Trawsfynydd Site **ENGINEERING DESIGN CALCULATION SHEET**			**SHEET 1 of 7**
ASSESSMENT OF ACMS ASSOCIATED WITH PC PANELS **DECOMMISSIONING PROGRAMME – HEIGHT REDUCTION (L28302)**			**DATE:** **09/07/2025**
CALCULATED BY: NAME: G. Van Heerden SIGNATURE: DATE: 14/07/25	CHECKED BY: NAME: Gruffudd Ap Gwyndaf SIGNATURE: DATE: 14/07/2025	APPROVED BY DESIGN AUTHORITY: NAME: G. Van Heerden SIGNATURE: DATE: 14/07/25	CALC. REF: TRAWS/L28302/DOC/0328

PURPOSE OF CALCULATION:

The Reactor Buildings (RBs) feature precast concrete panels (PCCP) which make up approximately 55%[(Ref.1)] of the elevation area. The PCCP contribution to the overall waste volume to be generated and processed by the Reactor Building Height Reduction (RBHR) project is therefore significant. Each PCCP features cast-in asbestos cement (AC) elements. This set of calculations identifies the known AC items and provides a breakdown per PCCP and total contribution. In addition, the second part of the calculation estimates the volume of asbestos containing material (ACM) utilised as soffit board/shutters in certain courses. The outputs should be considered for entry into the Project Waste Management Plan(PWMP) [(Ref.2)].

