pl,2}$ =$l_{eff,2}$ •t_f^2•p_y /4/γ_{M0}	205.6•14.2•14.2•275.0/4/1.0	2850.0 kN.mm	
2•m•n-e_w•(m+n)	2•32.14•40.18-11.00•(32.14+40.18)	1787.0	
$F_{T,1,Rd}$=(8•n-2•e_w)•$M_{pl,1}$ /1787.0	(8•40.18-2•11.00)•2799.5/1787.0	469.0 kN	
$F_{T,2,Rd}$=(2•$M_{pl,2}$+n•Nb•$F_{t,Rd}$)/(m+n)	(2•2850.0 + 40.18•2•203.3)/(32.14 + 40.18)	304.7 kN	
$F_{t,Rd}$ =min($F_{t,Rd}$ mode1,2,3)	min(469.0, 304.7, 406.7)	304.7 kN	

Beam Web Tension row 1 only

ω=fn(b_{eff}, t_w, A_{vc}, β)	fn(201.9, 9.4, 2215, 1.00)	0.72	
$F_{t,wc,Rd}$ =ω•$l_{eff,1}$ •t_{wc} •$f_{y,wc}$/γ_{M0}	0.72•201.9•9.4•275/1.00	373.4 kN	
	Stiffened within 0.87w thereofore will not govern		

End Plate row 1 only

m, e, e_x, w	50.4, 70.0, 40.0, 90.0		
$l_{eff,cp}$=min(Circ, Indiv End, Group)	min(316.7, 238.3, 248.3)	238.3 mm	T2.2 (a)
$l_{eff,ncp}$=min(Doubl,Indiv,Corn,Grp)	min(115.0, 251.6, 195.8, 170.8)	115.0 mm	T2.2 (a)
Mode 1 $l_{eff,1}$=min($l_{eff,cp}$, $l_{eff,cnp}$)	min(238.3, 115.0)	115.0 mm	
Mode 2 $l_{eff,2}$=$l_{eff,ncp}$	115.0	115.0 mm	
$M_{pl,1}$ =$l_{eff,1}$ •t_f^2•p_y /4/γ_{M0}	115.0•20.0•20.0•265.0/4/1.0	3047.5 kN.mm	
$M_{pl,2}$ =$l_{eff,2}$ •t_f^2•p_y /4/γ_{M0}	115.0•20.0•20.0•265.0/4/1.0	3047.5 kN.mm	
2•m•n-e_w•(m+n)	2•50.40•40.00-10.00•(50.40+40.00)	3128.0	
$F_{T,1,Rd}$=(8•n-2•e_w)•$M_{pl,1}$ /3128.0	(8•40.00-2•10.00)•3047.5/3128.0	292.3 kN	
$F_{T,2,Rd}$=(2•$M_{pl,2}$+n•Nb•$F_{t,Rd}$)/(m+n)	(2•3047.5 + 40•2•203.3)/(50.4 + 40)	247.4 kN	
$F_{t,Rd}$ =min($F_{t,Rd}$ mode1,2,3)	min(292.3, 247.4, 406.7)	247.4 kN	
Potential resistance of Bolt Row 1	$F_{t1,Rd}$	247.4 kN	Mode 2

BOLT ROW 2

Beam Flange row 2 only

m, e, mx, α	32.1, 57.9, 49.7, 6.4		
l_{eff} modes	$l_{eff,cp}$ = 201.9, $l_{eff,ncp}$ = 206.8		T2.2 (c)
Mode 1 $l_{eff,1}$=min($l_{eff,cp}$, $l_{eff,cnp}$)	min(201.9, 206.8)	201.9 mm	
Mode 2 $l_{eff,2}$=$l_{eff,ncp}$	206.8	206.8 mm	
$M_{pl,1}$ =$l_{eff,1}$ •t_f^2•p_y /4/γ_{M0}	201.9•14.2•14.2•275.0/4/1.0	2799.5 kN.mm	
$M_{pl,2}$ =$l_{eff,2}$ •t_f^2•p_y /4/γ_{M0}	206.8•14.2•14.2•275.0/4/1.0	2867.0 kN.mm	
2•m•n-e_w•(m+n)	2•32.14•40.18-11.00•(32.14+40.18)	1787.0	
$F_{T,1,Rd}$=(8•n-2•e_w)•$M_{pl,1}$ /1787.0	(8•40.18-2•11.00)•2799.5/1787.0	469.0 kN	
$F_{T,2,Rd}$=(2•$M_{pl,2}$+n•Nb•$F_{t,Rd}$)/(m+n)	(2•2867.0 + 40.18•2•203.3)/(32.14 + 40.18)	305.2 kN	
$F_{t,Rd}$ =min($F_{t,Rd}$ mode1,2,3)	min(469.0, 305.2, 406.7)	305.2 kN	

Beam Web Tension row 2 only

ω=fn(b_{eff}, t_w, A_{vc}, β)	fn(201.9, 9.4, 2215, 1.00)	0.72	
$F_{t,wc,Rd}$ =ω•$l_{eff,1}$ •t_{wc} •$f_{y,wc}$/γ_{M0}	0.72•201.9•9.4•275/1.00	373.4 kN	
	Stiffened within 0.87w thereofore will not govern		

End Plate row 2 only

m, e, mx, α	33.1, 70.0, 47.9, 6.9		
l_{eff} modes	$l_{eff,cp}$ = 207.7, $l_{eff,ncp}$ = 228.9		T2.2 (c)
Mode 1 $l_{eff,1}$=min($l_{eff,cp}$, $l_{eff,cnp}$)	min(207.7, 228.9)	207.7 mm	
Mode 2 $l_{eff,2}$=$l_{eff,ncp}$	228.9	228.9 mm	
$M_{pl,1}$ =$l_{eff,1}$ •t_f^2•p_y /4/γ_{M0}	207.7•20.0•20.0•265.0/4/1.0	5503.0 kN.mm	
$M_{pl,2}$ =$l_{eff,2}$ •t_f^2•p_y /4/γ_{M0}	228.9•20.0•20.0•265.0/4/1.0	6066.9 kN.mm	
2•m•n-e_w•(m+n)	2•33.05•41.31-10.00•(33.05+41.31)	1987.1	
$F_{T,1,Rd}$=(8•n-2•e_w)•$M_{pl,1}$ /1987.1	(8•41.31-2•10.00)•5503.0/1987.1	859.9 kN	
$F_{T,2,Rd}$=(2•$M_{pl,2}$+n•Nb•$F_{t,Rd}$)/(m+n)	(2•6066.9 + 41.31•2•203.3)/(33.05 + 41.31)	389.1 kN	
$F_{t,Rd}$ =min($F_{t,Rd}$ mode1,2,3)	min(859.9, 389.1, 406.7)	389.1 kN	

Column Web Tension row 2 only

$F_{t,wb,Rd}$ =$l_{eff,1}$ •t_{wb} •$f_{y,wb}$/γ_{M0}	207.7•7.9•275/1.00	451.1 kN	

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Potential resistance of Bolt Row 2	$F_{t2,Rd}$	305.2 kN	Mode 2

BOLT ROW 3

Beam Web Tension rows 2 to 3 combined

ω=fn(b_{eff}, t_w, A_{vc}, β)	fn(272.8, 9.4, 2215, 1.00)	0.60	
$F_{t,wc,Rd}$ =ω•$l_{eff,1}$ •t_{wc} •$f_{y,wc}$/γ_{M0}	0.60•272.8•9.4•275/1.00	425.9 kN	
$F_{t3,Rd}$=$F_{T,Rd}$-$F_{T,Rd}$2,2	425.9 - 305.2	120.7 kN	

Step 1C Plastic distribution Limit

T_p < d/1.9•√(f_{ub} /f_{yp})	20.0 < 24/1.9•√(800.0/265)	20.0 <= 21.9	Plastic
T_{fc} < d/1.9•√(f_{ub} /$f_{y,fc}$))	14.2 < 24/1.9•√(800.0/275)	14.2 <= 21.5	Plastic
$F_{t\ 2,Rd}$ < 1.9 $F_{t,rd}$	305.2 < 1.9•203.3		Plastic
Classification	Plastic Deformation occurs.	Use Plastic distribution	

Potential Tension Capacity

Sigma $F_{ti,Rd}$	247.4 + 305.2 + 120.7 kN	673.3 kN	OK

Step 2 & 6B: Compression Zone

Web Bearing

n =min(5,2+0.6•B_e /(t_{fc}+s))	min(5, 2 + 0.6•209.6/24.4)	5.000	
$b_{eff,c}$=t_{fb}+2s_f+n(t_{fc}+s)+s_p)	12.50+2•12.0+5.000(14.20+10.20)+40.00	198.5	
ω=fn(beff, t_w, A_{vc}, β)	fn(198.5, 9.4, 2215, 1.00)	0.72	
b_{sn}=b_{tfc}/2-t_wc-snipe	205.8/2 - 9.4 - 10.0	83.0 mm	
$N_{c,Rd}$ =(2•b_{sn}•ts+$b_{eff,c}$•t_{wc})•$f_{y,wc}$/γ_{M0}	(2•83.0•10+198.5•9.4)•275/1.00	969.6 kN	

Web Buckling

$A_{s,eff}$ =2•b_{sg} •t_s +L_w •t_w	2•95.0•10.0 + 270.7•9.4	4444 mm²	
I_s=t_s (2•b_{sg} +t_wc)³/12	10.0(2•95.0 + 9.4)³/12	6606846 mm4	
i_s=√(I_s /$A_{s,eff}$)	√(6606846/4444)	38.56 mm	
λ=(h_c-2•t_{fc})/i_s	(209.6 - 2•14.2)/38.56	0.05	
~k=min(1.0, 1/(Φ+√(Φ^2-λ^2))	min(1.0, 1/(0.47 + √(0.47^2-0.05^2))	1.000	
$N_{b,Rd}$ =~k•$A_{s,eff}$•f_y/γ_{M1}	1.00•4444.4•275/1.00	1222.2 kN	

Column Compression

$F_{c,fb,Rd}$= $M_{c,Rd}$/(h_b-t_{fb})	156.0•1000/(193.70)	805.5 kN	

Step 3: Beam Web Shear

$V_{wp,Rd}$=0.9•f_{yc} •A_{vc}/(γ_{M0}•√3)	0.9•275•2215.4/(1.0•√3)	316.6 kN	
Pc=Fn(As, Iyy, Ryy, L)(in comp.)	Fn(5642, 9910270, 41.9, 205)	275.0 N/mm²	
K Stiffener Capacity	(2•13.2•95)•275	691.2 kN	
Combined Capacity	316.6 + 691.2	1007.8 kN	
Tension bolts outside stiffened zone			
Fq=Fq_{web} •F_{web} /F+Fq_{Stiff} •F_{Stiff} /F	317•247 / 673 + 1008•426 / 673	753.8 kN	

Potential Compression Capacity

$F_{c,Rd}$min	Min(969.6, 1222.2, 805.5)	805.5 kN	OK

Step 4: Moment Capacity

$F_{c,Rd}$ =Min($F_{c,wc,Rd}$, $F_{c,fc,Rd}$)	min(969.6, 805.5)	805.5 kN	
Shear limit F_{ri}=min($F_{t,Rd}$ Total, $V_{wp,Rd}$)	min(673.3, 753.8)	673.3 kN	
$F_{t,Rd}$ Total < Min($F_{c,Rd}$ -N_{Ed}, $V_{wp,Rd}$)	No reduction in bolt forces required		

Final Bolt Forces and Moment Capacities

Bolt row 3 $M_{c,Rd}$3 =$F_{t3,Rd}$ •h_3	120.7•64.0	7.7 kN.m	
Bolt row 2 $M_{c,Rd}$2 =$F_{t2,Rd}$ •h_2	305.2•130.0	39.7 kN.m	
Bolt row 1 $M_{c,Rd}$1 =$F_{t1,Rd}$ •h_1	247.4•260.0	64.3 kN.m	
$M_{c,Rd}$		111.7 kN.m	
$M_{mod,Ed}$ =M-N_{Ed}•h_n	100.2 - -17.2•96.9	101.9 kN.m	OK
Tension Bolts	Only the first 2 rows are required to resist the applied moment The remaining rows shall be considered to be part of the shear zone.		
$M_{c,Rd}$' for 2 rows	64.3, 39.7	104.0 kN.m	
$F_{ri,Ed}$ for 2 rows	247.4, 305.2	552.6 kN	
$F_{ri,Ed}$ design=$F_{ri,Ed}$ •M_{Ed}/$M_{c,Rd}$'	552.6•101.9/104.0	541.5 kN	

