CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS

STRUCTURAL ASSESSMENT

FOR

PROPOSED ROOF MOUNTED PV INSTALLATION

AT

MORRISONS, CHIPPENHAM

CEPEN PARK NORTH, CHIPPENHAM

SN14 6UZ

CPA Project No: 2209-57

Date: 13th October 2022

CPA
Suite 6, Dorial House, 89a New Road Side, Horsforth, Leeds LS18 4QD
T: 0113 465 2000 E: info@cpa-consulting.co.uk W: www.cpa-consulting.co.uk

CPA is the trading name of Crabtree Potts Associates Limited (Registered in England & Wales No. 12933591).

CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS

Table of Contents

1. Introduction
2. Roof Deck Load Assessment
3. Purlin Load Assessment
4. Building Load Assessment
   - 4.1 Steel Frame Analysis & Design Checks
   - 4.2 Loadings
   - 4.3 Steel Frame Analysis Results
5. Maintenance Requirements
6. Conclusion & Recommendation

Appendix 1 – Roof Plan showing suitable locations for PV Installation

Appendix 2 – Selection of Photos from Site Visit

Limitations

This report has been prepared solely for the use of Wm. Morrison Supermarkets Limited. This report is confidential to Wm. Morrison Supermarkets Limited and Crabtree Potts Associates Limited (CPA) accepts no responsibility or liability for any use that is made of this document other than by Wm. Morrison Supermarkets limited, for the purposes for which the report was originally commissioned.

The contents of this report are based on conditions encountered at the time of the report and upon the information supplied to CPA. CPA carries no responsibility for events or changes occurring subsequent to the date the survey was undertaken and report was prepared.

The report is based on a visual survey and inspections have been carried out in limited areas to assess the structure / deck. It is assumed that all areas of the structure / deck are in a similar condition to that inspected, CPA carry no responsibility for the condition of elements in areas not inspected.

Comment upon the current condition, durability and flexibility of the ceiling, services and roof waterproofing systems is outside CPA's Scope of Services. It should be noted that analysis and design checks for the addition of PV's on the roof have been carried out in accordance with British Standards, including limiting the deflection of structural elements within recommended serviceability limit states. It is assumed that the systems noted above will perform adequately where limits on deflections are in accordance with British Standards. However, advice should be sought from the appropriate specialist on the suitability of the system, prior to the installation of any PVs.

Report Issue Record

REVISION	DATE	DESCRIPTION	BY	CHECKED
A	13.10.2022	First Issue	SLH	IC

1.0 Introduction

CPA has been commissioned by Wm. Morrison Supermarkets Limited to undertake a structural assessment of the load capacity of the roof for a proposed roof mounted PV installation.

The Morrison's Supermarket at Chippenham consists of:

- 66 m x 50 m main store area plus 45 m x 24 m store extension
- 27 m max x 21 m ground floor staff facilities
- 54 m x 11 m + 20 m x 16 m warehouse areas
- 24 m x 7 m first floor plantroom
- 23 m x 17 m warehouse extension plus 24 m x 6 m mezzanine plantroom

This commission relates to the consideration of a PV installation on the main store, warehouse & store extension roof areas only.

The proposed PV system is to be a ballasted system (i.e. not fixed through the roof covering) and induces an assumed load on the roof of 25kg/m^2 (0.25kN/m^2). This is the load used in the structural assessment and should be verified by the PV system designer.

As part of CPA's commission site visit/inspections were undertaken on 2nd October 2022. Photo records are shown in Appendix 2.