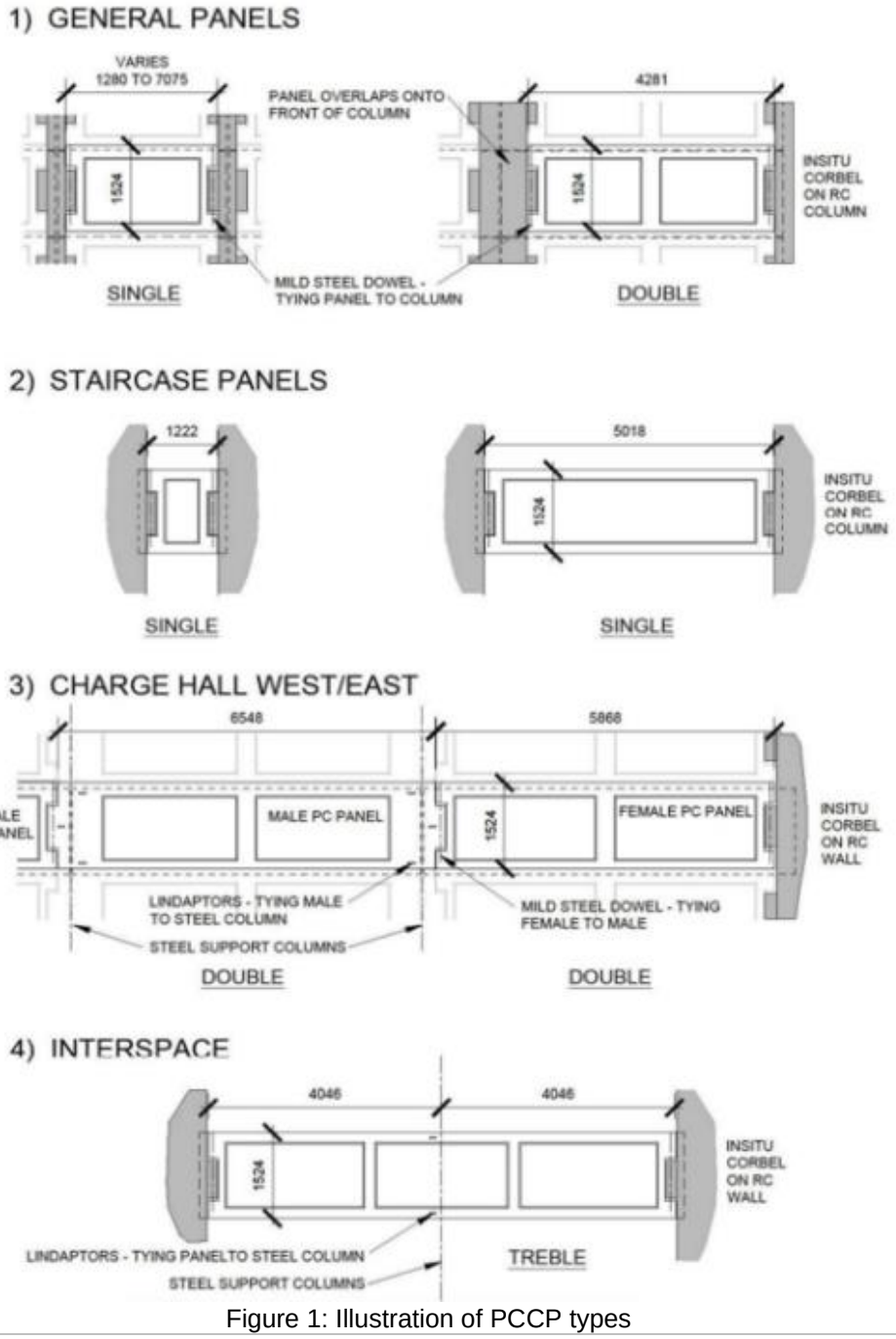


Figure 1: Illustration of PCCP types

DRAWINGS, CODES & REFERENCES:

Ref. 1: TRAWS/L28302/DOC/0307, EAN, Height Reduction Project Drivers.
Ref. 2: TRAWS/L28302/PWMP/0804, PWMP, Height Reduction Project.
Ref. 3: DD/10/C5360, Details of Units L/0 & L/0/H.
Ref. 4: BS 648:1964, Schedule of Weight of Building Materials.
Ref. 5: TRAWS/EAN/23/005, EAN, Precast Concrete Panels Overview.
Ref. 6: DD/10/00/C5350, Typical fixing and weathering details to PC cladding.
Ref. 7: AWWA C403-84, Standard practice for the selection of asbestos-cement transmission pipework.
Ref. 8: DIN 52102 / GSA, Determination of the bulk density.
Ref. 9: TRAWS/L28302/DOC/0034, Technical Scope of Work.
Ref. 10: DD/10/16/00/A02230, Slab edge to PRC Panels seals – general arrangements.
Ref. 11: DD/10/16/A02229, Slab edge to PRC Panels seals – typical details.
Ref. 12: TRAWS/L28302/DOC/0032, Preconstruction Information.
Ref. 13: HSG L143, Asbestos: the survey guide.

CHECKER's COMMENTS:

All comments from checker addressed. Signed off on page 1.

14/07/2025

Checklist:	
Is the purpose of the calculation clear?	Yes / ~~No *~~
Are all the reference documents valid?	Yes / ~~No *~~
Is the arithmetic correct?	Yes / ~~No *~~
Is the calculation technically correct?	Yes / ~~No *~~
Are the results valid?	Yes / ~~No *~~

Trawsfynydd Site

ENGINEERING DESIGN CALCULATION SHEET

ASSESSMENT OF ACMS ASSOCIATED WITH PC PANELS

DECOMMISSIONING PROGRAMME – HEIGHT REDUCTION (L28302)

CALC. REF: TRAWS/L28302/DOC/0328

SECTION 1: AC associated with precast panels nibs and lifting points

Broken down into 3 parts to assess volume and weight of:

- AC sleeve.
- Mild steel dowel.
- Grout (the material between the dowel and the inner wall of the sleeve).