Step 5: Shear Bolts

$F_{v,Rd}$=α_v •f_{ub} •A / γ_{M2}	0.6 • 800 • 353.0 / 1.25	135.6 kN	
Bearing $F_{b,Rd,End}$-End Plate, End	e1=40, e2=70, k_1=2.5, α_b=0.51, d=24, t=20, f_u=410	201.8 kN	
Bearing $F_{b,Rd}$-End Plate, Inner	p1=66, e2=70, k_1=2.5, α_b=0.60, d=24, t=20, f_u=410	234.6 kN	
Bearing $F_{b,Rd,End}$-Col Flange, End	e1=255, e2=58, k_1=2.5, α_b=1.00, d=24, t=14.2, f_u=410	279.5 kN	
Bearing $F_{b,Rd}$-Beam Flange, Inner	p1=66, e2=58, k_1=2.5, α_b=0.60, d=24, t=14.2, f_u=410	166.6 kN	
$F_{v,Rd,Sh}$=Min(bearing, shear)	Min(234.6, 166.6, 135.6)	135.6 kN	
$F_{v,Rd,T}$=min($F_{b,Rd}$,0.28•shr)	Min(234.6, 166.6, 38.0)	38.0 kN	
$F_{v,Rd,TEnd}$=min($F_{b,Rd,End}$,0.28•shr)	Min(201.8, 279.5, 38.0)	38.0 kN	
Shear=Ns•$F_{v,Rd,Sh}$	4•135.6	542.2 kN	

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Job ref	: 21187
Sheet	: **Sheet Ref / 91 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

Tension= (Nt-1)•$F_{v,Rd,T}$+ $F_{v,Rd,TEnd}$	2•38.0 + 2•38.0	151.8 kN	
$F_{v,Rd}$ Total=Shear+Tension	542.2 + 151.8	694 kN	OK

Combined Tension & Shear

Ft_{ave} =F/n	17/6	2.9 kN	
Fs=Ps•(1-Ft/(1.4•Pt))	135.6 • (1.0 - 2.9 / (203.3(1.4•Pt)))	134.2 kN	
$F_{v,Rd}$ Total=Ns•$F_{v,Rd}$ Shear+Nt•$F_{v,Rd}$Tension	2•135.6 + 6•134.2	1076 kN	OK

Step 6A: Beam Tension Stiffeners

Stiffener at Bolt Row 1

A_{sn} =b_{sn} •t_s	(95 - 10)•12	1020 mm²	
L_{wt} =L_u+P+L_l	77.9 + 130 + 33.0	240.9 mm	
$F_{t,wc,Rd}$=L_{wt}•t_{wc}•f_y/γ_{M0}	240.9•9.4•275/1000/1.00	622.6 kN	
F_{ri} =$F_{r1,Rd}$+$F_{r2,Rd}$	247.4 + 305.2	552.6 kN	
$F_{s,Ed}$ Web=(Fri -$F_{t,wc,Rd}$)/2	(552.6 - 622.6)/2	0.0 kN	
F_1 =$F_{r1,Rd}$ •m_1 /(m_1 +m_{2L})	247.4•32.1/(32.1 + 52.3)	94.2 kN	
F_2 =$F_{r2,Rd}$ •m_1 /(m_1 +m_2U)	305.2•32.1/(32.1 + 49.7)	119.8 kN	
$F_{s,Ed}$ Flange=(F_1+F_2)/2	(94.2 + 119.8)/2	107.0 kN	
$F_{s,Ed,max}$=max($F_{s,Ed,Web}$, $F_{s,Ed,Flng}$)	max(0.0, 107.0)	107.0 kN	
A_{sn} req =$F_{s,Ed}$•γ_{M0}/$f_{y,s}$	(107.0•1000•1.00)/275	389.1 mm²	OK
Stiff Len > 1.9•b_{sn}	181.2 >= 1.9•85.0	161.5 mm	OK
Ten weld leg >= S_{tk} •0.69	10 >= 12•0.69	10 >= 8.2	OK

Step 7: Welds

Column $f_{vw,d}$=f_u / (√3•$ß_w$) / γ_{M2}	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	

Flange Tension Weld

$Ft_{,flng}$ =min(B•T•P_y, F_{r1}+F_{r2})	Min(204.3•12.5•275, 242.4 + 299.1)	541.5 kN	
$F_{vw,Rd}$ =2•K•0.7•t_s •L•$f_{vw,d}$	2•1.225•0.7•12•(204.3 - 2•0.7•12)•223	867.5 kN	OK

Flange Compression Weld

Direct Bearing assumed. No check required

Web Welds in Tension Zone

Web Weld OK if >= 0.69•T	10 >= 0.69•7.9	>= 5.4 mm	OK

Web Welds in Shear Zone

Lws=D-(T_t+T_b)-r_t -r_b -Lwt	206.2 - 25.0 - 10.2 - 10.2 - 125	35.7 mm	
F_{wCap} =2•0.7•ts•Lws•$f_{vw,d}$	2•0.7•10•35.7•223	112.3 kN	OK

Compression Stiffener Web Weld

Beam $f_{vw,d}$=f_u / (√3•$ß_w$) / γ_{M2}	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	
F_{app} =F_t +N	541.5 + -17.2	524.3 kN	
F_wCap =2•2•0.7•t_s (D-2(T+r))•$f_{vw,d}$	2•2•0.7•8(209.6 - 2(14.2 + 10.2))•223	810.5 kN	OK

Shear Stiffener End Welds

End welds t_w >= 0.69•t_k	12 >= 0.69•15	10 mm	OK
Note:	Where stiffener is acute to the vertical the welds may be replaced with a full thickness fill-in weld and sealing run		

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Job ref	: 21187
Sheet	: **Sheet Ref / 92 -**
Made By	:
Date	**:08 June 2022**
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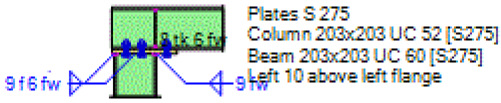
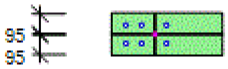
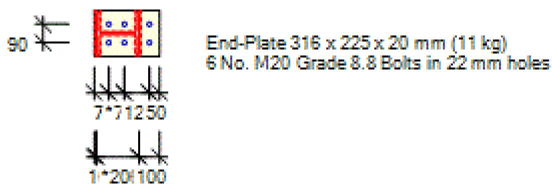
BRIEF 2

COLUMN TO BEAM FLANGE CONNECTION AT : END 2 OF MEMBER SCL1ID 51 - LEVEL 1







Column to Cap Beam Flange End-Plated Connection to EC 3 (UK NAD)

LOADING CASE 001 : DEAD PLUS LIVE B (ULTIMATE)

Basic Data

Integrated Applied Forces at Beam/Bottom Column Interface

Resultant Forces M, Fv, F	0.0 kNm, 0.0 kN, 30.9 kN
Load directions	Column in Compression.
Design to	EC 3: Part 1-8: 2005 Design of Connections
	SCI Green Book
	P398: Joints in steel construction: Moment-Resisting Joints to Eurocode 3
Weld Grades	All weld grades provided to suit minimum connected steel grade

Basic Dimensions

Beam-203x203UC60 [S 275]	D=209.6, B=205.8, T=14.2, t=9.4, r=10.2, py=275		
Column-203x203UC52 [S 275]	D=206.2, B=204.3, T=12.5, t=7.9, r=10.2, py=275		
Bolts 20 mm Ø in 22 mm holes	Grade 8.8 Bolts		
Plates S 275	All weld grades provided to suit minimum connected steel grade		
Beam Forces M, Fv, F	0.98 x 0 = 0 kN.m, 31 kN, 0 kN		
Beam Capacities Mc, Fvc, Fc	180.4 kN.m, 351.8 kN, 2100.2 kN	Fvc = 351.8 kN	OK

Summary of Results (Unity Ratios)

Compression Checks Right	0.02, 0.01, 0.02	0.02	OK
Web Welds	0.00	0.00	OK
Beam Compression stiff Web Weld	0.03	0.03	OK
Compression Checks Left	0.07, 0.07, 0.02	0.07	OK
Shear Capacity		0.00	OK

Step 2 & 6B: Right Compression Zone

Compression Force		15.43 kN	

Web Bearing

$n = \min(5, 2+0.6 \bullet B_e/(t_{fc}+s))$	min(5, 2 + 0.6•187.2/24.4)	5.000	
$b_{eff,c}=t_{fb}+2s_f+n(t_{fc}+s)+s_p)$	12.50+2•9.0+5.000(14.20+10.20)+40.00	192.5	
$\omega=fn(b_{eff}, t_w, A_{vc}, \beta)$	fn(192.5, 9.4, 2215, 1.00)	0.73	
$b_{sn}=b_{tfc}/2-t_{wc}$-snipe	205.8/2 - 9.4 - 10.0	83.0 mm	
$N_{c,Rd} = (2 \bullet b_{sn} \bullet ts+b_{eff,c} \bullet t_{wc}) \bullet f_{y,wc}/\gamma_{M0}$	(2•83.0•8+192.5•9.4)•275/1.00	862.8 kN	OK

Web Buckling

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Job ref	: 21187
Sheet	: **Sheet Ref / 93 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

$A_{s,eff}$ =2•b_{sg} •t_s +L_w •t_w	2•95.0•8.0 + 268.7•9.4	4046 mm²	
I_s=t_s (2•b_{sg} +t_{wc})³/12	8.0(2•95.0 + 9.4)³/12	5285477 mm4	
i_s=√(I_s /$A_{s,eff}$)	√(5285477/4046)	36.15 mm	
λ=(h_c-2•t_{fc})/i_s	(209.6 - 2•14.2)/36.15	0.06	
~k=min(1.0, 1/(Φ+√(Φ²-λ²))	min(1.0, 1/(0.47 + √(0.47²-0.06²))	1.000	
$N_{b,Rd}$ =~k•$A_{s,eff}$•f_y/γ_{M1}	1.00•4045.6•275/1.00	1112.6 kN	OK

Column Compression

$F_{c,fb,Rd}$= $M_{c,Rd}$/(h_b-t_{fb})	156.0•1000/(193.70)	805.5 kN	OK

Step 7: Right Welds

Column $f_{vw,d}$=f_u / (√3•β_w) / γ_{M2}	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	

Flange Right Compression Weld

Direct Bearing assumed. No check required

Web Welds in Shear Zone

Lws=D-(T_t+T_b)-r_t -r_b -Lwt	206.2 - 25.0 - 10.2 - 10.2 - 0	160.8 mm	
F_{wCap} =2•0.7•ts•Lws•$f_{vw,d}$	2•0.7•6•160.8•223	303.9 kN	OK

Compression Stiffener Right Web Weld

Beam $f_{vw,d}$=f_u / (√3•β_w) / γ_{M2}	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	
F_wCap =2•2•0.7•t_s (D-2(T+r))•$f_{vw,d}$	2•2•0.7•6(209.6 - 2(14.2 + 10.2))•223	607.9 kN	OK

Step 2: Left Compression Zone

Compression Force		15.43 kN	

Web Bearing

n =min(5,2+0.6•B_e /(t_{fc}+s))	min(5, 2 + 0.6•0.0/24.4)	2.000	
$b_{eff,c}$=t_{fb}+2s_f+n(t_{fc}+s)+s_p)	12.50+2•9.0+2.000(14.20+10.20)+21.00	100.3	
ω=fn(b_{eff}, t_w, A_{vc}, β)	fn(100.3, 9.4, 2215, 1.00)	0.90	
$\sigma_{com,Ed}$=M_ed/W_el+N_ed/A < fy	0.0•1000/584.7+0.0•10/76.4	0.0 N/mm²	
k_{wc}	$\sigma_{com,Ed}$ < 0.7•f_y	1.00	
$F_{c,wc,Rd}$ =ω•k_{wc}•$b_{eff,c}$•t_{wc}•f_y/γ_{M0}	0.900•1.000•100.3•9.4•275/1.00	233.3 kN	OK

Web Buckling

λ_p=0.932√($b_{eff,c}$•d_{wc}•f_y/(E•t_{wc}^2)	0.932√100.3•160.8•275/(210000•9.40²)	0.456	
Buckling factor ~r	λ_p <= 0.72	1.00	
$F_{c,wc,Rd}$ =~r•ω•k_{wc}•$b_{eff,c}$•t_{wc}•f_y/γ_{M1}	1.00•0.90•1.00•100.3•9.4•275/1.00	233.3 kN	OK

Column Compression

$F_{c,fb,Rd}$= $M_{c,Rd}$/(h_b-t_{fb})	156.0•1000/(193.70)	805.5 kN	OK

Step 3: Beam Web Shear

$V_{wp,Rd}$=0.9•f_{yc} •A_{vc}/(γ_{M0}•√3)	0.9•275•2215.4/(1.0•√3)	316.6 kN	
Shear Force Max.	Comp.Left+ Comp. Right, 15.43 + 15.43	30.9 kN	OK

N.B. Stiffener strength based on lesser grade of steel

Step 7: Left Welds

Column $f_{vw,d}$=f_u / (√3•β_w) / γ_{M2}	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	