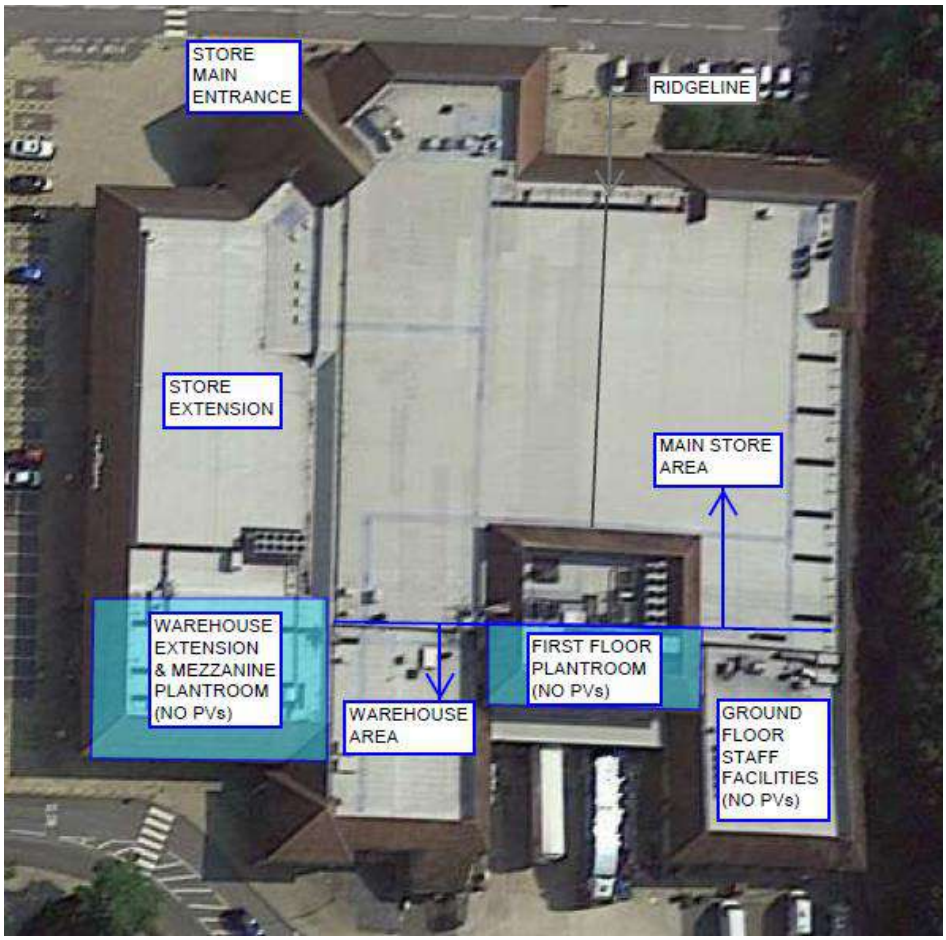

Figure 1 – Aerial View of Roof.

2.0 Roof Deck Load Assessment

We do not have any information on the specification of the roof build-up to the original store & warehouse and store extension roof areas.

The profile of the bottom sheet measured in the warehouse and seen above the ceiling in the original store areas appears to correlate with TATA Steel RoofDek D46. We have carried out our analysis using RoofDek D46, 0.7 mm steel load tables.

The profile of the bottom sheet measured in the store extension area appears to correlate with TATA Steel RoofDek D60. We have carried out our analysis using RoofDek D60, 0.7 mm steel load tables.
Our analysis suggests that the existing roof coverings are suitable to support the new PV loading.



Figure 2 view on the underside of the roof deck in the warehouse



Figure 3 view on the underside of the roof deck in the store extension

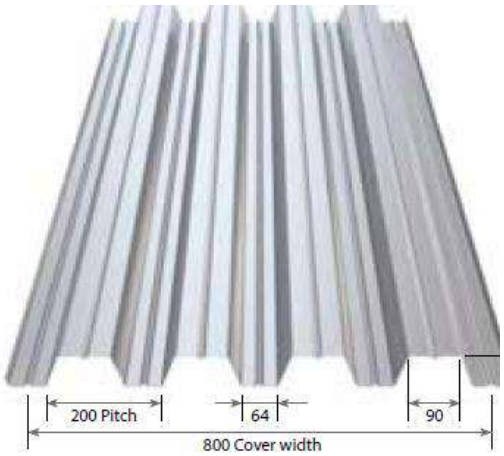

Figure 4 TATA Steel D46 Roof Profile



Figure 5 TATA Steel D60 Roof Profile

3.0 Purlin Load Assessment

Purlins to the original store roof are Metsec ref 232Z16, max. span = 6.0 m, sleeved system, maximum spacing = 1.8 m, determined from CPA inspections. Analysis has been carried out using Metspec14 Design software.

