Technical Insulation

Tipping the Scales?

A Weight Comparison of Differing Insulated HVAC Ductwork Specifications

Kingspan®

Contents

Introduction

Executive Summary

The Kingspan KoolDuct® System must be considered as the product of choice for projects where there are load bearing constraints as:

- Ductwork fabricated from The Kingspan KoolDuct® System can weigh 70% less than ductwork constructed from galvanised sheet steel and insulated with mineral fibre.

Current Practice & The Alternatives

Current Practice

- Air conditioning and ventilation systems are commonly added to built environments, which have not previously incorporated such systems;
- Existing building structures commonly have inadequate load capacities for new service loads;
- Traditionally, HVAC ductwork is constructed from galvanised sheet steel, which is installed first and then insulated separately as a second operation;
- Time constraints mean that projects may commence before their design is complete;
- The ductwork material is commonly not considered until late in a project's design process;
- Those who are not intimate with a project's constraints commonly select the ductwork material;
- Detailed surveys of existing structures to the level required to plan service layouts are commonly not available before construction commences;
- Services design co-ordination commonly occurs concurrently with construction;
- Delays are commonly caused by unforeseen items, only discovered once construction commences and full exposure of the structure occurs; and
- Delays are commonly caused by design changes that are required during the construction period.

Assessing the Alternatives

The purpose of this report is to examine insulated sheet metal ductwork and The Kingspan KoolDuct® System, their relative performance with regards to weight and the benefits this can incur.

Traditionally, the majority of ductwork is manufactured using galvanised sheet steel, which is installed first and then insulated separately as a second operation. The selection of ductwork material is therefore generally assumed. Additionally, the construction project client's specification for ductwork is normally limited to a set of performance criteria rather than a specific material.

The actual selection of the ductwork material is made by the mechanical services sub-contractor or, more often, its ductwork sub-sub-contractor. Indeed, because of existing manufacturing set-ups, it may be disadvantageous to move away from the existing specification norms and use The Kingspan KoolDuct® System.

With the selection of material so removed from those dealing with the specific project constraints, it is not surprising that the selection of the most appropriate material often occurs well into the design process or, to the client's disadvantage, not at all.

Nevertheless, The Kingspan KoolDuct® System eliminates the problem of weight associated with galvanised sheet steel, whilst, at the same time, offering additional advantages to the specifying engineer, the architect, the M&E contractor, the fabricator, the facilities manager, the property developer and the building owner.

The Kingspan KoolDuct® System comprises premium performance Kingspan KoolDuct® panels, fabrication methods, coupling systems and a complete line of accessories to produce pre–insulated rectangular ductwork in sections up to 2.95 m long for the UK.

Kingspan KoolDuct® panels comprise a fibre–free rigid thermoset phenolic insulation core faced with silver aluminium foil on one side and either silver or black coated aluminium foil on the other side.

Fibre-free Core

Review of the Alternatives

For some projects the main reason for the selection of The Kingspan KoolDuct® System would be that it can overcome severe constraints on structural loadings. In these circumstances, the selection of The Kingspan KoolDuct® System, over a galvanised sheet steel ductwork system, would often be the only realistic choice, the alternative normally being the introduction, at potentially significant additional cost, of secondary steel supports to transfer service loads back to the structure. In some projects, even this option may not be available, e.g. where buildings contain listed features that can not be obscured by the introduction of new structural members.

In addition, the lightweight nature of The Kingspan KoolDuct® System can also make the installation process easier. A further, more direct result of the lightweight properties, is that the material has a much reduced hazard potential. Risk assessments, required for all construction operations, can be less onerous than those associated with installing the far heavier alternative materials and hence the safety strategies and protection measures that were adopted were also less onerous.

The easier installation process can also mean faster installation speeds. The reduced weight of The Kingspan KoolDuct® System means less labour is required to install it. Both of these aspects reduce the impact of the ductwork installation operation on other site activities and the cost of installation.

Current Practice & The Alternatives

Results of the Analysis

A comparison of weights, per linear metre of ductwork, between pre-insulated ductwork fabricated from The Kingspan KoolDuct® System, and galvanised sheet steel ductwork insulated with mineral fibre is shown in Table 1. The report concentrates on ductwork carrying chilled air, as the demand for air conditioning in UK buildings is common practice today.