FlangeLeft Compression Weld

Direct Bearing assumed. No check required

Step 5: Shear Bolts

Bolt Shear Capacity	BSC=91.875, tg=34.2	94.1 kN	
Bearing Capacity-End Plate	pb=460, edge=50.0, Ø=20, tk=20, kbs=1.00	184.0 kN	
Bearing Capacity-Beam Flange	pb=460, edge=65.0, Ø=20, tk=14.2, kbs=1.00	130.6 kN	
Bearing Capacity-Bolts	pb=1000, Ø=20, tk=14.2	284.0 kN	
Pss=Min(bearing...,shear)	Min(184.0, 130.6, 284.0, 94.1)	94.1 kN	
Pts Min(bearing...,0.4•shear)	Min(184.0, 130.6, 284.0, 37.6)	37.6 kN	
V=Ns•Pss+Nt•Pts	6•94.1 + 0•37.6	564 kN	OK

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Job ref	: 21187
Sheet	: **Sheet Ref / 94 -**
Made By	:
Date	**:08 June 2022**
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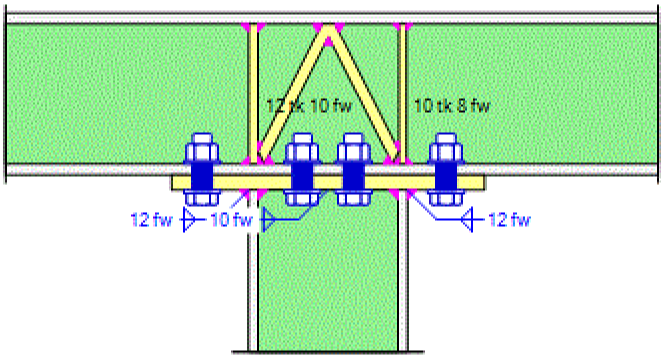
COPY OF BRIEF 2

COLUMN TO BEAM FLANGE CONNECTION AT : END 2 OF MEMBER SCL1ID 63 - LEVEL 1



Column to Cap Beam Flange End-Plated Connection to EC 3 (UK NAD)

LOADING CASE 001 : DEAD PLUS LIVE B (ULTIMATE)

Basic Data

Integrated Applied Forces at Beam/Bottom Column Interface

Resultant Forces M, Fv, F	112.0 kNm, -33.0 kN, 94.2 kN
Load directions	Left of Connection in Tension, Column moving Left and in Compression.
Design to	EC 3: Part 1-8: 2005 Design of Connections
	SCI Green Book
	P398: Joints in steel construction: Moment-Resisting Joints to Eurocode 3
Weld Grades	All weld grades provided to suit minimum connected steel grade

Basic Dimensions

Beam-203x203UC60 [S 275]	D=209.6, B=205.8, T=14.2, t=9.4, r=10.2, py=275		
Column-203x203UC52 [S 275]	D=206.2, B=204.3, T=12.5, t=7.9, r=10.2, py=275		
Bolts 24 mm Ø in 26 mm holes	Grade 8.8 Bolts		
Plates S 275	All weld grades provided to suit minimum connected steel grade		
Beam Forces M, Fv, F	0.93 x 1 = 1 kN.m, 1 kN, 33 kN		
Beam Capacities Mc, Fvc, Fc	180.4 kN.m, 351.8 kN, 2100.2 kN	Fc = 2100.2 kN	OK

Summary of Results (Unity Ratios)

Moment Capacity 111.7 kNm (for 3 rows of bolts) (Modified Applied Mom. M_{mod} =102.9 kNm)		0.92	OK
Moment Capacity 104.0 kNm (for the 2 rows of bolts required in the tension zone)		0.99	OK
Shear Capacity		0.05	OK
Beam Tension Stiffener at row 1	0.38, 0.89, 0.82	0.89	OK
Flange Welds	0.63	0.63	OK
Web Welds	0.54, 0.29	0.54	OK
Beam Compression stiff Web Weld	0.79	0.79	OK
Shear stiff End Welds	0.86	0.86	OK

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Job ref	: 21187
Sheet	: **Sheet Ref / 95 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

Step 1: Tension Zone

Basics

Bm/Plt b_p , W, t_{wb} , S_w , m_p , e_p , n_p	230.0, 90, 7.9, 10, 33.1, 70.0, 41.3		
Beam B_c , t_wc , r_c , m_c , e_c , n_c	205.8, 9.4, 10.2, 32.1, 57.9, 40.2		
Column extension x, e_x , s_f , m_x , e , n_x	60.0, 40, 12, 50.4, 70.0, 40.0		
$F_{t,Rd}=k_2 \cdot f_{ub} \cdot A / \gamma_{m2}$	0.90•800•353/1.25	203.3 kN	
$F_{T,3,Rd}=\Sigma F_{t,Rd}$	2•203.3	406.7 kN	

BOLT ROW 1

Beam Flange row 1 only

m, e, mx, α	32.1, 57.9, 52.3, 6.4		
l_{eff} modes	$l_{eff,cp}$ = 201.9, $l_{eff,ncp}$ = 205.6		T2.2 (c)
Mode 1 $l_{eff,1}=\min(l_{eff,cp}, l_{eff,cnp})$	min(201.9, 205.6)	201.9 mm	
Mode 2 $l_{eff,2}=l_{eff,ncp}$	205.6	205.6 mm	
$M_{pl,1} = l_{eff,1} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	201.9•14.2•14.2•275.0/4/1.0	2799.5 kN.mm	
$M_{pl,2} = l_{eff,2} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	205.6•14.2•14.2•275.0/4/1.0	2850.0 kN.mm	
$2 \cdot m \cdot n - e_w \cdot (m+n)$	2•32.14•40.18-11.00•(32.14+40.18)	1787.0	
$F_{T,1,Rd}=(8 \cdot n-2 \cdot e_w) \cdot M_{pl,1}$ /1787.0	(8•40.18-2•11.00)•2799.5/1787.0	469.0 kN	
$F_{T,2,Rd}=(2 \cdot M_{pl,2}+n \cdot Nb \cdot F_{t,Rd})/(m+n)$	(2•2850.0 + 40.18•2•203.3)/(32.14 + 40.18)	304.7 kN	
$F_{t,Rd} = \min(F_{t,Rd}$ mode1,2,3)	min(469.0, 304.7, 406.7)	304.7 kN	

Beam Web Tension row 1 only

$\omega = fn(b_{eff}, t_w, A_{vc}, \beta)$	fn(201.9, 9.4, 2215, 1.00)	0.72	
$F_{t,wc,Rd} = \omega \cdot l_{eff,1} \cdot t_{wc} \cdot f_{y,wc}/\gamma_{M0}$	0.72•201.9•9.4•275/1.00	373.4 kN	
	Stiffened within 0.87w thereofore will not govern		

End Plate row 1 only

m, e, e_x, w	50.4, 70.0, 40.0, 90.0		
$l_{eff,cp}$=min(Circ, Indiv End, Group)	min(316.7, 238.3, 248.3)	238.3 mm	T2.2 (a)
$l_{eff,ncp}$=min(Doubl,Indiv,Corn,Grp)	min(115.0, 251.6, 195.8, 170.8)	115.0 mm	T2.2 (a)
Mode 1 $l_{eff,1}=\min(l_{eff,cp}, l_{eff,cnp})$	min(238.3, 115.0)	115.0 mm	
Mode 2 $l_{eff,2}=l_{eff,ncp}$	115.0	115.0 mm	
$M_{pl,1} = l_{eff,1} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	115.0•20.0•20.0•265.0/4/1.0	3047.5 kN.mm	
$M_{pl,2} = l_{eff,2} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	115.0•20.0•20.0•265.0/4/1.0	3047.5 kN.mm	
$2 \cdot m \cdot n - e_w \cdot (m+n)$	2•50.40•40.00-10.00•(50.40+40.00)	3128.0	
$F_{T,1,Rd}=(8 \cdot n-2 \cdot e_w) \cdot M_{pl,1}$ /3128.0	(8•40.00-2•10.00)•3047.5/3128.0	292.3 kN	
$F_{T,2,Rd}=(2 \cdot M_{pl,2}+n \cdot Nb \cdot F_{t,Rd})/(m+n)$	(2•3047.5 + 40•2•203.3)/(50.4 + 40)	247.4 kN	
$F_{t,Rd} = \min(F_{t,Rd}$ mode1,2,3)	min(292.3, 247.4, 406.7)	247.4 kN	
Potential resistance of Bolt Row 1	$F_{t1,Rd}$	247.4 kN	Mode 2

BOLT ROW 2

Beam Flange row 2 only

m, e, mx, α	32.1, 57.9, 49.7, 6.4		
l_{eff} modes	$l_{eff,cp}$ = 201.9, $l_{eff,ncp}$ = 206.8		T2.2 (c)
Mode 1 $l_{eff,1}=\min(l_{eff,cp}, l_{eff,cnp})$	min(201.9, 206.8)	201.9 mm	
Mode 2 $l_{eff,2}=l_{eff,ncp}$	206.8	206.8 mm	
$M_{pl,1} = l_{eff,1} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	201.9•14.2•14.2•275.0/4/1.0	2799.5 kN.mm	
$M_{pl,2} = l_{eff,2} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	206.8•14.2•14.2•275.0/4/1.0	2867.0 kN.mm	
$2 \cdot m \cdot n - e_w \cdot (m+n)$	2•32.14•40.18-11.00•(32.14+40.18)	1787.0	
$F_{T,1,Rd}=(8 \cdot n-2 \cdot e_w) \cdot M_{pl,1}$ /1787.0	(8•40.18-2•11.00)•2799.5/1787.0	469.0 kN	
$F_{T,2,Rd}=(2 \cdot M_{pl,2}+n \cdot Nb \cdot F_{t,Rd})/(m+n)$	(2•2867.0 + 40.18•2•203.3)/(32.14 + 40.18)	305.2 kN	
$F_{t,Rd} = \min(F_{t,Rd}$ mode1,2,3)	min(469.0, 305.2, 406.7)	305.2 kN	

Beam Web Tension row 2 only

$\omega = fn(b_{eff}, t_w, A_{vc}, \beta)$	fn(201.9, 9.4, 2215, 1.00)	0.72	
$F_{t,wc,Rd} = \omega \cdot l_{eff,1} \cdot t_{wc} \cdot f_{y,wc}/\gamma_{M0}$	0.72•201.9•9.4•275/1.00	373.4 kN	
	Stiffened within 0.87w thereofore will not govern		

End Plate row 2 only

m, e, mx, α	33.1, 70.0, 47.9, 6.9		
l_{eff} modes	$l_{eff,cp}$ = 207.7, $l_{eff,ncp}$ = 228.9		T2.2 (c)
Mode 1 $l_{eff,1}=\min(l_{eff,cp}, l_{eff,cnp})$	min(207.7, 228.9)	207.7 mm	
Mode 2 $l_{eff,2}=l_{eff,ncp}$	228.9	228.9 mm	
$M_{pl,1} = l_{eff,1} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	207.7•20.0•20.0•265.0/4/1.0	5503.0 kN.mm	
$M_{pl,2} = l_{eff,2} \cdot t_f^2 \cdot p_y /4/\gamma_{M0}$	228.9•20.0•20.0•265.0/4/1.0	6066.9 kN.mm	
$2 \cdot m \cdot n - e_w \cdot (m+n)$	2•33.05•41.31-10.00•(33.05+41.31)	1987.1	
$F_{T,1,Rd}=(8 \cdot n-2 \cdot e_w) \cdot M_{pl,1}$ /1987.1	(8•41.31-2•10.00)•5503.0/1987.1	859.9 kN	
$F_{T,2,Rd}=(2 \cdot M_{pl,2}+n \cdot Nb \cdot F_{t,Rd})/(m+n)$	(2•6066.9 + 41.31•2•203.3)/(33.05 + 41.31)	389.1 kN	
$F_{t,Rd} = \min(F_{t,Rd}$ mode1,2,3)	min(859.9, 389.1, 406.7)	389.1 kN	

Column Web Tension row 2 only

$F_{t,wb,Rd} = l_{eff,1} \cdot t_{wb} \cdot f_{y,wb}/\gamma_{M0}$	207.7•7.9•275/1.00	451.1 kN	

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Job ref	: 21187
Sheet	: **Sheet Ref / 96 -**
Made By	:
Date	**:08 June 2022**
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Potential resistance of Bolt Row 2	$F_{t2,Rd}$	305.2 kN	Mode 2

BOLT ROW 3

Beam Web Tension rows 2 to 3 combined

ω=fn(b_{eff}, t_w, A_{vc}, β)	fn(272.8, 9.4, 2215, 1.00)	0.60	
$F_{t,wc,Rd}$ =ω•$l_{eff,1}$ •t_{wc} •$f_{y,wc}/\gamma_{M0}$	0.60•272.8•9.4•275/1.00	425.9 kN	
$F_{t3,Rd}$=$F_{T,Rd}$-$F_{T,Rd}$2,2	425.9 - 305.2	120.7 kN	