Purlins to the warehouse roof are Kingspan ref M205065160, max. span = 5.20 m, sleeved system, maximum spacing = 1.8 m, determined from CPA inspections. Analysis has been carried out using Kingspan Toolkit 8.0 Design software.

Purlins to the store extension roof are Metsec ref 202Z16, max. span = 6.0 m, sleeved system, maximum spacing = 1.8 m, determined from CPA inspections.
Analysis has been carried out using Metspec14 Design software.

Our loading assessments and site inspection suggests that the purlins will generally satisfactorily support the new PV loading. However, the addition of PV panels is not acceptable within areas of significant snow drift due to exceedance of purlin capacities, refer to Appendix 1.

4.0 Building Load Assessment

The primary frame to the original main store and warehouse roof areas consists of secondary lattice trusses at 6.0 m maximum centres spanning 23 m maximum between spine trusses. Spine trusses are 2.35 m deep and generally consist of 254 UC top and bottom booms with 254 UC vertical and diagonal internal members and span 24 m between steel columns. Secondary lattice trusses are 2.3 m average overall depth and generally consist of 152 UC top & bottom booms with 178 x 102 UB vertical and diagonal internal members. The purlins span 6.0 m between the secondary lattice trusses.

The roof above the store extension comprises 870 x 229 Cell beam rafters at 6.0 m maximum centres spanning 23 m between steel columns. The purlins span 6.0 m between the Cell beam rafters.

All lattice trusses and spine trusses are considered to be grade S275, all Cell beam rafters are considered to be grade S355.

Refer to Figure 6 for the roof steelwork layout.

