CPA CIVIL & STRUCTURAL CONSULTING ENGINEERS

STRUCTURAL ASSESSMENT

FOR

PROPOSED ROOF MOUNTED PV INSTALLATION

AT

MORRISONS, WESTON SUPERMARE

SUMMER LANE, WESTON SUPERMARE

BS24 7AY

CPA Project No: 2209-86

Date: 16th September 2022

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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	16.09.2022	First Issue	SLH	IC

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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 Weston Supermare consists of:

- 64 m x 60 m main store area plus 34 m x 11 m store extension, 20 m x 11 m customer services area extension & 48 m x 8 m café extension.
- 57 m x 16 m warehouse plus 19 m x 7 m warehouse extension.
- 33 m x 11 m ground floor staff facilities.
- 28 m x 7 m first floor plantroom.

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

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 11th September, 2022. Photo records are shown in Appendix 2.

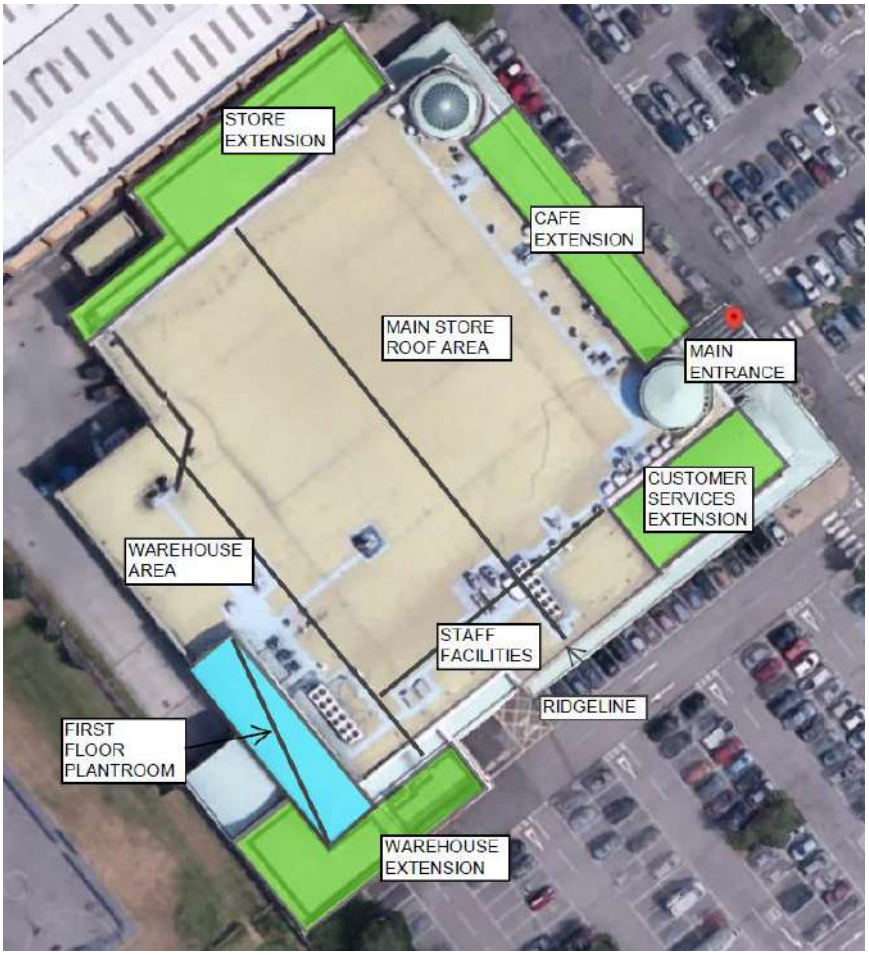

Figure 1 – Google Earth view of Roof.

2.0 Roof Deck Load Assessment

We do not have any information on the specification of the roof build-up to the main store, warehouse and staff facilities roof.

The profile of the bottom sheet seen above the ceiling in the main store and measured in the warehouse area appears to correlate with SMD SR30+ Steel Deck profile. We have carried out our analysis using SMD SR30+, 0.7 mm steel load tables.