Step 1C Plastic distribution Limit

T_p < d/1.9•$\sqrt{(f_{ub}/f_{yp})}$	20.0 < 24/1.9•√(800.0/265)	20.0 <= 21.9	Plastic
T_{fc} < d/1.9•$\sqrt{(f_{ub}/f_{y,fc})}$)	14.2 < 24/1.9•√(800.0/275)	14.2 <= 21.5	Plastic
$F_{t\,2,Rd}$ < 1.9 $F_{t,rd}$	305.2 < 1.9•203.3		Plastic
Classification	Plastic Deformation occurs.	Use Plastic distribution	

Potential Tension Capacity

Sigma $F_{ti,Rd}$	247.4 + 305.2 + 120.7 kN	673.3 kN	

Step 2 & 6B: Compression Zone

Web Bearing

n =min(5,2+0.6•B_e /(t_{fc}+s))	min(5, 2 + 0.6•209.6/24.4)	5.000	
$b_{eff,c}$=t_{fb}+2s_f+n(t_{fc}+s)+s_p)	12.50+2•12.0+5.000(14.20+10.20)+40.00	198.5	
ω=fn(b_{eff}, t_w, A_{vc}, β)	fn(198.5, 9.4, 2215, 1.00)	0.72	
b_{sn}=b_{tfc}/2-t_{wc}-snipe	205.8/2 - 9.4 - 10.0	83.0 mm	
$N_{c,Rd}$ =(2•b_{sn}•ts+$b_{eff,c}$•t_{wc})•$f_{y,wc}/\gamma_{M0}$	(2•83.0•10+198.5•9.4)•275/1.00	969.6 kN	

Web Buckling

$A_{s,eff}$ =2•b_{sg} •t_s +L_w •t_w	2•95.0•10.0 + 270.7•9.4	4444 mm²	
I_s=t_s (2•b_{sg} +t_{wc})³/12	10.0(2•95.0 + 9.4)³/12	6606846 mm4	
$i_s=\sqrt{(I_s/A_{s,eff})}$	√(6606846/4444)	38.56 mm	
λ=(h_c-2•t_{fc})/i_s	(209.6 - 2•14.2)/38.56	0.05	
~k=min(1.0, 1/($\Phi+\sqrt{(\Phi^2-\lambda^2)}$))	min(1.0, 1/(0.47 + √(0.47²-0.05²))	1.000	
$N_{b,Rd}$ =~k•$A_{s,eff}$•f_y/γ_{M1}	1.00•4444.4•275/1.00	1222.2 kN	

Column Compression

$F_{c,fb,Rd}$= $M_{c,Rd}$/(h_b-t_{fb})	156.0•1000/(193.70)	805.5 kN	

Step 3: Beam Web Shear

$V_{wp,Rd}$=0.9•f_{yc} •A_{vc}/(γ_{M0}•√3)	0.9•275•2215.4/(1.0•√3)	316.6 kN	
Pc=Fn(As, Iyy, Ryy, L)(in comp.)	Fn(5642, 9910270, 41.9, 205)	275.0 N/mm²	
K Stiffener Capacity	(2•13.2•95)•275	691.2 kN	
Combined Capacity	316.6 + 691.2	1007.8 kN	
Tension bolts outside stiffened zone			
Fq=Fq_{web} •F_{web} /F+Fq_{Stiff} •F_{Stiff} /F	317•247 / 673 + 1008•426 / 673	753.8 kN	

Potential Compression Capacity

$F_{c,Rd}$min	Min(969.6, 1222.2, 805.5)	805.5 kN	OK

Step 4: Moment Capacity

$F_{c,Rd}$ =Min($F_{c,wc,Rd}$, $F_{c,fc,Rd}$)	min(969.6, 805.5)	805.5 kN	
Shear limit F_{ri}=min($F_{t,Rd}$ Total, $V_{wp,Rd}$)	min(673.3, 753.8)	673.3 kN	
$F_{t,Rd}$ Total < Min($F_{c,Rd}$ -N_{Ed}, $V_{wp,Rd}$)	No reduction in bolt forces required		

Final Bolt Forces and Moment Capacities

Bolt row 3 $M_{c,Rd}$3 =$F_{t3,Rd}$ •h_3	120.7•64.0	7.7 kN.m	
Bolt row 2 $M_{c,Rd}$2 =$F_{t2,Rd}$ •h_2	305.2•130.0	39.7 kN.m	
Bolt row 1 $M_{c,Rd}$1 =$F_{t1,Rd}$ •h_1	247.4•260.0	64.3 kN.m	
$M_{c,Rd}$		111.7 kN.m	
$M_{mod,Ed}$ =M-N_{Ed}•h_n	112.0 - 94.2•96.9	102.9 kN.m	OK
Tension Bolts	Only the first 2 rows are required to resist the applied moment The remaining rows shall be considered to be part of the shear zone.		
$M_{c,Rd}$' for 2 rows	64.3, 39.7	104.0 kN.m	
$F_{ri,Ed}$ for 2 rows	247.4, 305.2	552.6 kN	
$F_{ri,Ed}$ design=$F_{ri,Ed}$ •M_{Ed}/$M_{c,Rd}$'	552.6•102.9/104.0	546.7 kN	

Step 5: Shear Bolts

$F_{v,Rd}$=α_v •f_{ub} •A / γ_{M2}	0.6 • 800 • 353.0 / 1.25	135.6 kN	
Bearing $F_{b,Rd,End}$-End Plate, End	e1=40, e2=70, k_1=2.5, α_b=0.51, d=24, t=20, f_u=410	201.8 kN	
Bearing $F_{b,Rd}$-End Plate, Inner	p1=66, e2=70, k_1=2.5, α_b=0.60, d=24, t=20, f_u=410	234.6 kN	
Bearing $F_{b,Rd,End}$-Col Flange, End	e1=255, e2=58, k_1=2.5, α_b=1.00, d=24, t=14.2, f_u=410	279.5 kN	
Bearing $F_{b,Rd}$-Beam Flange, Inner	p1=66, e2=58, k_1=2.5, α_b=0.60, d=24, t=14.2, f_u=410	166.6 kN	
$F_{v,Rd,Sh}$=Min(bearing, shear)	Min(234.6, 166.6, 135.6)	135.6 kN	
$F_{v,Rd,T}$=min($F_{b,Rd}$,0.28•shr)	Min(234.6, 166.6, 38.0)	38.0 kN	
$F_{v,Rd,TEnd}$=min($F_{b,Rd,End}$,0.28•shr)	Min(201.8, 279.5, 38.0)	38.0 kN	
Shear=Ns•$F_{v,Rd,Sh}$	4•135.6	542.2 kN	

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Tension= $(N_t-1)\bullet F_{v,Rd,T}+F_{v,Rd,TEnd}$	2•38.0 + 2•38.0	151.8 kN	
$F_{v,Rd}$ Total=Shear+Tension	542.2 + 151.8	694 kN	OK

Step 6A: Beam Tension Stiffeners

Stiffener at Bolt Row 1

$A_{sn} = b_{sn} \bullet t_s$	(95 - 10)•12	1020 mm²	
$L_{wt} = L_u+P+L_l$	77.9 + 130 + 33.0	240.9 mm	
$F_{t,wc,Rd}=L_{wt}\bullet t_{wc}\bullet f_y/\gamma_{M0}$	240.9•9.4•275/1000/1.00	622.6 kN	
$F_{ri} = F_{r1,Rd}+F_{r2,Rd}$	247.4 + 305.2	552.6 kN	
$F_{s,Ed}$ Web=$(F_{ri} - F_{t,wc,Rd})/2$	(552.6 - 622.6)/2	0.0 kN	
$F_1 = F_{r1,Rd} \bullet m_1 / (m_1 + m_{2L})$	247.4•32.1/(32.1 + 52.3)	94.2 kN	
$F_2 = F_{r2,Rd} \bullet m_1 / (m_1 + m_2U)$	305.2•32.1/(32.1 + 49.7)	119.8 kN	
$F_{s,Ed}$ Flange=$(F_1+F_2)/2$	(94.2 + 119.8)/2	107.0 kN	
$F_{s,Ed,max}=\max(F_{s,Ed,Web}, F_{s,Ed,Flng})$	max(0.0, 107.0)	107.0 kN	
A_{sn} req $=F_{s,Ed}\bullet\gamma_{M0}/f_{y,s}$	(107.0•1000•1.00)/275	389.1 mm²	OK
Stiff Len > $1.9\bullet b_{sn}$	181.2 >= 1.9•85.0	161.5 mm	OK
Ten weld leg >= $S_{tk} \bullet 0.69$	10 >= 12•0.69	10 >= 8.2	OK

Step 7: Welds

Column $f_{vw,d}=f_u / (\sqrt{3}\bullet\beta_w) / \gamma_{M2}$	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	

Flange Tension Weld

$Ft_{,flng} = \min(B\bullet T\bullet P_y, F_{r1}+F_{r2})$	Min(204.3•12.5•275, 244.7 + 302.0)	546.7 kN	
$F_{vw,Rd} = 2\bullet K\bullet 0.7\bullet t_s \bullet L\bullet f_{vw,d}$	2•1.225•0.7•12•(204.3 - 2•0.7•12)•223	867.5 kN	OK

Flange Compression Weld

Direct Bearing assumed. No check required

Web Welds in Tension Zone

Web Weld OK if >= 0.69•T	10 >= 0.69•7.9	>= 5.4 mm	OK

Web Welds in Shear Zone

$Lws=D-(T_t+T_b)-r_t-r_b-Lwt$	206.2 - 25.0 - 10.2 - 10.2 - 125	35.7 mm	
$F_{wCap} = 2\bullet 0.7\bullet ts\bullet Lws\bullet f_{vw,d}$	2•0.7•10•35.7•223	112.3 kN	OK

Compression Stiffener Web Weld

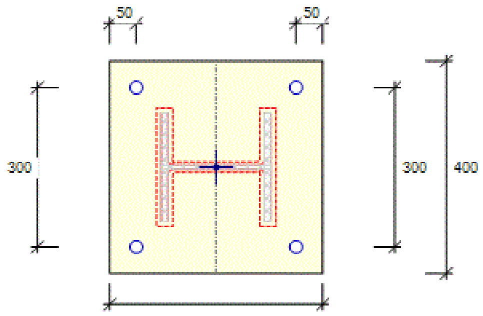
Beam $f_{vw,d}=f_u / (\sqrt{3}\bullet\beta_w) / \gamma_{M2}$	410.0 / √3 / 0.85 / 1.25	222.8 N/mm²	
$F_{app} = F_t + N$	546.7 + 94.2	640.9 kN	
$F_wCap = 2\bullet 2\bullet 0.7\bullet t_s (D-2(T+r))\bullet f_{vw,d}$	2•2•0.7•8(209.6 - 2(14.2 + 10.2))•223	810.5 kN	OK

Shear Stiffener End Welds

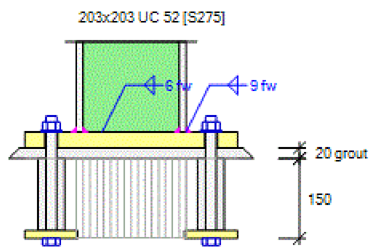
End welds $t_w >= 0.69\bullet t_k$	12 >= 0.69•15	10 mm	OK
Note:	Where stiffener is acute to the vertical the welds may be replaced with a full thickness fill-in weld and sealing run		

BRIEF 4

BASE PLATE AT : END 1 OF MEMBER SCL1ID 51 - LEVEL 0



Base-Plate 400 x 400 x 30 mm (38 kg)
With 4 No. 24 mm holes
For 20 mm Grade 8.8 Bolts.