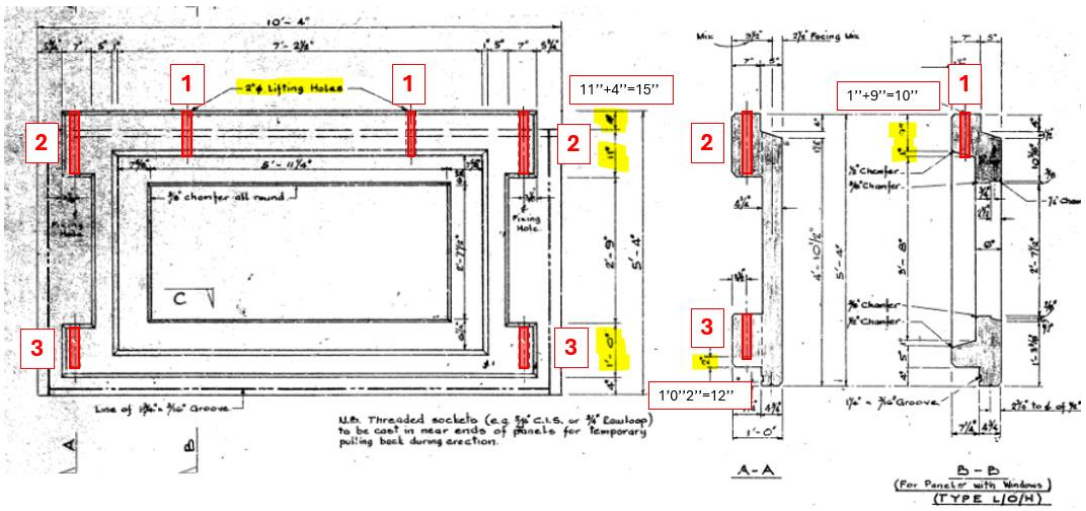


Figure 2: Modified extract from DD/10/C5360

[Ref. 3]

Based upon the above indicative breakdown each PCCP contains AC in each of the following:

- Component 1: lifting sleeves = 10'' or 0.254m x 2 = 0.508m
- Component 2: top nib sleeves = 15'' or 0.381m x 2 = 0.762m
- Component 3: bottom nib sleeves = 12'' or 0.3048mm x 2 = 0.6096m

[Ref. 4]

Total length of sleeve per panel → $L_{(AC)}$= 0.508 + 0.762 + 0.6096 = 1.8796m say 1.88m

Thickness of sleeve $t_{(AC)}$= 6.35mm = 0.00635m say 0.0064m

[Ref. 3]

Outside diameter of sleeve = 2'' + (¼'' x 2) = 64mm = 0.064m → outer radius (R) = 0.032m

Inner radius of sleeve: thickness = 0.032 - 0.0064 → inner (r) = 0.0256m say 0.026m

Mild steel dowel diameter = 22 mm = 0.022m → radius R = 0.011m

[Ref. 5 – page 5]

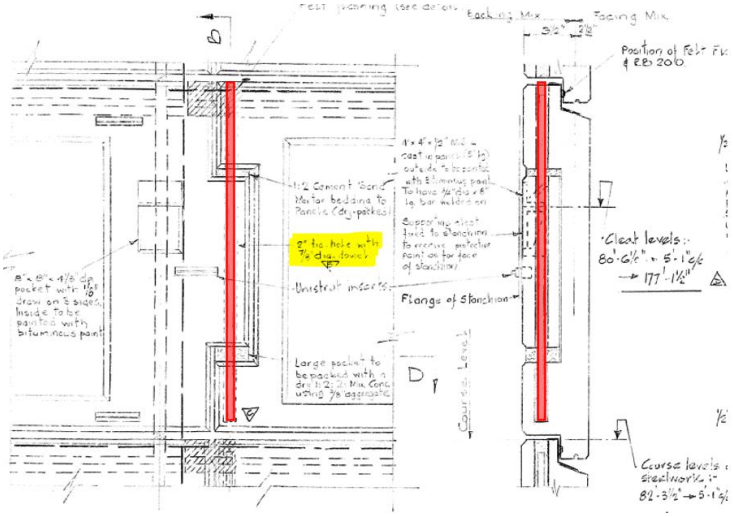


Figure 3: Modified extract from DD/10/00/C5350 (mild steel dowel)

[Ref. 6]

1. Volume of AC Sleeve
$V_{(AC)} = \pi h(R^2 - r^2)$ = π x 1.88 x (0.032²- 0.026²) = 0.00205 say 0.0021m³

2. Volume of Mild Steel Dowel
$V_{(STEEL)} = \pi hr^2$ = π x 1.37 x (0.011²) = 0.00052m³

3. Volume of Grout
For nibs:
$V_{(grout)} = r^2_{(inner)} - r^2_{(dowel)}$ = 0.026² - 0.0011² = 0.00067m³
$V_{(grout)}$ = π x 1.37 x 0.00067 = 0.00288 say 0.0029m³