The profile of the bottom sheet in the store extension area indicated on archive drawings is a PMF D60 – 0.7 mm steel deck. 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

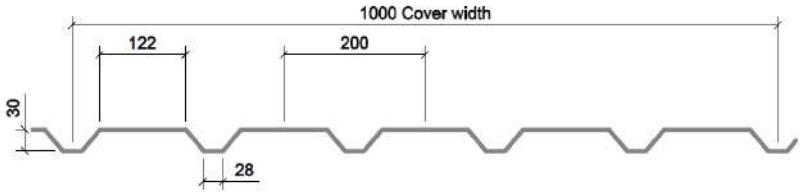

Figure 3 SR30+ Roof Profile

Figure 4 view on the underside of the roof deck in the store extension

Figure 5 TATA Steel D60 Roof Profile

3.0 Purlin Load Assessment

Purlins to the main store and warehouse roof are Kingspan ref P23518, max. span = 6.6 m (7.2 m in the warehouse), sleeved system with sag rods, maximum spacing = 1.8 m, determined from CPA inspections.
Analysis has been carried out using Kingspan Design Toolkit software.

Purlins to the store extension roof are Metsec ref 202Z15, sleeved system with sag rods, max. span = 5.85 m, maximum spacing = 1.2 m, determined from archive drawings.
Analysis has been carried out using Metspec14 Design software.

Our loading assessments and site inspection suggests that the purlins will satisfactorily support the new PV loading.

4.0 Building Load Assessment

The primary frame to the main store, staff facilities and warehouse roof areas consists of secondary lattice trusses at 6.6 m centres (7.2 m centres, in warehouse) spanning 17.55 m max between spine trusses. Spine trusses are 1.7 m deep and generally consist of 254 UC top and bottom booms with 100 x 100 RSAs, in pairs, diagonal internal members and 100 x 100 SHS vertical internal members. Spine trusses span 19.8 m max. between steel columns. Secondary lattice trusses are 1.25 m deep and generally consist of 152 UC top and bottom booms with 100 x 100 x 10 RSA diagonal internal members.
The purlins span 6.6 m/7.2 m between the secondary lattice trusses.

The primary frame to the store extension comprises 406 x 178 UB rafters which span 11.4 m between steel columns. The purlins span 5.85 m between the UB rafters.

All UB rafters, lattice trusses and spine trusses are considered to be grade S275.

Refer to Figure 6 for the roof steelwork layout.

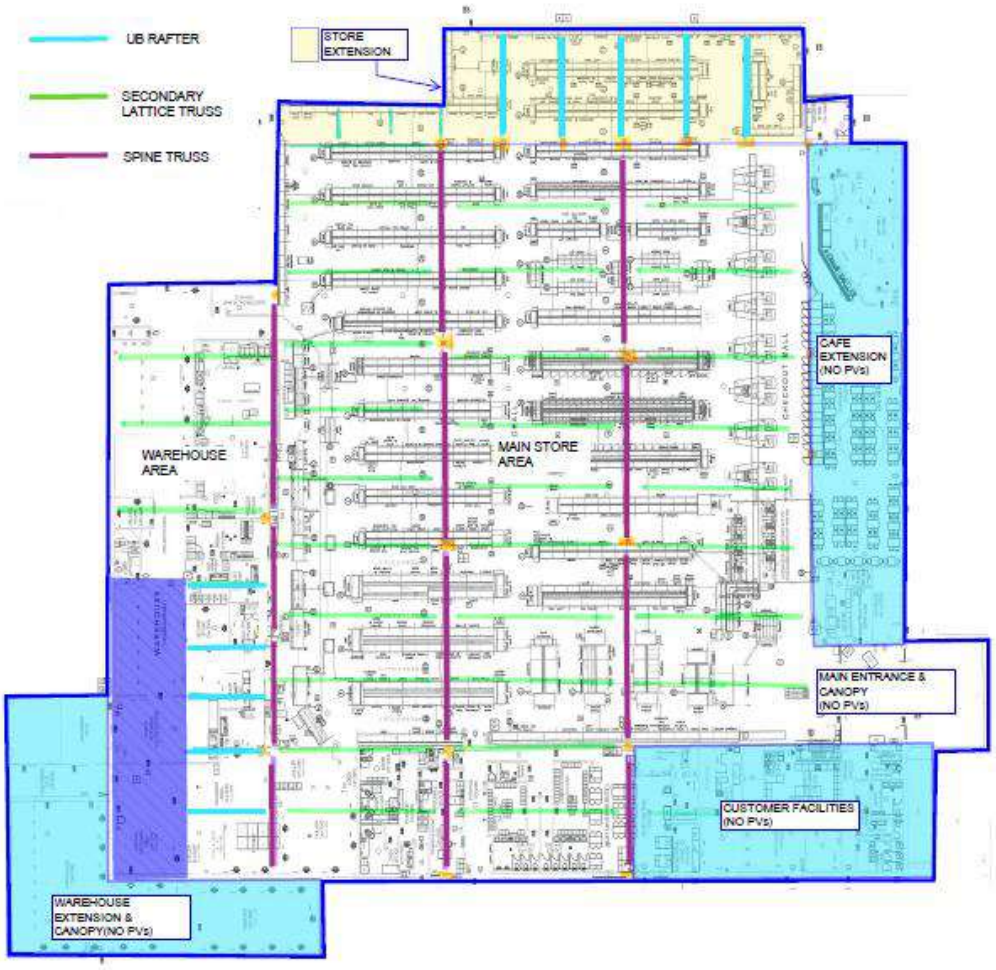

Figure 6 - Existing Roof Steelwork Layout.