Washers 100 x 100 x 15 mm thick with 50 mm Void
All Plates S 275

Base-Plate Connection to EC 3 (UK NAD)

LOADING CASE 001 : DEAD PLUS LIVE B (ULTIMATE)

Basic Data

Integrated Applied Forces at Interface

Resultant Forces M, Fv, F	Moment +0.0 kNm, Shear +0.0 kN, Axial +33.1 kN Forces taken from Support Reaction (Axial Compression)

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Job ref	: 21187
Sheet	: **Sheet Ref / 98 -**
Made By	:
Date	**:08 June 2022**
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Basic Dimensions

Column: 203x203UC52 [28]	D=206.2, B=204.3, T=12.5, t=7.9, r=10.2, py=275		
Bolts 20 mm Ø in 24 mm holes	Grade 8.8 Bolts		
Plates S 275	All weld grades provided to suit minimum connected steel grade		
Grout Fck, Conc Fck, vc, fy, slope	20 N/mm², 25 N/mm², 0.35 N/mm², 265 N/mm², 30 deg to vertical		
Design to	EC 3: Part 1-8: 2005 Design of Connections		
SCI Green Book	P358: Joints in steel construction: Simple joints to Eurocode 3		
Column Capacities Mc, Fvc, Fc	156.0 kN.m, 297.6 kN, 1822.7 kN	Fc = 1822.7 kN	OK

Summary of Results (Unity Ratios)

Concrete Pressure	0.24	OK
Base-Plate thickness in Compression	0.01	OK

STEP 2 - COMPRESSION T-STUB

Pad Edge, Depth. Plt L, W	500, 500, 400, 400		
Pad diffusion Ratio α=Sqrt(A_{c1} / A_{c0})	Sqrt(8100 / 1600) but (1<3)	2.25	EC2 6.6(2)
Grout Ratio β_J		0.67	
$F_{cd} = \alpha_{cc} \cdot F_{ck} / \gamma_c$	0.85 • 25.00 / 1.50	14.17 N/mm²	
Bearing Stress $F_Jd = \beta_J \cdot \alpha \cdot F_{cd}$	0.67 • 2.25 • 14.17	21.25 N/mm²	
Max $c = T_{bp} \cdot \sqrt{(f_{y.bp} / (3 \cdot f_Jd \cdot \gamma_{M0}))}$	30•√(265 / 3•(21.25•1.0))	61.2 mm	

Step 1-2: Base-Plate Pressure

Base ecc=M/F	0.0/33.1	0.0 mm	
Pressure Configuration	Compression Only with Optimised Compression Area		
Proj C, Xcc	0.0, 200.0		
L Zones X1, X2, X3, X4, X5	96.9, 12.6, 181.1, 12.6, 0.0		
W Zones Wstiff, Wflange, Wweb	0.0, 204.4, 8.0		
$Ac = x_f \cdot wf_c + x_w \cdot ww_c + x_f \cdot wf_t$	12.56•204.36 + 181.14•7.96 + 12.56•204.36	65.8 cm²	
Conc Cap Fc=•F_{jd} •Ac	21.3•6575.2	139.7 kN	OK
Pressure=P•1000/Ac	33.1•1000/6575	5.03 N/mm²	OK

Step 2a: Plate Compression Bending

e=C	0.0	0.0 mm	
$M_{app} = p \cdot e^2/2$	5.0•0.0²/2	0 Nmm/mm	
$tp = \sqrt{(6 \cdot M_{app} \cdot \gamma_{M0} / p_y)}$	√(6•1•1.00/265)	0.2 mm	OK

Step 5: Flange & Web Welds

Load dispersal	Flanges resist Moment and Axial, Web resists Axial and Shear. Direct Bearing therefore design for tensile forces only.
Areas A, Af, Aw	66.3, 2 x 25.5, 14.3 cm²

Flange Welds

Fapp=F•Af/A	33.1•25.5/66.3 No Resultant Tensile Force	-12.7 kN

Web Welds

No Shear or Resultant Axial Force in Web.

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Sheet	: **Sheet Ref / 99 -**
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Date	:**08 June 2022**
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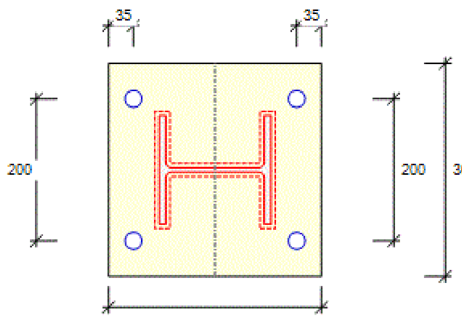
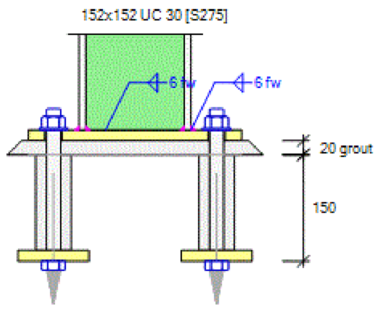
COPY OF BRIEF 4

BASE PLATE AT : END 1 OF MEMBER SCL1ID 55 - LEVEL 0



Base-Plate 300 x 300 x 15 mm (11 kg)
With 4 No. 24 mm holes
For 20 mm Grade 8.8 Bolts.



Washers 100 x 100 x 15 mm thick with 50 mm Void
All Plates S 275

Base-Plate Connection to EC 3 (UK NAD)

LOADING CASE 002 : DEAD PLUS LIVE A (ULTIMATE)

Basic Data

Integrated Applied Forces at Interface

Resultant Forces M, Fv, F	Moment +0.0 kNm, Shear -24.6 kN, Axial -50.2 kN Forces taken from Support Reaction (Axial Up-Lift)		

Basic Dimensions

Column: 152x152UC30 [28]	D=157.6, B=152.9, T=9.4, t=6.5, r=7.6, py=275		
Bolts 20 mm Ø in 24 mm holes	Grade 8.8 Bolts		
Plates S 275	All weld grades provided to suit minimum connected steel grade		
Grout Fck, Conc Fck, vc, fy, slope	20 N/mm², 25 N/mm², 0.35 N/mm², 275 N/mm², 30 deg to vertical		
Design to	EC 3: Part 1-8: 2005 Design of Connections SCI Green Book P398: Joints in steel construction: Moment-Resisting Joints to Eurocode 3		
Column Capacities Mc, Fvc, Fc	68.1 kN.m, 183.5 kN, 1052.2 kN	Fvc = 183.5 kN	OK

Summary of Results (Unity Ratios)

Bolt Tension		0.09	OK
Plate Tension Bending	0.19	0.19	OK
Concrete Embedment		0.16	OK
Washer size	1.00, 1.00	1.00	OK
Pullout Cones	0.37, 0.45, 0.62	0.62	OK
Horizontal Shear		0.45	OK
Flange & Web Welds	0.06, 0.10, 0.04, 0.11, 0.03	0.11	OK

STEP 2 - COMPRESSION T-STUB

Pad Edge, Depth. Plt L, W	500, 500, 300, 300		
Pad diffusion Ratio α=Sqrt(A_{c1} / A_{c0})	Sqrt(6400 / 900) but (1<3)	2.67	EC2 6.6(2)
Grout Ratio β_J		0.67	
F_{cd} =α_{cc} •F_{ck} / γ_c	0.85 • 25.00 / 1.50	14.17 N/mm²	
Bearing Stress $F_J d$= β_J • α • F_{cd}	0.67 • 2.67 • 14.17	25.19 N/mm²	
Max c =T_{bp} •√($f_{y.bp}$ / (3•$f_J d$ •γ_{M0}))	15•√(275 / 3•(25.19•1.0))	28.6 mm	

Step 1-2: Base-Plate Pressure

No Net Compression	Tension Only		
Bolt ecc=L-Lcent-Rcent	300.0 - 35.0 - 35.0	230.0 mm	
Fmom=M/Bolt ecc	0.0/230.0	0.0 kN	
Bolt Force=Fa/2+Fmom	50.2/2 + 0.0 (per side)	25.1 kN	
$F_{t,Rd}$=k_2 •f_{ub} •A / γ_{m2}	0.90•800•245/1.25	141.1 kN	
Bolt Capacity=$F_{t,Rd}$ •No.Bolts	141.1•2	282.2 kN	OK

Step 3: Plate Tension Bending

External Bolt Row

F_t=Ftot•Row1 bolts / Tot bolts	25.1•2/ 2	25.1 kN	
m_x, e, e_x	31.4, 50.0, 35.0		

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Sheet	: **Sheet Ref / 100 -**
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Date	:**08 June 2022**
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$l_{eff,cp}$=min(Circ, Indiv End)	min(197.3, 168.6)	168.6 mm	T5.3
$l_{eff,ncp}$=min(Single,Indiv,Corn,Grp)	min(150.0, 169.4, 134.7, 184.7)	134.7 mm	T5.3
$l_{eff,1}$=min($l_{eff,cp}$, $l_{eff,cnp}$)	min(168.6, 134.7)	134.7 mm	
$M_{pl,1} = l_{eff,1} \bullet t^2 \bullet f_y / 4 / \gamma_{M0}$	134.7•15.0•15.0•275.0/ 4/1.0	2083.3 kN.mm	
$F_{t,Rd}=2 \bullet M_{pl,1}/m_x$	2•2083.3 / 31.4	132.7 kN	OK

Step 3: Bolt Pullout

Washer Embedment

Min Embedment Fn(Ft, Void, F_{cd})	12.5, 50,14.17	4.1 mm	
Actual Embedment	(100 - 50)/2	25.0 mm	OK

Washer Size

Washer Thickness tk >= 0.8•Ø	15 >= 0.8•20 (16 >> 15mm SCI P207/95 T.6.3)	15.0 mm	OK
Washer width Lap >= 5•Ø	100 >= 5•20	100.0 mm	OK

Individual Cones

Limit Washer width Lap=5•t/0.8	5•15/0.8	93.8 mm	
Force per Bolt		12.54 kN	
Capacity Fn(w, Slope, h, Pyq)	93.8, 3, 135, 0.35	33.82 kN	OK

Single Cone

Total Bolt Force		25.08 kN	
Limit Washer width Lap=5•t/0.8	5•15/0.8	93.8 mm	
Capacity Fn(w, d, Slope, h, Pyq)	93.8, 293.8, 3, 135, 0.35	55.64 kN	OK

Single Cone on All Bolts

Total Bolt Force		50.15 kN	
Limit Washer width Lap=5•t/0.8	5•15/0.8	93.8 mm	
Capacity Fn(w, d, Slope, h, Pyq)	323.75, 293.75, 3, 135, 0.35	80.74 kN	OK
Note	Minimum distance from any tension Bolt to free edge	203 mm	
	If less then pullout cone shear capacity will be less than calculated		

Step 4: Shear

Base Friction

Friction Fr=0.30•Fc	0.30•-50.2 kN uplift therefore ignore	0.0 kN	

Check 4a: Bolt Shear

$\alpha_{bc}=0.44-0.0003 \bullet f_{yb}$	0.44 - 0.0003 • 640	0.248	
$F_{v,Rd}=\alpha_{bc} \bullet f_{ub} \bullet A / \gamma_{M2}$	0.248 • 800 • 245.0 / 1.25	38.9 kN	

Check 4b: Base-Plate Bearing

P_1 , e_1 , P_2 , e_2 , α_b , k_1	230.0, 35.0, 300.0, 50.0, 0.530, 2.500		
$F_{b,Rd}=0.8 \bullet k_1 \bullet \alpha_b \bullet f_{up} \bullet d \bullet t_p / \gamma_{M2}$	0.8 • 2.5 • 0.530 • 410 • 20 • 15.0 / 1.25	104.4 kN	
Conc. Bearing $Cb=3 \bullet Ø^2 \bullet F_{cd,min}$	3•20²•1•11 (No Shear Reinf.)	13.6 kN	
$F_{v,Rd} =(1-Ft/F_{t,Rd}/1.4) \bullet F_{v,Rd}$	(1 - 12.5 /141.1/ 1.4)•38.9	36.4 kN	
Pts=Min(F_{Vrd1} , Cb, Pb, Bb)•nbt	Min(36.4, 13.6, 104.4, 300.0) = 13.6•4	54.4 kN	

Total Shear Capacity

Total Cap=Pts	54.4	54.4 kN	OK

Step 5: Flange & Web Welds

Load dispersal	Flanges resist Moment and Axial, Web resists Axial and Shear.		
	Direct Bearing therefore design for tensile forces only.		
Areas A, Af, Aw	38.3, 2 x 14.4, 9.0 cm²		

Flange Welds

Fapp=F•Af/A	-50.2•14.4/38.3	18.8 kN	
Fapp w=Fapp/(2•B-t-tw•4)•2	18.8/(2•152.9 - 6.5 - 6•4)•2	0.14 kN/mm	
Weld f_{vw}.d $=f_u$ / 1.73 / (~B_w • γ_{M2})	410/ 1.73 / 0.85 / 1.25	223 N/mm²	
Fcap w=k•2•0.7•f_w •f_{vw}.d	1.225•2•0.7•6•223	2.29 kN/mm	OK