The functional unit used in the comparison was: a 1200 mm long rectangular ductwork section; with internal dimensions of 1250 x 800 mm (plus an additional 46 mm for one longitudinal Pittsburgh Lock seam on the sheet steel duct); constructed to operate at a static pressure of 500 Pa; and insulated such that it complies with the insulation thickness requirements of BS 5422: 2023 (Thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to +700 °C. Method for specifying), Table 12 for condensation control on ductwork carrying chilled air at 10 °C.

The weights were calculated to include the mass of aluminium in the facings of the insulation for all insulants. An appropriate duct support and hanger system was also included.

Details of the ductwork specifications analysed are shown in Appendices A & B.

NB If required for load calculations, a schedule of weights for straight ductwork sections fabricated from The Kingspan KoolDuct® System using the aluminium grip flange, 4-bolt flange and Tiger Clip coupling systems is contained in 'The Kingspan KoolDuct® System Fabrication Manual'. All weights given in the tables are for guidance purposes only and may not denote actual weights. Weights shall always be independently determined by the fabricator and / or installer.

It is clear that, as a result of the findings, The Kingspan KoolDuct® System should be considered the product of choice for HVAC ductwork systems where low weight insulated ductwork is a key requirement.

Specification	Insulation Thickness (Practical)		Mass per Linear Metre		Weight Reduction (%)
	Kingspan KoolDuct®	Mineral Fibre	Kingspan KoolDuct® and 4-bolt Flange	Mineral Fibre Insulated Galvanised Sheet Steel	
Ductwork carrying chilled air	30 mm	50 mm	15.98 kg	54.68 kg	70.8

Table 1: Weight Comparison between Pre-insulated Ductwork Fabricated from The Kingspan KoolDuct® System with 4–Bolt Flange and Galvanised Sheet Steel Ductwork Insulated with Mineral Fibre including supports and hangers.

Appendix A

Ductwork Specification – The Kingspan KoolDuct® System (30 mm thick) with 4-bolt Flange

Source Data

Description	Measurement	Value	Total Mass (kg)
Rectangular Ductwork Section Sides (Kingspan KoolDuct® Panel)			
	Section Height x Width x Length (mm) Internal Perimeter Length (mm) Wall Thickness (mm) Mass per Square Metre (kg / m²) Total Surface Area (m²)	800 x 1250 x 1200 4100 30 2.14 5.208	11.145
4-bolt Flange Coupling System			
4-bolt Flange	Units (No.) Total Length (mm) Mass per Linear Metre (kg / m²)	2 4020 0.75	6.030
4-bolt Flange Corner	Units (No.) Unit Mass (kg)	8 0.080	0.640
Galvanised Steel Duct Support and Hanger System* (at 2400 mm centres)			
Supports (Hilti MV-30)	Total Length (mm) Mass per Linear Metre (kg / m²)	730 0.49	0.358
Threaded Bar Hangers (M8)	Unit Diameter (mm) Total Length (mm) Mass per Linear Metre (kg / m²)	8 1060 0.31	0.329
Aluminium Reinforcement System**			
Negative Reinforcement Bars	Units (No.) Total Length (mm) Mass per Linear Metre (kg / m²)	1 798 0.163	0.130
Positive Reinforcement Bars	Units (No.) Total Length (mm) Mass per Linear Metre (kg / m²)	1 875 0.136	0.119
Reinforcement Discs	Units (No.) Unit Mass (kg)	4 0.017	0.068
Speed Clips	Units (No.) Unit Mass (kg)	2 0.002	0.004
Aluminium Foil Vapour Barrier Tape (Aluminium)			
	Total Length (mm) Mass per Linear Metre (kg / m²)	10600 0.0092	0.098
Aluminum Tiger Clips			
	Units (No.) Unit Mass (kg)	8 0.006	0.048
Silicone Sealant			
	Total Length (mm) Mass per Linear Metre (kg / m²)	13000 0.0155	0.202

* In accordance with the manufacturer's recommendations.
** In accordance with the duct design parameters.