4.1 Steel Frame Analysis & Design Checks

The UB rafters, secondary lattice trusses & spine trusses to the main store, warehouse, staff facilities and 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 (store areas)	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, staff facilities, warehouse and 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 UB rafters, secondary lattice trusses and spine trusses to the main store, staff facilities, warehouse and store extension roof areas will satisfactorily support the new PV loading.

5.0 Maintenance Requirements

We noted that the upstand to the roof perimeter was low (less than 900 mm) in several areas with no other edge protection provided. The client may wish to consider the provision of additional edge protection prior to the installation of any PV panels.

The store extension roof area is accessed via steel stairs/ladders, this should be taken into consideration from an access perspective when installing PVs.

A shopping trolley had been left on the roof which should be removed.

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 addition of PV panels, of approximate weight of 25 kg/m^2, to the main store 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 West 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.

We noted that the upstand to the roof perimeter was low (less than 900 mm) in several areas with no other edge protection provided. The client may wish to consider the provision of additional edge protection prior to the installation of any PV panels.

The store extension roof area is accessed via steel stairs/ladders, this should be taken into consideration from an access perspective when installing PVs.

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.

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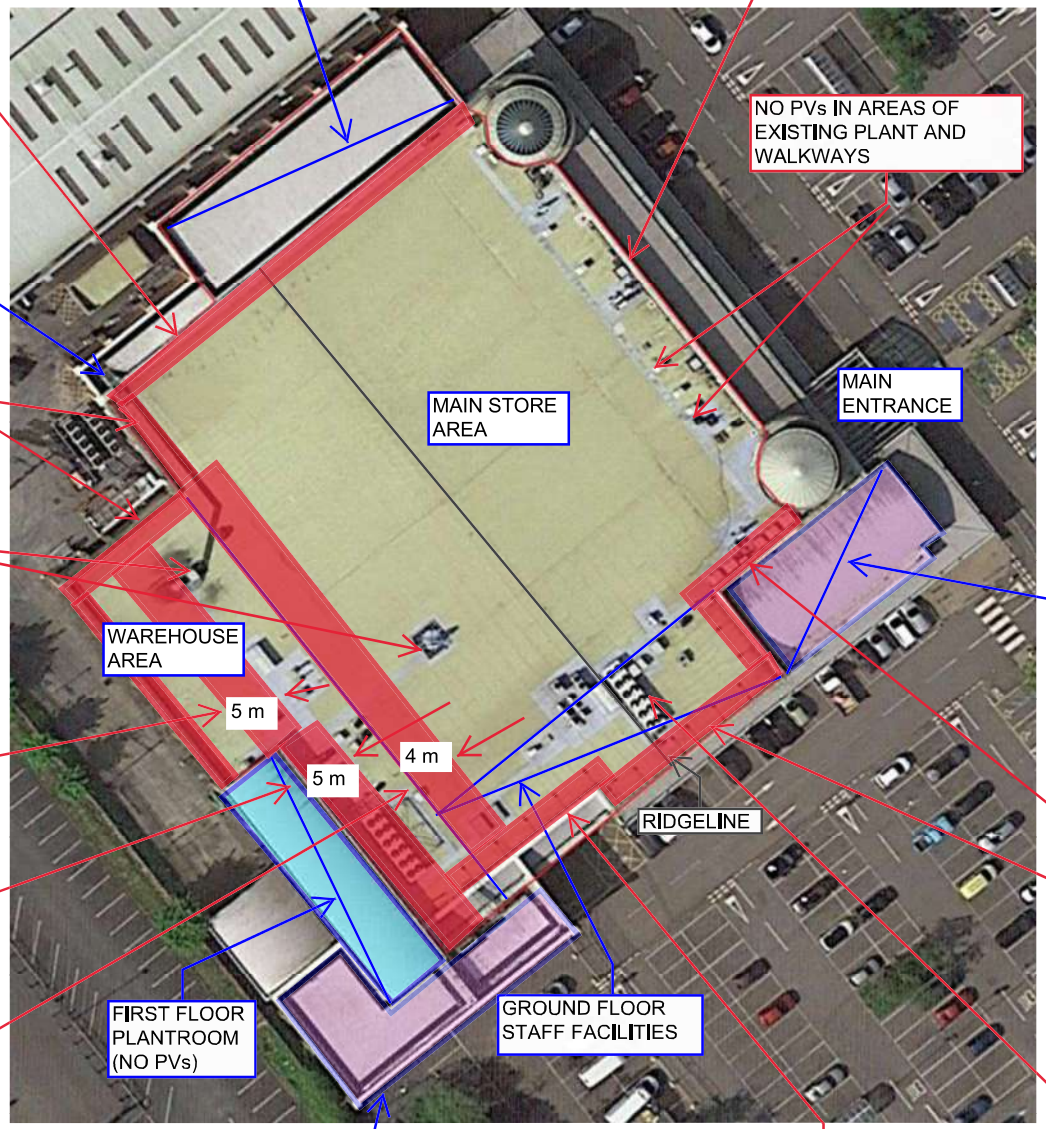
APPENDIX 1