Web Welds

Web weld load=Fv/(D-2(fw+T))	24.6/(157.6 - 2(6 +9.4))	0.19 kN/mm	
Weld f_{vw}.d$=f_u$ / 1.73 / (~B_w • γ_{M2})	410/ 1.73 / 0.85 / 1.25	223 N/mm²	
Fcap w=2•0.7•f_w •f_{vw}.d	2•0.7•6•223	1.87 kN/mm	OK
F_{axial}=F•Aw/A	50.2•9.0/38.3	11.8 kN	
Web weld load=F_{axial} /(D-2(fw+T))	11.8/(157.6 - 2(6 +9.4)) (on 2 welds/mm)	0.09 kN/mm	
Weld f_{vw}.d$=f_u$ / 1.73 / (~B_w • γ_{M2})	410/ 1.73 / 0.85 / 1.25	223 N/mm²	
Fcap w=2•k•0.7•f_w •f_{vw}.d	2•1.225•0.7•6•223	2.29 kN/mm	OK
σ_{perp}, τ_{perp}	0.09 • 0.707 / a / 2 • 1000	7.77 N/mm²	
τ_{parl}	0.19 / a / 2 • 1000	22.86 N/mm²	
$f_{w.Ed}=\sqrt{(\sigma_{perp}^2+3 \bullet (\tau_{perp}^2+\tau_{parl}^2))}$	√(7.8² + 3•(7.8² + 22.9²))	42.5 N/mm²	cl 4.5.3.2
$f_{w.Rd}=f_u /(\sim B_w \bullet \gamma_{M2})$	410.0 / (0.9 • 1.25)	385.9 N/mm²	OK

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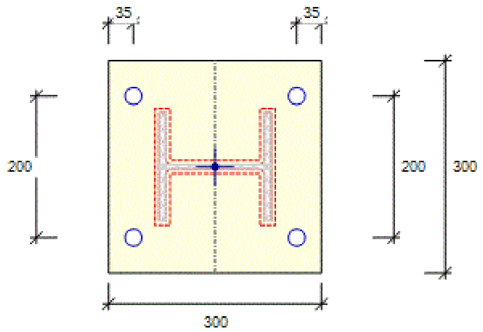
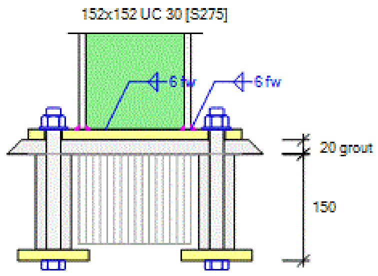
and σ_{perp} <= 0.9•f_u / γ_{M2}	7.8 <= 0.9 • 410 / 1.25 No Shear or Resultant Axial Force in Web.	295.2 N/mm²	OK

COPY OF COPY OF BRIEF 4

BASE PLATE AT : END 1 OF MEMBER SCL1ID 53 - LEVEL 0



Base-Plate 300 x 300 x 15 mm (11 kg)
With 4 No. 24 mm holes
For 20 mm Grade 8.8 Bolts.



Washers 100 x 100 x 15 mm thick with 50 mm Void
All Plates S 275

Base-Plate Connection to EC 3 (UK NAD)

LOADING CASE 002 : DEAD PLUS LIVE A (ULTIMATE)

Basic Data

Integrated Applied Forces at Interface

Resultant Forces M, Fv, F	Moment +0.0 kNm, Shear -0.3 kN, Axial +36.6 kN Forces taken from Support Reaction (Axial Compression)		

Basic Dimensions

Column: 152x152UC30 [28]	D=157.6, B=152.9, T=9.4, t=6.5, r=7.6, py=275		
Bolts 20 mm Ø in 24 mm holes	Grade 8.8 Bolts		
Plates S 275	All weld grades provided to suit minimum connected steel grade		
Grout Fck, Conc Fck, vc, fy, slope	20 N/mm², 25 N/mm², 0.35 N/mm², 275 N/mm², 30 deg to vertical		
Design to	EC 3: Part 1-8: 2005 Design of Connections		
SCI Green Book	P358: Joints in steel construction: Simple joints to Eurocode 3		
Column Capacities Mc, Fvc, Fc	68.1 kN.m, 183.5 kN, 1052.2 kN	Fc = 1052.2 kN	OK

Summary of Results (Unity Ratios)

Concrete Pressure		0.38	OK
Base-Plate thickness in Compression		0.01	OK
Horizontal Shear		0.00	OK
Flange & Web Welds	0.00	0.00	OK

STEP 2 - COMPRESSION T-STUB

Pad Edge, Depth. Plt L, W	500, 500, 300, 300		
Pad diffusion Ratio α=Sqrt(A_{c1} / A_{c0})	Sqrt(6400 / 900) but (1<3)	2.67	EC2 6.6(2)
Grout Ratio β_J		0.67	
F_{cd} =α_{cc} •F_{ck} / γ_c	0.85 • 25.00 / 1.50	14.17 N/mm²	
Bearing Stress F_Jd= β_J • α • F_{cd}	0.67 • 2.67 • 14.17	25.19 N/mm²	
Max c =T_{bp} •√($f_{y.bp}$ / (3•f_Jd •γ_{M0}))	15•√(275 / 3•(25.19•1.0))	28.6 mm	

Step 1-2: Base-Plate Pressure

Base ecc=M/F	0.0/36.6	0.0 mm	
Pressure Configuration	Compression Only with Optimised Compression Area		
Proj C, Xcc	0.0, 150.0		
L Zones X1, X2, X3, X4, X5	71.2, 9.5, 138.7, 9.5, 0.0		
W Zones Wstiff, Wflange, Wweb	0.0, 153.0, 6.6		
Ac=x_f •wf_c+x_w •ww_c+x_f •wf_t	9.46•152.96 + 138.74•6.56 + 9.46•152.96	38.0 cm²	
Conc Cap Fc=•F_{jd} •Ac	25.2•3802.3	95.8 kN	OK
Pressure=P•1000/Ac	36.6•1000/3802	9.64 N/mm²	OK

Step 2a: Plate Compression Bending

e=C	0.0	0.0 mm	
M_{app}=p•e²/2	9.6•0.0²/2	0 Nmm/mm	
tp=√(6•M_{app} •γ_{M0} /p_y)	√(6•1•1.00/275)	0.2 mm	OK

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Step 4: Shear

Base Friction

Friction Fr=0.30•Fc	0.30•+36.6 kN	11.0 kN	

Check 4a: Bolt Shear

α_{bc}=0.44-0.0003•f_{yb}	0.44 - 0.0003 • 640	0.248	
$F_{v,Rd}$=α_{bc} •f_{ub} •A / γ_{M2}	0.248 • 800 • 245.0 / 1.25	38.9 kN	

Check 4b: Base-Plate Bearing

P_1 , e_1 , P_2 , e_2 , α_b , k_1	230.0, 35.0, 300.0, 50.0, 0.530, 2.500		
$F_{b,Rd}$=0.8•k_1 • α_b •f_{up} •d•t_p / γ_{M2}	0.8 • 2.5 • 0.530 • 410 • 20 • 15.0 / 1.25	104.4 kN	
Conc. Bearing Cb=3•Ø²•$F_{cd,min}$	3•20²•1•11 (No Shear Reinf.)	13.6 kN	
Pss=Min(F_{Vrd1} , Cb, Pb, Bb)•nbs	Min(38.9, 13.6, 104.4, 300.0) = 13.6•2	27.2 kN	
Pts=Min(F_{Vrd1} , Cb, Pb, Bb)•nbt	Min(38.9, 13.6, 104.4, 300.0) = 13.6•2, (no tension)	27.2 kN	

Total Shear Capacity

Total Cap=Fr+Pss+Pts	11.0 + 27.2 + 27.2	65.4 kN	OK

Step 5: Flange & Web Welds

Load dispersal	Flanges resist Moment and Axial, Web resists Axial and Shear. Direct Bearing therefore design for tensile forces only.		
Areas A, Af, Aw	38.3, 2 x 14.4, 9.0 cm²		

Flange Welds

Fapp=F•Af/A	36.6•14.4/38.3 No Resultant Tensile Force	-13.8 kN	

Web Welds

Web weld load=Fv/(D-2(fw+T))	0.3/(157.6 - 2(6 +9.4))	0.00 kN/mm	
Weld f_{vw}.d=f_u / 1.73 / (~B_w • γ_{M2})	410/ 1.73 / 0.85 / 1.25	223 N/mm²	
Fcap w=2•0.7•f_w •f_{vw}.d	2•0.7•6•223 No Shear or Resultant Axial Force in Web.	1.87 kN/mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS EN 1995-1-1:2004 + A1:2008

Member TBL1Id 14 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.25 D1 + 1.5 L1, 1.35 D1 + 1.05 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 225, h = 200, 200x225 in Strength Class C24
Section Properties (c,cm³,cm)	Area 450, $W_{el.y}$ 1500, $W_{el.z}$ 1687.5, i_y 5.77, i_z 6.5
Specification	1 : Internal use in continuously heated building Long term loading, 3 pieces of softwood
Integrated Design Critical Case	: Dead plus Live b (Ultimate)
Member Details	N_{Ed} = 0.0 kN, L = 4.465 m, L_y = 1.0 m, L_z = 1.0 m, $L_{cr.y}$ = 1.0 L_y , $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d}$ = K_{mod}.K_{hy}.K_{sys}.$f_{m.k}$/γ_m	0.70 x 1.00 x 1.10 x 24.00/1.3	14.22 N/mm²	
$f_{m.z.d}$ = K_{mod}.K_{hz}.K_{sys}.$f_{m.k}$/γ_m	0.70 x 1.00 x 1.10 x 24.00/1.3	14.22 N/mm²	
$f_{c.90.d}$ = K_{mod}.$K_{c.90}$.K_{sys}.$f_{c.90.k}$/γ_m	0.70 x 1.50 x 1.10 x 2.50/1.3	2.22 N/mm²	
$f_{v.d}$ = K_{mod}.K_{sys}.$f_{v.k}$/γ_m	0.70 x 1.10 x 4.00/1.3	2.37 N/mm²	
$E_m$ean	Instantaneous Deflection	11000 N/mm²	Deflection

Axial Load with Moments Check

Critical Design Location	X = 2.233		
$\sigma_{m.y.d}$ = M_y/$W_{el.y}$	12.922 / 1500 ≤ 14.22	8.61 N/mm²	OK
$\sigma_{m.z.d}$ = M_z/$W_{el.z}$	0.103 / 1687.5 ≤ 14.22	0.06 N/mm²	OK

$U_{m.y} = \sigma_{m.y.d}/f_{m.y.d}$	8.610/14.215	0.606	OK
$U_{m.z} = \sigma_{m.z.d}/f_{m.z.d}$	0.060/14.215	0.004	OK
$U_{m.y}+k_m.U_{m.z}$	0.606+0.7x0.004	0.609	OK
$k_m.U_{m.y}+U_{m.z}$	0.7x0.606+0.004	0.428	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5 \sqrt{(V_{y.Ed}{}^2+V_{z.Ed}{}^2)}$ / Area / kcr	1.5 √(11.581²+0.046²) / 450 / 0.67 ≤ 2.37	0.58 N/mm²	OK
$\sigma_c\perp_{ax} = V_{y.Ed}$ / ($b.l_y$)	11.581 / (225 x 75) ≤ 2.22	0.69 N/mm²	OK
$\sigma_c\perp_{ay} = V_{z.Ed}$ / ($h.l_z$)	0.046 / (200 x 75) ≤ 2.22	0.00 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead + Live			
$\delta = \delta_m$	In-span 12.07 ≤ L/250	12.07 mm	OK

MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS EN 1995-1-1:2004 + A1:2008

Member TBL1Id 15 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.25 D1 + 1.5 L1, 1.35 D1 + 1.05 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 225, h = 200, 200x225 in Strength Class C24
Section Properties (c,cm³,cm)	Area 450, $W_{el.y}$ 1500, $W_{el.z}$ 1687.5, i_y 5.77, i_z 6.5
Specification	1 : Internal use in continuously heated building Long term loading, 3 pieces of softwood
Integrated Design Critical Case	: Dead plus Live b (Ultimate)
Member Details	N_{Ed} = -0.132 kN, L = 4.465 m, L_y = 4.465 m, L_z = 4.465 m, $L_{cr.y}$ = 1.0 L_y , $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.10 x 24.00/1.3	14.22 N/mm²	
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.10 x 24.00/1.3	14.22 N/mm²	
$f_{t.0.d} = K_{mod}.K_h.K_{sys}.f_{t.0.k}/\gamma_m$	0.70 x 1.00 x 1.10 x 14.00/1.3	8.29 N/mm²	
$f_{c.90.d} = K_{mod}.K_{c.90}.K_{sys}.f_{c.90.k}/\gamma_m$	0.70 x 1.50 x 1.10 x 2.50/1.3	2.22 N/mm²	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.70 x 1.10 x 4.00/1.3	2.37 N/mm²	
$E_m$ean	Instantaneous Deflection	11000 N/mm²	Deflection