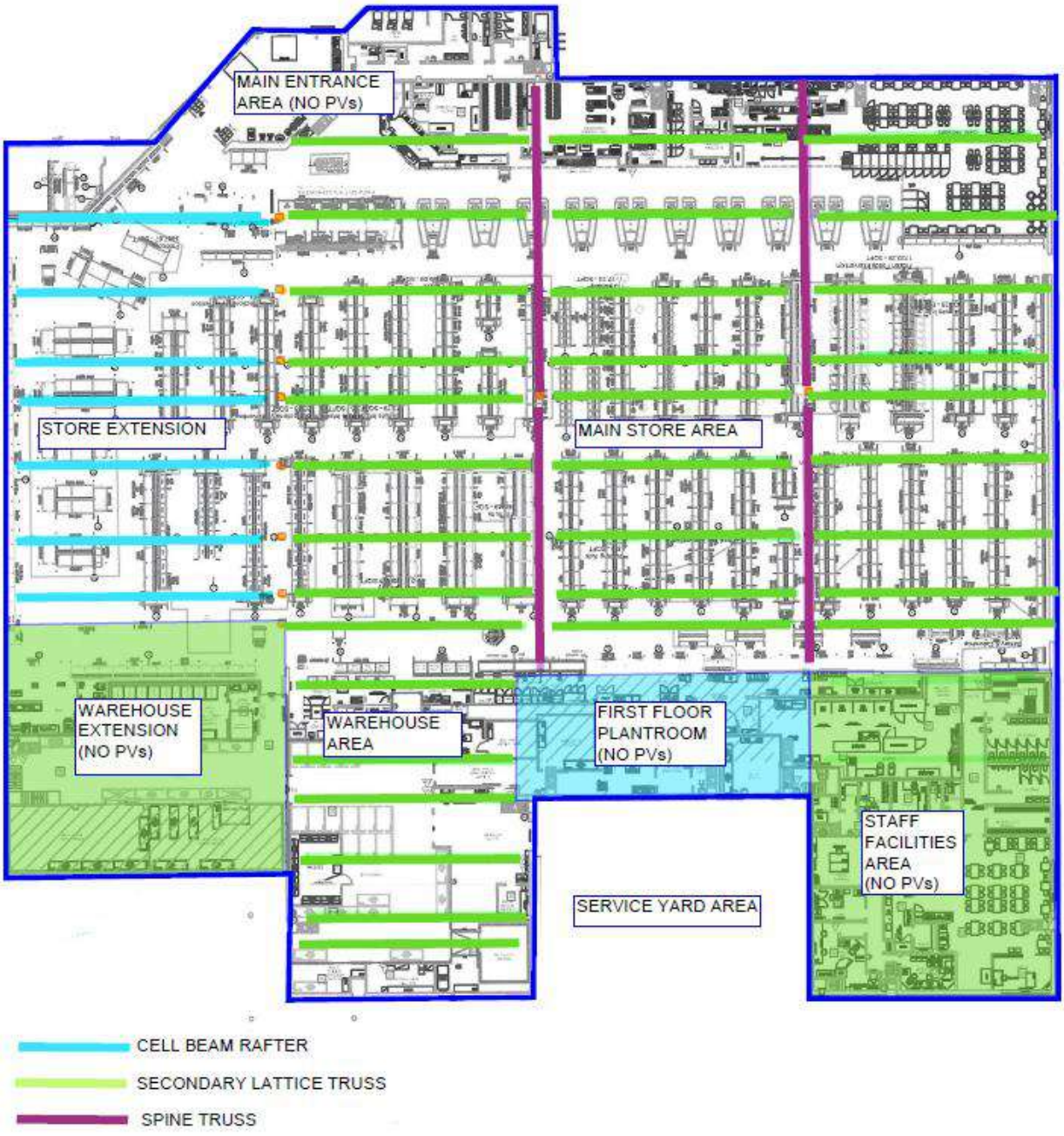

Figure 6 - Existing Roof Steelwork Layout.

4.1 Steel Frame Analysis & Design Checks

The Cell beam UB rafters, secondary lattice trusses & spine trusses to the main store, warehouse & store extension roof areas have been analysed and checked. Existing load cases are initially considered, using loads taken from existing drawings or assessed from visual inspection. The load cases are then re-analysed with allowances for roof mounted PV panels.

The results of the analyses are compared to check whether the addition of PV panels would cause a sufficient increase in member forces to require more detailed investigation, leading to possible strengthening works.

The analysis and design checks are carried out in accordance with BS 6399 for loading and BS 5950 for structural steelwork.

4.2 Loadings

Roof loadings used in the analyses are as follows:

Imposed:	
Roof imposed	0.6 kN/m²
Dead:	
Roof Deck & Purlins	0.18 kN/m²
Steel self-weight	0.15 kN/m²
Services	0.15 kN/m²
Ceiling,	0.05 kN/m²
Proposed PV panels	0.25 kN/m²
Total assessed dead loads	0.78 kN/m²
Total assessed dead loads (Purlin)	0.63 kN/m²

Proposed PV panels are assumed to be required on the main store, warehouse & store extension roof areas only.

4.3 Steel Frame Analysis Results

Based on the proposed methodology described in 4.1 above, our loading assessments and site inspection suggests that the Cell beam rafters, secondary lattice trusses and spine trusses to the main store, warehouse and store extension roof areas will satisfactorily support the new PV loading.

5.0 Maintenance Requirements

During our site visit we noted several patch repairs to the roof deck finishes. The finishes should be inspected and verified as suitable by the appropriate specialist prior to the installation of PVs. We were also mad aware of ongoing issues with rainwater ingress at the store which should be investigated.

CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS

6.0 Conclusion & Recommendation

The Client should be advised that the Health and Safety file should be updated to include a statement that no additional services or load can be supported by the roof structure without an assessment by a suitably qualified Structural Engineer.

Maintenance requirements as noted in 5.0 above to be undertaken.

The store and warehouse extension areas are effectively separated from the main roof area via steel stairs. This should be taken into consideration from an access perspective when installing PVs.