For lifting points:
$V_{(grout)} = r^2_{(inner)} - r^2_{(dowel)}$ = 0.026² - 0.0011² = 0.00067m³
$V_{(grout)}$ = π x 0.508 x 0.00067 = 0.00107 say 0.0011m³

$V_{(grout\text{-}total)}$ = 0.0029 + 0.0011 = 0.004m³

Weight calculation:
Typical densities:

- Asbestos cement ≈ 1,600 kg/m³ [Ref. 7 & 8]
- Mild steel ≈ 7,850 kg/m³
- Grout ≈ 2,300 kg/m³

Volumes × densities: [Ref. 3]

- Asbestos Cement = 0.0021 x 1600 = 3.36kg
- Mild Steel = 0.00052 x 7850 = 4.1kg
- Grout = 0.004 x 2300 = 9.2kg

Volume summary for PCCP nibs & lifting pins:

Item	Material	Volume (m³)	Weight (kg)
1	AC	0.0021	3.36
2	Mild steel dowel	0.00072	5.65
3	Grout	0.004	9.2
	Total of 1 + 2 + 3	0.00682	18.21

Note: if nibs/lifting pins are removed as complete section and methodology does not involve further segregation/processing then due cognisance needs to be given to total volume which does not take account for proximity cut. The waste volumes will therefore be much influence by cutting pattern.

SECTION 2: AC associated with column corbels

Broken down into 3 parts to assess volume and weight of:

- Asbestos cement sleeve
- Mild steel dowel
- Grout

From DD/10/C5360 length of corbel = 2'9'' or 0.838m x 2 = 1.676m say 1.7m

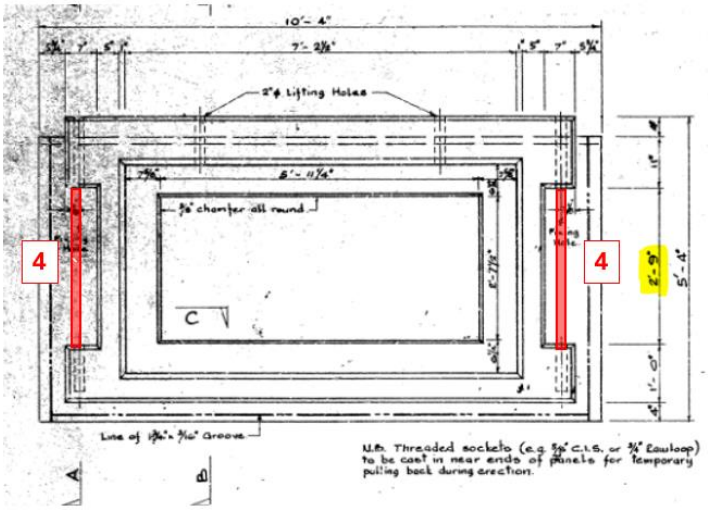


Figure 4: Modified extract from DD/10/C5360 (column corbel)

1. Volume of AC Sleeve
$V_{(AC)} = \pi h(R^2 - r^2) = \pi$ x 1.7 x (0.032²- 0.026²) = 0.00185 say 0.0019m³

2. Volume of Mild Steel Dowel
$V_{(STEEL)} = \pi hr^2 = \pi$ x 1.7 x (0.011²) = 0.00065m³

3. Volume of Grout
$V_{(grout)} = r^2_{(inner)} - r^2_{(dowel)}$ = 0.026² - 0.0011² = 0.00067m³
$V_{(grout)} = \pi$ x 1.7 x 0.00067 = 0.00357 say 0.0036m³

Volumes × densities:

- Asbestos Cement = 0.0019 x 1600 = 3.04kg
- Mild Steel = 0.00065 x 7850 = 5.1kg
- Grout = 0.0036 x 2300 = 8.3kg

Volume summary for corbels:

Item	Material	Volume (m³)	Weight (kg)
1	AC	0.0019	3.04
2	Mild steel dowel	0.00065	5.1
3	Grout	0.0036	8.3
	Total of 1 + 2 + 3	0.0062	16.44

Note: if corbel is removed as complete section and methodology does not involve further segregation/processing then due cognisance needs to be given to total volume which does not take account for proximity cut. The waste volumes will therefore be much influence by cutting pattern.