Tensile Resistance

$\sigma_{t.a} = N_{Ed}$ /Area	0.132 / 450 ≤ 8.29	0.00 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 2.233		
$\sigma_{m.y.d} = M_y/W_{el.y}$	12.922 / 1500 ≤ 14.22	8.61 N/mm²	OK
$\sigma_{m.z.d} = M_z/W_{el.z}$	0.103 / 1687.5 ≤ 14.22	0.06 N/mm²	OK
$U_t = \sigma_{c.0.d}/f_{t.0.d}$	0.003/8.292	0.000	OK
$U_{m.y} = \sigma_{m.y.d}/f_{m.y.d}$	8.610/14.215	0.606	OK
$U_{m.z} = \sigma_{m.z.d}/f_{m.z.d}$	0.060/14.215	0.004	OK
$U_t+U_{m.y}+k_m.U_{m.z}$	0.000+0.606+0.7x0.004	0.609	OK
$U_t+k_m.U_{m.y}+U_{m.z}$	0.000+0.7x0.606+0.004	0.429	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5 \sqrt{(V_{y.Ed}{}^2+V_{z.Ed}{}^2)}$ / Area / kcr	1.5 √(11.581²+0.046²) / 450 / 0.67 ≤ 2.37	0.58 N/mm²	OK
$\sigma_c\perp_{ax} = V_{y.Ed}$ / ($b.l_y$)	11.581 / (225 x 75) ≤ 2.22	0.69 N/mm²	OK
$\sigma_c\perp_{ay} = V_{z.Ed}$ / ($h.l_z$)	0.046 / (200 x 75) ≤ 2.22	0.00 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead + Live			
$\delta = \delta_m$	In-span 12.07 ≤ L/250	12.07 mm	OK

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Sheet	: **Sheet Ref / 104 -**
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Checked	:
Approved	:

MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS EN 1995-1-1:2004 + A1:2008

Member TBL1Id 16 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.25 D1 + 1.5 L1, 1.35 D1 + 1.05 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 225, h = 200, 200x225 in Strength Class C24
Section Properties (c,cm³,cm)	Area 450, $W_{el.y}$ 1500, $W_{el.z}$ 1687.5, i_y 5.77, i_z 6.5
Specification	1 : Internal use in continuously heated building Long term loading
Integrated Design Critical Case	: Dead plus Live b (Ultimate)
Member Details	N_{Ed} = -0.132 kN, L = 1.695 m, L_y = 1.695 m, L_z = 1.695 m, $L_{cr.y}$ = 1.0 L_y , $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.00 x 24.00/1.3	12.92 N/mm²	
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.00 x 24.00/1.3	12.92 N/mm²	
$f_{t.0.d} = K_{mod}.K_h.K_{sys}.f_{t.0.k}/\gamma_m$	0.70 x 1.00 x 1.00 x 14.00/1.3	7.54 N/mm²	
$f_{c.90.d} = K_{mod}.K_{c.90}.K_{sys}.f_{c.90.k}/\gamma_m$	0.70 x 1.50 x 1.00 x 2.50/1.3	2.02 N/mm²	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.70 x 1.00 x 4.00/1.3	2.15 N/mm²	
$E_m$ean	Instantaneous Deflection	11000 N/mm²	Deflection

Tensile Resistance

$\sigma_{t.a} = N_{Ed}$ /Area	0.132 / 450 ≤ 7.54	0.00 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.847		
$\sigma_{m.y.d} = M_y/W_{el.y}$	1.862 / 1500 ≤ 12.92	1.24 N/mm²	OK
$U_t = \sigma_{c.0.d}/f_{t.0.d}$	0.003/7.538	0.000	OK
$U_{m.y} = \sigma_{m.y.d}/f_{m.y.d}$	1.240/12.923	0.096	OK
$U_t+U_{m.y}$	0.000+0.096	0.096	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5\ V_{y.Ed}$ / Area / k_{cr}	1.5 x 4.396 / 450 / 0.67 ≤ 2.15	0.22 N/mm²	OK
$\sigma_{c\perp ax} = V_{y.Ed}$ / (b.l_y)	4.396 / (225 x 75) ≤ 2.02	0.26 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead + Live			
$\delta = \delta_m$	In-span 0.25 ≤ L/250	0.25 mm	OK

MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS EN 1995-1-1:2004 + A1:2008

Member TBL1Id 17 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.25 D1 + 1.5 L1, 1.35 D1 + 1.05 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 225, h = 200, 200x225 in Strength Class C24
Section Properties (c,cm³,cm)	Area 450, $W_{el.y}$ 1500, $W_{el.z}$ 1687.5, i_y 5.77, i_z 6.5
Specification	1 : Internal use in continuously heated building Long term loading
Integrated Design Critical Case	: Dead plus Live b (Ultimate)
Member Details	N_{Ed} = 0.22 kN, L = 3.717 m, L_y = 3.717 m, L_z = 3.717 m, $L_{cr.y}$ = 1.0 L_y , $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.10 x 24.00/1.3	14.22 N/mm²
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.10 x 24.00/1.3	14.22 N/mm²
$f_{c.0.d} = K_{mod}.K_{sys}.f_{c.0.k}/\gamma_m$	0.70 x 1.10 x 21.00/1.3	12.44 N/mm²

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$f_{c.90.d} = K_{mod}.K_{c.90}.K_{sys}.f_{c.90.k}/\gamma_m$	0.70 x 1.50 x 1.10 x 2.50/1.3	2.22 N/mm²	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.70 x 1.10 x 4.00/1.3	2.37 N/mm²	
E_{m}ean	Instantaneous Deflection	11000 N/mm²	Deflection

Compression Resistance

$\lambda_y = L_{ey}/i_y$	372/5.774 ≤ 180	64.4	OK
$\lambda_{rel.y} = \lambda_y/\sim p \sqrt{(f_{c.0.k}/E_{0.05})}$	64.4/~p √ 21/7400	1.092	
$k_{c.y} = fn(\beta_c, \lambda_{rel.y}, k_y)$	0.2, 1.092, 1.175	0.621	
$f_{c.y.0.d} = k_{c.y} . f_{c.0.d}$	0.621 x 12.44	7.73 N/mm²	
$\lambda_z = L_{ez}/i_z$	372/6.495 ≤ 180	57.2	OK
$\lambda_{rel.z} = \lambda_z/\sim p \sqrt{(f_{c.0.k}/E_{0.05})}$	57.2/~p √ 21/7400	0.970	
$k_{c.z} = fn(\beta_c, \lambda_{rel.z}, k_z)$	0.2, 0.970, 1.038	0.711	
$f_{c.z.0.d} = k_{c.z} . f_{c.0.d}$	0.711 x 12.44	8.85 N/mm²	
$\sigma_{c.a} = N_{Ed}$ /Area	0.22 / 450 ≤ 7.73	0.00 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.951		
$\sigma_{m.y.d} = M_y/W_{el.y}$	8.392 / 1500 ≤ 14.22	5.59 N/mm²	OK
$\sigma_{m.z.d} = M_z/W_{el.z}$	0.354 / 1687.5 ≤ 14.22	0.21 N/mm²	OK
$U_{c.y} = \sigma_{c.0.d}/(k_{c.y} \bullet f_{c.0.d})$	0.005/(0.621x12.438)	0.001	OK
$U_{c.z} = \sigma_{c.0.d}/(k_{c.z} \bullet f_{c.0.d})$	0.005/(0.711x12.438)	0.001	OK
$U_{m.y} = \sigma_{m.y.d}/f_{m.y.d}$	5.590/14.215	0.393	OK
$U_{m.z} = \sigma_{m.z.d}/f_{m.z.d}$	0.210/14.215	0.015	OK
$U_{c.y}+U_{m.y}+k_m.U_{m.z}$	0.001+0.393+0.7x0.015	0.404	OK
$U_{c.z}+k_m.U_{m.y}+U_{m.z}$	0.001+0.7x0.393+0.015	0.291	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5 \sqrt{(V_{y.Ed}{}^2+V_{z.Ed}{}^2)}$ / Area / kcr	1.5 √(9.928²+0.056²) / 450 / 0.67 ≤ 2.37	0.49 N/mm²	OK
$\sigma_{c\perp ax} = V_{y.Ed}$ / (b.l_y)	9.928 / (225 x 75) ≤ 2.22	0.59 N/mm²	OK
$\sigma_{c\perp ay} = V_{z.Ed}$ / (h.l_z)	0.056 / (200 x 75) ≤ 2.22	0.00 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead + Live			
$\delta = \delta_m$	In-span 5.39 ≤ L/250	5.39 mm	OK

MASTERKEY : TIMBER DESIGN

FLITCH BEAM DESIGN TO BS EN 1995-1-1:2004 + A1:2008
Member TBL1Id 47 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.25 D1 + 1.5 L1, 1.35 D1 + 1.05 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 200, (2) 75 x 200 in Strength Class C24
Steel Plates Section Size	b = 10, h = 190, (1) 10 x 190 in Grade S 275
Section Properties (cm²,cm³,cm)	Area 150, $W_{el.y}$ 2065.2, $W_{el.z}$ 856.8, i_y 5.62, i_z 3.24
Steel Properties (cm²,cm⁴)	Area 19, I_y 10652.2, I_z 29.5
Specification	1 : Internal use in continuously heated building Long Term loading
Integrated Design Critical Case	: Dead plus Live b (Ultimate)
Member Details	N_{Ed} = 0.365 kN, L = 2.444 m, L_y = 2.444 m, L_z = 2.444 m, $L_{cr.y}$ = 1.0 L_y , $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.00 x 24.00/1.3	12.92 N/mm²	
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.15 x 1.00 x 24.00/1.3	14.84 N/mm²	
$f_{c.0.d} = K_{mod}.K_{sys}.f_{c.0.k}/\gamma_m$	0.70 x 1.00 x 21.00/1.3	11.31 N/mm²	
$f_{c.90.d} = K_{mod}.K_{c.90}.K_{sys}.f_{c.90.k}/\gamma_m$	0.70 x 1.50 x 1.00 x 2.50/1.3	2.02 N/mm²	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.70 x 1.00 x 4.00/1.3	2.15 N/mm²	
E_{m}ean	Instantaneous Deflection	11000 N/mm²	Deflection

Compression Resistance

$\lambda = L_{ey} / i_y$	2444 / 56.19 = 180	43.49	OK
$\lambda_{rel, y} = \lambda_y / \sim p \sqrt{(f_{c,0,k} / E_{0,05})}$	43.49 / ~p √21 / 7.4	0.738	
$k_{c,y} = fn(\beta_c, \lambda_{rel, y}, k_y)$	0.2, 0.738, 0.816	0.859	
$f_{c,y,0,d} = k_{c,y} \bullet f_{c,0,d}$	0.859 x 11.31	9.71 N/mm²	
$\lambda = L_{ey} / i_y$	2444 / 32.37 = 180	75.5	OK
$\lambda_{rel, y} = \lambda_y / \sim p \sqrt{(f_{c,0,k} / E_{0,05})}$	75.5 / ~p √21 / 7.4	1.28	

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Job ref	: 21187
Sheet	: **Sheet Ref / 106 -**
Made By	:
Date	**:08 June 2022**
Checked	:
Approved	:

$k_{c,y} = fn(\beta_c, \lambda_{rel,y}, k_y)$	0.2, 1.28, 1.42	0.494	
$f_{c,y,0,d} = k_{c,y} \bullet f_{c,0,d}$	0.494 x 11.31	5.58 N/mm²	
$\sigma_{c,a} = N_{Ed} / A_t$	0.365 / 300 = 5.58	0.012 N/mm²	OK

Bending Stresses in Timber

$U_{c,y} = \sigma_{c,0,d} / (k_{c,y} \bullet f_{c,0,d})$	0.012 / (0.859 x 11.31)	0.001	OK
$U_{c,z} = \sigma_{c,0,d} / (k_{c,z} \bullet f_{c,0,d})$	0.012 / (0.494 x 11.31)	0.002	OK
$\sigma_{t,m,y,d} = M_y / W_{el,y}$	1.17 / 2065.22 = 12.92	0.565 N/mm²	OK
$U_{m,t} = \sigma_{m,y,d} / f_{m,y,d}$	0.565 / 12.92	0.044	OK
$\sigma_{t,m,z,d} = M_z / W_{el,z}$	0.019 / 856.81 = 12.92	0.022 N/mm²	OK
$U_{m,t} = \sigma_{m,z,d} / f_{m,z,d}$	0.022 / 14.84	0.001	OK
$U_{c,y} + U_{t,m,y} + k_m \bullet U_{t,m,z}$	0.001 + 0.044 + 0.7 x 0.001	0.046	OK
$U_{c,z} + U_{t,m,y} \bullet k_m + U_{t,m,z}$	0.002 + 0.044 x 0.7 + 0.001	0.034	OK

Bending Stresses in Steel

$\sigma_{s,m,y,d} = mr \bullet M_y / W_{el,y}$	(18.98 x 1.17) / 2214.17 = 275	10 N/mm²	OK
$\sigma_{s,m,z,d} = mr \bullet M_z / W_{el,z}$	(18.98 x 0.019) / 14.0e3 = 275	0.026 N/mm²	OK
$U_{comb} = U_{ms,y} + U_{ms,z}$	0.036 + 0	0.036	OK