ROOF PLAN INDICATING AREAS OF ROOF WHERE PV INSTALLATION IS RECOMMENDED

WMS WESTON SUPERMARE



NOTE

1. KEEP CLEAR OF PENETRATIONS & 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 PV PANELS ARE NOT PERMITTED

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APPENDIX 2

SELECTION OF PHOTOS FROM SITE VISIT.

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Store Main Entrance North East Elevation

View along the South East Elevation looking towards the warehouse extension

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View along the North East elevation

View along the North East elevation looking towards the Main Entrance

View along the South West elevation from the service yard area

View on the South West elevaton looking onto the store extension

View across the ridgeline looking South East

View looking North East across the roof

from the roof over the warehouse area

View looking North East onto the store extension roof

from the existing store roof

Steel stair access to the store extension roof

View looking East across the roof towards the Main Entrance area

View looking North East towards the first floor plantroom

View along the rear of the North East parapet looking towards the Main Entrance area

View looking South across the store roof towards the

first floor plantroom & warehouse area

View across the roof looking West onto the first floor plantroom

View along the rear of the first floor plantroom

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

Note the extended bases to the handrail support posts

Shopping trolley left on the roof

View on the underside of the roof decking and secondary lattice truss to the warehouse area

View of the underside of Warehouse Roof Structure – lattice trusses

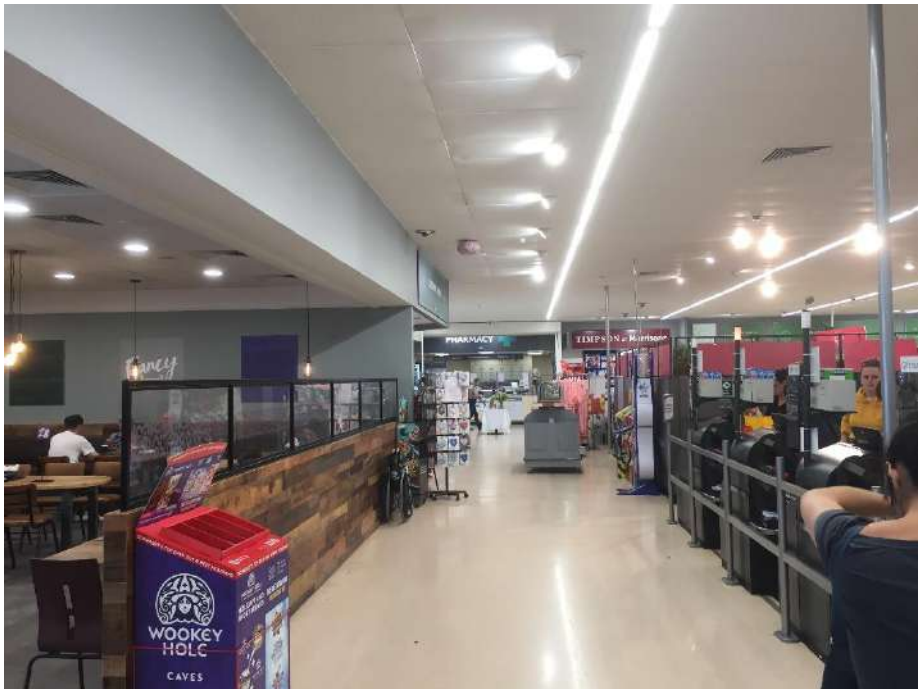
Secondary lattice truss seen above the ceiling, in the store area

View along a spine truss seen above the ceiling in the store area

Fully plated end to a spine truss at the column connection,
seen above the ceiling in the store area

View on the underside of the roof decking and UB rafters in the store extension
Seen above the ceiling in the store area

Lightweight ceiling seen throughout the store



View along the check out mall

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