SECTION 3: PCCP Conclusion

Item	Material	Volume (m³)	Weight (kg)
1	AC	0.0021 + 0.0019 = 0.004	3.36 + 3.04 = 6.4
2	Mild steel dowel	0.00072 + 0.00065 = 0.00137	5.65 + 5.1 = 10.75
3	Grout	0.004 + 0.0036 = 0.0076	9.2 + 8.3 = 17.5
	Total	0.013	34.65

Note: if corbel/nibs/lifting pins are removed as complete section and methodology does not involve further segregation/processing then due cognisance needs to be given to total volume which does not take account for proximity cut. The waste volumes will therefore be much influence by cutting pattern.

Based upon the above, each panel contains the following:

- 6.4kg or 0.004m³ of undiluted AC (other ACMs are present within the PCCP anatomy however not covered by this assessment).
- Given that 1511No panels need to be removed, the total AC undiluted contribution can be estimated at 9,670kg (1511 x 6.4). If no segregation of components occurs as part of a proven optimised methodology, the waste volume consigned as asbestos waste could exceed 52.4Tonnes or 19.64m³.
- Given the composite nature, the amount of asbestos waste could be vastly impacted by the demolition methodology.

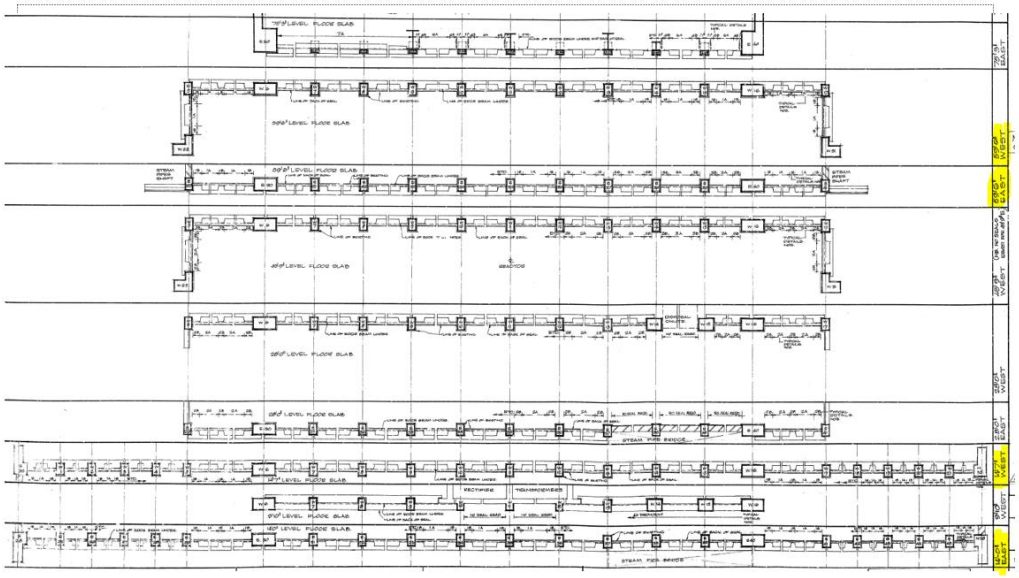
[Ref. 9 – Page 26]

SECTION 4: Assessment of AIB & AC associated with select PCCP courses

Context:

