APPENDIX 4

Engineering Report

awnconsulting

Séamus Lynch t/a Corroville Designs.
Planning & Design Consultant

Client:

Brandon Products

Kilcolman

Asdee

Co. Kerry

Scope:

Review of Overall Stability of Proposed Stainless Steel Chimney Stack

Consultant:

Séamus Lynch NCEA Dip. Civ. Eng. MIEI ICIOB
t/a Corroville Designs.
Design & Planning Consultant.
Belville,
Kilmeedy,
Co. Limerick
Tel: 087 9486000
Email: seamus.lynch@gmail.com

Introduction

Corroville Designs have been retained by Brandon Products in conjunction with a proposed stainless steel flue at one of their projects.
The function of this document is to review at high level the suitability of the flue diameter, material chosen, and possible foundation solution for the scheme.
This is not an exhaustive design document, particularly with regard to the flue itself, which requires detailed design from the manufacturer.

Scope

This document addresses the following items:

1. Design Premise & Presumptions
2. Loadings
3. Calculation of Bending/Overturning Moment
4. Check of flue diameter and thickness
5. Check of possible foundation solution

1. Design Premise & Presumptions

- The relevant design standards for this checking exercise are:
    - Wind loading to BS 6349
    - Concrete Design to BS 8110
    - Steel Design to BS 5950
- From a design perspective, the most important particulars include:
    - All stainless steel to be grade 316 with a yield stress of 220 N/mm^2.
    - All bolts to be Grade 8.8.
    - All substructure concrete is to be grade C37 (Cube Strength)
    - 40mm cover to be provided to reinforced concrete
    - All steel reinforcement is to be CARES approved and of "H" grade (460 N/mm^2).
- Bearing capacity of the soil is presumed to be 100 kN/m^2 SLS, which is to be verified on site.

2. Loadings

Conservative design loadings will be utilised to ensure the robustness of the structure.
A wind load of 2.0 kN/m^2 has been considered for the site. This is an extremely conservative figure.
For a 700mm wide flue, the load imparted to the flue structure by the wind is therefore:
(2.0)(0.7) = 1.4 kN/m Serviceability Load State (SLS)(Unfactored)
Using the Partial Safety Factor of 1.4 outlined below for Wind Loadings, the Ultimate Limit State (ULS)(Factored) load is:
(1.4)(1.4) = 1.96 kN/m of flue = W

Partial Safety Factors

Dead Load	1.4
Imposed Load	1.6
Wind Load	1.4

3. Calculation of Bending/Overturning Moment

The bending moment for a cantilevered member is $(W)(L)^2/2$
W = 1.96 kN/m from above
L = Height of Flue = 25m

Overturning Moment, therefore = (1.96)(25)(25)/2 = 613 kNm ULS

4. Check of flue diameter and thickness

A 700mm flue of 8mm wall thickness is proposed.
The section modulus of this pipe is:

$Z = (\pi)(D^4-d^4)/32D$

Where: D = 700mm
D = 700-8-8 = 684mm

Therefore, $Z = (\pi)(700^4-684^4)/(32)(700)$
= 2974803mm^3
The bending capacity of the section, using steel of 220 N/mm^2, is:
(2974803)(220)/1000000 = 654 kNm
This is lower than the applied moment of 613 kNm, using conservative loadings and appropriate safety factors.
Whilst the flue is subject to further design, the diameter and material chosen appears from high level review to be suitable.

5. Check of possible foundation solution

The cross sectional area of the flue is:
$A = (\pi)(D^2-d^2)/4 = 17391$mm^2
The density of Grade 316 stainless steel is 8000 kg/m^3
The flue therefore weighs:

(17391)(25)(8000)(9.81)/(1000000)(1000) = 34.12 kN
The weight of the flue and the pad foundation will be utilised to resist overturning.
No cable stays will be considered in this calculation.
As these are beneficial restoring forces, a factor of 0.9 will be applied to them and compared against the fully factored overturning moments.

Consider a pad foundation of 4m x 4m x 0.4m thick.
The density of concrete is 2400 kg/m^3
This pad weighs (4)(4)(0.4)(2400)(9.81)/1000 = 376 kN
The restoring moment created by a lever-arm of 4/2 = 2m = (376)(2) = 753 kNm
The restoring moment created by the flue, using the same lever arm is (34)(2) = 68 kNm
The total restoring moment, applying appropriate safety factors is (753 + 68)(0.9) = 738 kNm
This is in excess of the ULS overturning moment of 613 kNm, and so the pad foundation is adequate.

Conclusion

A review of the overall stability of this flue, using conservative wind loads, and considering appropriate material thicknesses and flue diameter, indicates that the overall arrangement is stable.
The flue is subject to further detailed design.
Flues experience dynamic effects when placed in groups, and this design considers a single flue only.
It also considers only the flue indicated in the drawings provided, namely adjacent to a single building and not subject to increased wind forces due to funnelling effects between multiple buildings etc.
The possible use of rope stays has been conservatively ignored in the design check. These will significantly reduce the bending and overturning moments, and can be utilised if required.
Also conservatively ignored is the increased flue diameter at low-level. The significant increase in strength at this location will more than compensate for the marginally increased cross-sectional area which will be subject to increased wind loading near the base of the flue.