Total Mass of Materials

Material	Mass per Linear Metre of Ductwork (kg / m²)	Mass (kg)
Kingspan KoolDuct® Panel	9.29	11.145
Galvanised Steel	6.13	7.357
Aluminium	0.39	0.467
Silicone Sealant	0.17	0.202
Total	**15.98**	**19.17**

Appendix B

Ductwork Specification – Galvanised Sheet Steel Ductwork Insulated with 50 mm Rock Mineral Fibre

Source Data

Description	Measurement	Value	Total Mass (kg)
Rectangular Ductwork Section Sides (Galvanised Steel Sheet)*			
	Section Height x Width x Length (mm) Internal Perimeter Length (mm) Wall Thickness (mm) Mass per Square Metre (kg / m^2) Total Surface Area (m^2)	800 x 1250 x 1250 4146 1.0 7.8426 5.188	40.644
Galvanised Steel Flange Coupling System			
Flange Profile (Doby EP130/11)	Units (No.) Total Length (mm) Mass per Linear Metre (kg / m^2)	2 3980 0.869	6.917
Corner Pieces (Doby S30/12)	Units (No.) Unit Mass (kg)	8 0.076	0.608
Self Piercing Rivets (at 300 mm centres)	Units (No.) Unit Mass (kg)	14 0.001	0.014
Galvanised Steel Duct Support and Hanger System* (at 2500 mm centres)			
Supports (Hilti MQ-41)	Total Length (mm) Mass per Linear Metre (kg / m^2)	750 2.08	1.560
Threaded Bar Hangers (M10)	Unit Diameter (mm) Total Length (mm) Mass per Linear Metre (kg / m^2)	10 1100 0.49	0.539
Galvanised Steel Reinforcement System*			
Stiffener (Back to Back with Bolted Corners)	Units (No.) Thickness (mm) Height (mm) Width (mm) Total Length (mm) Surface Area (m^2) Mass per Square Metre (kg / m^2)	1 1.6 40 100 4420 0.442 12.5481	5.546
Pop Rivets (at 150 mm centres)	Units (No.) Unit Mass (kg)	28 0.001	0.028
Water Based Sealant			
	Total Length (mm) Mass per Linear Metre (kg / m^2)	1350 0.016	0.021
Insulation (Rock Mineral Fibre)			
	Density (kg / m^3) Thickness (mm) Surface Area (m^2) Volume (m^3)	45 50 5.375 0.26875	12.094
Aluminium Foil Vapour Barrier Facing to Insulation (Aluminium)			
	Surface Area (m^2) Surface Area Density (kg / m^2)	5.375 0.069	0.371

* In accordance with B&ES DW/144 (Building & Engineering Services Association Specification for Sheet Metal Ductwork, 1998 Edition).
** Including additional 46 mm required for longitudinal Pittsburgh Lock seam.