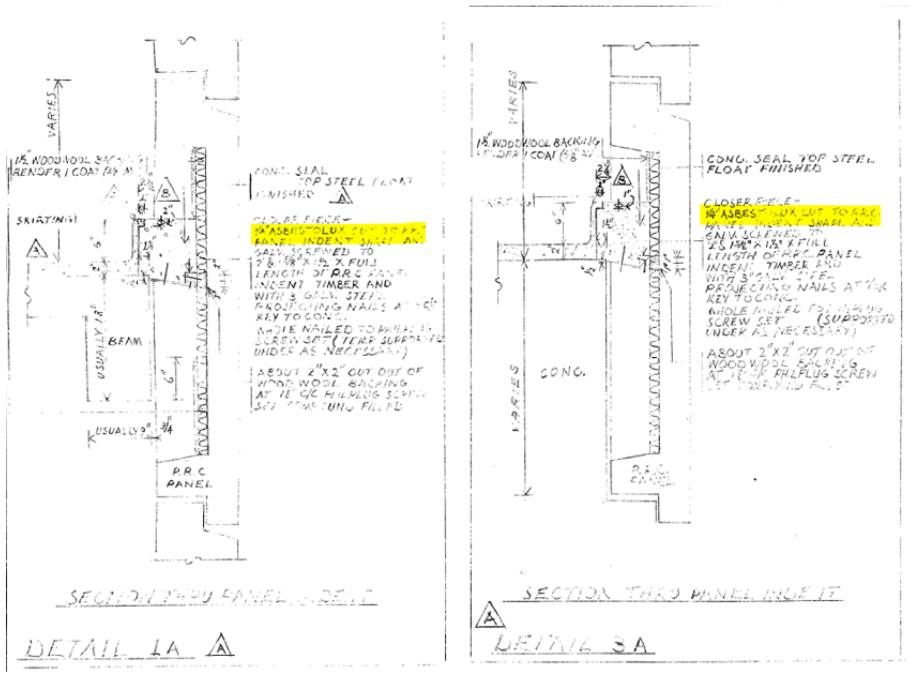
Select PCCP courses feature complex details at intersecting floor slabs. The edge down stand beam construction details included the utilisation of AIB or AC as permanent shuttering. Base upon desktop examination of the associated drawings, the details occur at the following locations:

- 59'6'' west = 4th floor level.
- 59'6'' east = 4th floor level.
- 14'7'' west = 1st floor level.
- 14' east = 1st floor level.



[Ref. 10]

Figure 5: Extract from DD/10/16/00/A02230



[Ref. 11]

Figure 6: Extract from DD/10/16/00/A02229 (details 1A & 3A featuring AIB)

The above drawings details ¼'' 'asbestolux' shutter to panel indent. These details should be read in conjunction with the RBHR Preconstruction Information (Ref. 12) for completeness. Based upon the above details the following calculations assume all shuttering to be asbestolux (AIB) which is worst case from a material friability risk and licensing category. Attention is drawn to the fact that the R&D surveys have identified a mix of AIB and AC in a number of areas (AC local to corridor extremity areas).

[Ref. 12]

From DD/10/16/A0229 = ¼'' = 6.35 say 6.4mm

Extract from HSG L143 detailing typical composition of 'asbestolux' AIB:

Insulating board in cores and linings of composite products.	Found in fire doors, cladding infill panels, domestic boiler casings, partition and ceiling panels, oven linings and suspended floor systems. Used as thermal insulation and sometimes as acoustic attenuators.	Crocidolite used for some boards up to 1965, amosite up to 1980, when manufacture ceased. 16–40% amosite or a mixture of amosite and chrysotile.	Can be broken by impact; significant surface release possible by abrasion, but usually painted or plastered. Sawing and drilling will also give significant releases. 'Asbestolux'. Caposil.

[Ref. 13]

The soffit boards were utilised to infill between the edge of the slab and interior face of PCCP. The original construction drawings detail this offset as 7'' however conservatism is applied and a dimension of 220mm is utilised in the following calculations. Equally, the infill section span between the RC columns however for convenience the entire length of the corridor has been utilised in the below calculations. This accounts for miscellaneous 'finds' during the demolition phase.

[Ref. 3]

Total length of each corridor:

- 59'6'' west (4th floor level) = 40.7 + 1.55 + 1.55 = 43.8m [accounting for east / west returns]
- 59'6'' east = 4th floor level = 40.7m
- 14'7'' west = 1st floor level = 70.4m
- 14' east = 1st floor level = 70.4m

Total length of AIB = 225.3m

Volume of AIB per RB = 225.3 x 0.0064 x 0.220 = 0.32m³
Total volume of AIB = 0.32 x 2 = 0.63m³

Density range of AIB = 700 - 950kg/m³.
Assuming worst case density = 0.63 x 0.95 = 0.59 say 0.6 Tonnes

[Ref. 13]

SECTION 5: Soffit board Conclusion

Based upon the above, the RBHR project will generate in excess of:

- 0.6 Tonnes or 0.63m³ of AIB/AC from the PCCP soffit boards.
- The above figures feature some conservatism however do not take account of the removal methods and bound substrate which could increase the expectant volumes exponentially.

_____END_____