Shear and Bearing Check

$\tau_{a,y} = \sqrt{(f_{vy} \bullet Fv_y / A_t)^2 + (f_{vz} \bullet Fv_z / A_t)^2} / k_{cr}$	$\sqrt{(0.726 x 0.936^2 + 1.4 x 0.008^2)}/300 / 0.67$	0.034 N/mm²	OK
$\sigma_{ca} = V_{y,Ed} / (b.B.No_t)$	0.936 / (75 x 75 x 2) = 2.02	0.083 N/mm²	OK
$\sigma_{ca} = V_{z,Ed} / (b.B.No_t)$	0.008 / (200 x 10 x 2) = 1.68	0.004 N/mm²	OK

Deflection

0.093 = L / 250		0.093 mm	OK

Minimum Bolt Capacity

Permissible shear & bearing stress	pbss = 160 N/mm², pbbs = 460 N/mm²		
Load for bolt, $F_{v,Rk,90}$	Perpendicular to grain, from Clause 8 EC5	5.51 kN	Load for bolt, $F_{v,Rk,0}$Parallel to grain, from Clause 8 EC56.06 kN
$F_{b,Rd} = (k_1 \bullet a_b \bullet f_u \bullet d \bullet t) / \gamma_{M2}$	(2.5 x 0.976 x 410 x 8 x 10) / (1.25 x 1000)	64 kN	
$F_{v,Rd} = a_v \bullet f_{ub} \bullet A_s / 1000 \bullet ?_{M2}$	(0.6 x 400 x 37) / (1000 • 1.25)	7.1 kN	
Bolt Capacity = $Min(F_{v,Rk}, F_{v,Rd}, N_{plt}.F_{b,Rd}/N_{pln})$	min(5.51, 7.1, 1X64/2)	5.51 kN	

Minimum Number Of Bolts Along Length

$P_{stl,y} = UDL \bullet L \bullet I_{eff,s} / I_{cmb}$	0.458 x 2.44 x 10.7e3 / 20.7e3	0.577 kN	
$P_{stl,z} = Fv \bullet A_{eff,s} \bullet z's / I_{cmb,z} \bullet L$	100 x 0.008 x 504.09 x 1.26 / 6854.51 x 2.44	0.182 kN	
$P_{stl,Total} = Sqrt(P_{stl,y}/N_{pln}^2 + P_{stl,z}^2)$	$Sqrt(0.577/2^2 + 0.182^2)$	0.341 kN	
Max Bolt Spc. = $Min(2.5 \bullet h_t, 600)$	Min(2.5 x 200, 600)	500 mm	
N_{bmin} = L/Max Spacing	2444 / 500	5	
No. Bolts=$Max(N_{bmin}, P_{stl} / Bolt_{cap})$	max(5, 0.341 / 5.51)	5	
Bolt load = P_{stl} / Num Bolts	0.341 / 5	0.068 kN	
Ut_{blt} = Bolt Load / Bolt Capacity	0.068 / 5.51	0.012	OK

Minimum Number of Bolts At Ends

Load for bolt, $F_{v,Rk}$, from Clause 8 EC5			
$P_{blt} = N_{s\ int} \bullet F_{v,Rk}$	2 x 5.17	10.34 kN	
$P_{stl} = Fv \bullet I_{eff,s} / I_{cmb}$	(0.936 x 10.7e3 / 20.7e3)	0.483 kN	
Num Bolts = $Max(P_{stl} / P_{blt}, 2)$	Max(0.483 / 10.34, 2)	2	

Minimum Spacings And Washer Size

End Spacing = Max(7 • d, 80)	Max(7 x 8, 80)	80 mm	
Edge Spacing = 4 • d	4 x 8	32 mm	
Bolt Spacing = 4 • d	4 x 8	32 mm	
Washer Diameter = 3 • d	3 x 8	24 mm	
Washer Thickness = 0.3 • d	0.3 x 8	2 mm	

Bolt Summary

Minimum requirement for supports:	2 No. 8 mm diameter Grade 4.6 bolts.
Minimum requirement for beam:	5, 8 mm diameter Grade 4.6 bolts, at a maximum of 500 mm centres, alternately staggered 50 mm above and below the centre line.

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Job ref	: 21187
Sheet	: **Sheet Ref / 107 -**
Made By	:
Date	**:08 June 2022**
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Approved	:

MASTERKEY : TIMBER DESIGN

FLITCH BEAM DESIGN TO BS EN 1995-1-1:2004 + A1:2008
Member TBL1Id 48 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.25 D1 + 1.5 L1, 1.35 D1 + 1.05 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 200, (2) 75 x 200 in Strength Class C20
Steel Plates Section Size	b = 10, h = 190, (1) 10 x 190 in Grade S 275
Section Properties (cm^2,cm^3,cm)	Area 150, $W_{el.y}$ 2233.4, $W_{el.z}$ 857.4, i_y 5.61, i_z 3.11
Steel Properties (cm^2,cm^4)	Area 19, I_y 12334.2, I_z 34.2
Specification	1 : Internal use in continuously heated building Long Term loading
Integrated Design Critical Case	: Dead plus Live a (Ultimate)
Member Details	N_{Ed} = 0.006 kN, L = 2.447 m, L_y = 2.447 m, L_z = 2.447 m, $L_{cr.y}$ = 1.0 L_y , $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C20)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.00 x 1.00 x 20.00/1.3	10.77 N/mm²	
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.70 x 1.15 x 1.00 x 20.00/1.3	12.37 N/mm²	
$f_{c.0.d} = K_{mod}.K_{sys}.f_{c.0.k}/\gamma_m$	0.70 x 1.00 x 19.00/1.3	10.23 N/mm²	
$f_{c.90.d} = K_{mod}.K_{c.90}.K_{sys}.f_{c.90.k}/\gamma_m$	0.70 x 1.50 x 1.00 x 2.30/1.3	1.86 N/mm²	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.70 x 1.00 x 3.60/1.3	1.94 N/mm²	
$E_m$ean	Instantaneous Deflection	9500 N/mm²	Deflection

Compression Resistance

$\lambda = L_{ey} / i_y$	2447 / 56.09 = 180	43.63	OK
$\lambda_{rel,y} = \lambda_y$ / ~p $\sqrt{(f_{c,0,k} / E_{0,05})}$	43.63 / ~p √19 / 6.4	0.757	
$k_{c,y} = fn(\beta_c, \lambda_{rel,y}, k_y)$	0.2, 0.757, 0.832	0.849	
$f_{c,y,0,d} = k_{c,y} \bullet f_{c,0,d}$	0.849 x 10.23	8.69 N/mm²	
$\lambda = L_{ey} / i_y$	2447 / 31.08 = 180	78.73	OK
$\lambda_{rel,y} = \lambda_y$ / ~p $\sqrt{(f_{c,0,k} / E_{0,05})}$	78.73 / ~p √19 / 6.4	1.37	
$k_{c,y} = fn(\beta_c, \lambda_{rel,y}, k_y)$	0.2, 1.37, 1.54	0.445	
$f_{c,y,0,d} = k_{c,y} \bullet f_{c,0,d}$	0.445 x 10.23	4.55 N/mm²	
$\sigma_{c,a} = N_{Ed} / A_t$	0.006 / 300 = 4.55	0 N/mm²	OK

Bending Stresses in Timber

$U_{c,y} = \sigma_{c,0,d} / (k_{c,y} \bullet f_{c,0,d})$	0 / (0.849 x 10.23)	0	OK
$U_{c,z} = \sigma_{c,0,d} / (k_{c,z} \bullet f_{c,0,d})$	0 / (0.445 x 10.23)	0	OK
$\sigma_{t,m,y,d} = M_y / W_{el,y}$	0.481 / 2233.42 = 10.77	0.215 N/mm²	OK
$U_{m,t} = \sigma_{m,y,d} / f_{m,y,d}$	0.215 / 10.77	0.02	OK
$U_c + U_{t,m,y}$	0 + 0.02	0.02	OK
$L_{eff} = L \bullet k_{LTB}$	2.45 x 0	2447 mm	
$\sigma_{m,crit} = 0.78 \bullet E_{0.05} \bullet b^2 / h \bullet l_{eff}$	0.78 x 6.4 x (2 x 75)^2 / 200 x 2447	229.51 N/mm²	
$\lambda_{rel,m} = \sqrt{(f_{m,k} / \sigma_{m,crit})}$	√(20 / 229.51)	0.295	
k_{crit}	$\lambda_{rel,m} < 0.75$, $k_{crit} = 1$	1	
$U_c + (\sigma_{m,a} / (k_{crit} \bullet f_{m,d}))^2$	0 + (0.215 / (1 x 10.77))²	0	OK

Bending Stresses in Steel

$\sigma_{s,m,y,d}$ = mr $\bullet M_y / W_{el,y}$	(21.81 x 0.481) / 2375.97 = 275	4.41 N/mm²	OK
$U_{m,s} = \sigma_{m,y,d} / f_{m,y,d}$	4.41 / 275	0.016	OK

Shear and Bearing Check

$\tau_{a,y}$ = (1.5 Fv / k_{cr}) / Area	(1.5 x 0.764 / 0.67) / 300	0.057 N/mm²	OK
$\sigma_{ca} = V_{y,Ed}$ / (b.B.No_t)	0.764 / (75 x 75 x 2) = 1.86	0.068 N/mm²	OK

Deflection

0.039 = L / 250		0.039 mm	OK

Minimum Bolt Capacity

Permissible shear & bearing stress	pbss = 160 N/mm², pbbs = 460 N/mm²	
Load for bolt, $F_{v,Rk,90}$	Perpendicular to grain, from Clause 8 EC5	4.98 kN
$F_{b,Rd} = (k_1 \bullet a_b \bullet f_u \bullet d \bullet t) / \gamma_{M2}$	(2.5 x 0.976 x 410 x 8 x 10) / (1.25 x 1000)	64 kN
$F_{v,Rd} = a_v \bullet f_{ub} \bullet A_s$ / 1000 • $?_{M2}$	(0.6 x 400 x 37) / (1000 • 1.25)	7.1 kN
Bolt Capacity = Min($N_{pln}.F_{v,Rk}$, $N_{pln}.F_{v,Rd}$,$N_{plt}.F_{b,Rd}$)	min(2x4.98, 2x7.1, 1x64)	9.96 kN

Minimum Number Of Bolts Along Length

$P_{stl,y}$ = UDL • L • $I_{eff,s} / I_{cmb}$	0.425 x 2.45 x 12.3e3 / 22.3e3	0.574 kN

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Job ref	: 21187
Sheet	: **Sheet Ref / 108 -**
Made By	:
Date	**:08 June 2022**
Checked	**:**
Approved	:

Max Bolt Spc. = Min(2.5 • h_t, 600)	Min(2.5 x 200, 600)	500 mm	
N_{bmin} = L/Max Spacing	2447 / 500	5	
No. Bolts=Max(N_{bmin} ,P_{stl} / $Bolt_{cap}$))	max(5, 0.574 / 9.96)	5	
Bolt load = P_{stl} / Num Bolts	0.574 / 5	0.115 kN	
Ut_{blt} = Bolt Load / Bolt Capacity	0.115 / 9.96	0.012	OK

Minimum Number of Bolts At Ends

Load for bolt, F_(v,Rk), from Clause 8 EC5

P_(blt) = N_(s int) • F_(v,Rk)	2 x 4.98	9.96 kN
P_(stl) = Fv • I_(eff,s) / I_(cmb)	(0.764 x 12.3e3 / 22.3e3)	0.422 kN
Num Bolts = Max(P_(stl) / P_(blt), 2)	Max(0.422 / 9.96, 2)	2

Email Correspondence from Client regarding Optical Levelling

From: Time for Change <khaliq.123@live.co.uk>
Sent: 11 August 2022 21:58
To: V Francis
Subject: Re: FW: Planning Discharge Conditions

d) A method for monitoring local ground conditions, water movement and subsidence.

Optical Levelling
Repeat optical levelling and global positioning system GPS surveys, ground reconnaissance, photo-geological analysis, groundwater monitoring, and tape-extensometers is suggested.

The use of survey techniques provides a means of forming a network for various instrumentation systems, with the approach being an effective method to monitor ground deformation. More than often gradual and small relative movements are to be measured for ground subsidence, consequently verification of accuracy is a vital aspect of this segment of the measurement program.

Conventional optical levelling remains one of the most reliable and widely adopted methods for obtaining highly accurate elevation data at the scale that most land subsidence occurs. Relational elevation differences between dedicated survey monuments should be determined through the use of differential digital level loops, or conventional level techniques. When plausible, these measurements should be taken in relation to a stable bedrock benchmark, however it is often sufficient to observe relative differences without a direct tie to a stable point. Elevations measured by levelling should be expected to meet an accuracy of at least ±3 mm and monument spacing needs to be planned to achieve that level of accuracy.

Regards,

Ammar

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