During our site visit we were made aware by Wm Morrison's staff of ongoing issues with rainwater ingress at the store in several areas. Advise should be sought from a waterproof membrane specialist/roof covering specialist on the suitability of the roof covering prior to the installation of any PVs.

The addition of PV panels, of approximate weight of 25 kg/m^2, to the main store, warehouse and store extension roof will be generally acceptable, except for the points noted below:

Addition of PV panels not acceptable within areas of significant snow drift on the main store roof due to exceedance of purlin capacities. Refer to Appendix 1.

PV panels cannot be added to the main store roof parallel to the Southwest elevation as indicated on Appendix 1. This is due to the presence of bulkheads and the presence of dividing walls without a suitable deflection head detail. This is to protect against the PV loading causing the roof to deflect and impose forces into the partition walls, potentially leading to cracking of the walls.

Where existing plant and pipe runs are present on the main store roof the PV panels should be positioned sufficiently clear, say 1.0-1.5m away, to prevent possible localised overloading and allow safe maintenance of the plant and PV panels. If panels are required at a closer separation, then further detailed load assessment will be required. PV panels should also be positioned clear of any designated walkways on the roof.

Adjacent to roof penetrations the PV panels should be sufficiently clear to allow safe maintenance and Specialist advise should be obtained for the minimum clearances required around PV panels, existing plant and services. This must be signed off by the Principal Designer.

The above conclusions and recommendations are based on the average PV panel weight of 25 kg/m^2 only. When proposed panel layouts and ballast arrangements are made available additional checks may be required if there are localised areas of increased ballast loading.

Appendix 1 shows the areas of roof where PV installation is recommended.
Appendix 2 shows a selection of photos.

CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS

APPENDIX 1

ROOF PLAN INDICATING AREAS OF ROOF WHERE PV INSTALLATION IS RECOMMENDED

WMS CHIPPENHAM



NOTE

1. KEEP CLEAR OF PENETRATIONS AND EXISTING SERVICES.
2. ACTUAL SETTING OUT OF PV PANELS TO BE CONFIRMED BY PV SPECIALIST.
3. PROVISION OF SAFE ACCESS/EDGE PROTECTION MUST BE CONSIDERED.

DENOTES AREAS WHERE PVs ARE NOT PERMITTED

CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS

APPENDIX 2

SELECTION OF PHOTOS FROM SITE VISIT.



Store Main Entrance North Elevation



View along the North East elevation



View on the North East elevation – Customer café area



View on the store entrance seen from the West

CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS



View along the West elevation looking North



View along the South West elevation, looking East

Service yard is to the RHS



View on the South West elevation loading bay area from the service yard



View looking North West across the store roof onto the mansard plant screen area



View looking North East across the roof above the warehouse area

Looking towards the Main Entrance area



View looking North West onto the warehouse extension roof

Note access via steel steps



View looking South West across the store extension roof towards the warehosue extension roof area



View looking North towards the Main Entrance area along the junction between the origianl store and the store extension



View looking West across the original main store roof



View looking South East across the roof towards the first floor plantroom and plant screen at the step in level between warehouse and main store roof areas



View looking South East from the store extension onto the orginal store roof area



View looking South East along the rear of the North East parapet



View looking South West along the rear of the mansard looking towards the staff facilities area the first floor plantroom/plant screen is on the RHS.



Patch repairs to roof covering



View on the underside of the roof decking to the warehouse area



View of the underside of Warehouse Roof Structure – lattice trusses



View on the underside of the roof decking seen in the extension area



View of the underside of store extension roof structure – Cell beam rafters



View on the underside of the roof decking seen above the ceiling in the store area



View of the underside of store area roof structure – secondary lattice trusses



View along a secondary lattice truss seen above the ceiling in the store area



Junction of a secondary lattice truss with a spine truss seen above the ceiling level in the store area



Lightweight ceiling seen throughout the store



View along the check out mall



View along the bulkheads to front of the Prep Areas (parallel to the South West elevation)



View along the bulkheads to front of the Prep Areas