Total Mass of Materials

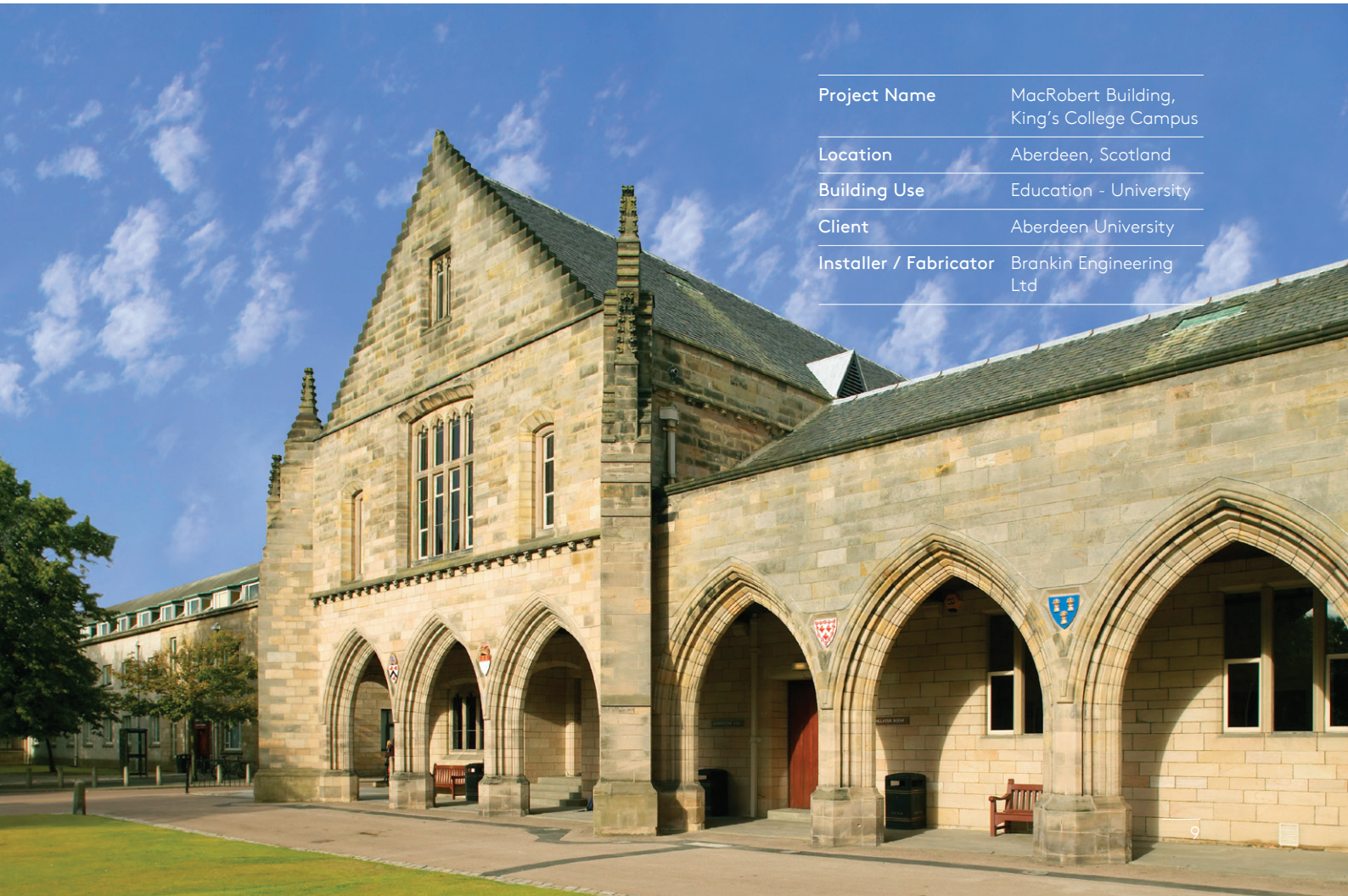
Material	Mass per Linear Metre of Ductwork (kg / m^2)	Mass (kg)
Galvanised Steel	44.69	55.86
Rock Mineral Fibre	9.68	12.09
Mastic	0.02	0.02
Aluminium	0.30	0.37
Total	**54.68**	**68.35**

NB Vapour barrier tape, insulation pins in addition to the reinforcing scrim and backing to the aluminium foil facing were omitted from the analysis.

Example Refurbishment Projects

Project Name	Cadogan Hall
Location	Sloane Square, London, UK
Building Use	Theatre
Client	Cadogan Estates
Structural Engineer	Adams Kara Taylor
M&E Consulting Engineer	Voce Case
M&E Contractor	Gratte Manley
Installer / Fabricator	Sterling Thermal Ltd

Project Name	Edinburgh Castle
Location	Edinburgh, Scotland
Building Use:	War Museum
M&E Consultant	Hulley & Kirkwood
M&E Contractor	Rotary Ltd
Ductwork Contractor	Ductform Ventilation UK Ltd



Project Name	MacRobert Building, King's College Campus
Location	Aberdeen, Scotland
Building Use	Education - University
Client	Aberdeen University
Installer / Fabricator	Brankin Engineering Ltd

Project Name	House of Fraser
Location	King William Street, London, UK
Building Use	Retail Outlet
Client	House of Fraser plc
Main Contractor:	Havelock Europa
M&E Consulting Engineer	Slender Winter Partnership
M&E Contractor	Jackson Rich Ltd
Installer / Fabricator	Sterling Thermal Ltd

Project Name	National Theatre
Location	London, UK
Building Use	Leisure - Theatre
Architect	Haworth Tompkins
Installer	Airtech Ductwork Systems Ltd

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