

CONCEPTUAL DESIGN OF A MIDDLE-OF-THE-MARKET AIRCRAFT FOR EDUCATIONAL PURPOSES

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Abstract

In this paper, the conceptual design of the G-26 Mhòr, a 245-seat Middle-of-the-Market commercial transport aircraft, is presented. This design was used as an educational tool for a new, project-based MEng course at the University of Glasgow, in which students were tasked with refining this design to an early-detailed stage as a group, mimicking the industrial aircraft development process. The G-26 features an elliptical fuselage cross-section, ultra-high bypass ratio geared turbofans, a boundary layer ingesting fan driven by a superconducting electrical motor, advanced composite materials, and active laminar control. This suite of technologies offered the students an opportunity to explore a sustainable and industrially relevant aircraft design challenge to work from. To perform the conceptual design, standard textbook and analysis methods were combined with state-of-the-art projections from the literature. The resulting design offered approximately 50% reduction in mission fuel burn compared with a selected reference aircraft (the Boeing 767-200ER). This reduction is consistent with predictions documented in the literature for concepts with similar technology. The MEng course was held for the first time in the first half of 2026. It was delivered successfully, although certain challenges, such as differing levels of task complexity and design consistency across student groups had to be managed.

Keywords: Aircraft conceptual design, middle-of-the-market, midsized aeroplane, aircraft design education.

1. Introduction

The University of Glasgow has a long history of being at the forefront of aeronautical research and education [1]. To advance its current curriculum further, and to adapt to new accreditation requirements, the University recently developed a new final-year, project-based MEng course, designed to offer students the experience of working on a (simulated) commercial aircraft development programme. In this programme, the students receive a conceptual design at the beginning of the course, which they then need to collectively advance to a late-preliminary/early detailed stage. In particular, the aim is to reach a level equivalent to a preliminary design review (PDR) stage. Each student is assigned membership of a representative aerospace 'organisation' working on this programme. The organisations include a mock aircraft manufacturer, an engine manufacturer, and airframe systems suppliers. These mock organisations need to work together for the duration of the course to successfully complete the programme within budget, time, and simulated legal, security, and commercial constraints.

Within their respective ‘organisations,’ the students work within a variety of roles, each specialising on a specific aspect of the design of the aircraft, its systems, or engines. These roles include technical roles, such as aerodynamics, structures, and propulsion modelling, as well as professional roles, such as leadership and management, innovation, diversity and inclusion, marketing, and security (each student must choose one technical and one professional role).

This course, designated ‘ENG5341’ in the University of Glasgow course catalogue, was delivered for the first time in the first half of 2026 (Semester 2 of the 2025/26 academic year) and ran over ten weeks.

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A key challenge of delivering such a course is to produce conceptual designs for aircraft that are relevant and realistic, and which can expose students to a wide range of technical and non-technical aspects of large civil transport aircraft development programmes. These considerations led the authors to produce a conceptual design for the 'G-26' ('G' referring to 'Glasgow' and '26' the year of the cohort).

This paper introduces the conceptual design of this aircraft as the foundation of this course. It is a 2040-Entry-into-Service, net-zero, 'Middle-of-the-Market' (MoM) aircraft, which features an elliptical fuselage, makes maximum use of composites and sustainable aviation fuels, and employs a superconducting turbo-electric distributed propulsion architecture, which incorporates a boundary layer ingesting fan mounted on the centreline of the rear-fuselage.

The paper covers the initial sizing and analysis of the G-26, as well as a discussion regarding the experience gained from employing it as an educational tool. This introduction is followed by a section introducing MoM aircraft and then by an overview of the concept. After this, the initial sizing is detailed, which is followed by a description and results of the academic and educational assessment, before final conclusions are drawn.

2. The Middle-of-the-Market

In the large commercial transport aircraft market, there are two major segments that respectively cover short-to-medium-range narrowbodies and long-haul, high-capacity widebodies. Positioned between these two, there exists a segment which is usually called the 'Middle-of-the-Market (MoM).' Though there is no formal definition, MoM generally refers to the segment of the market which encompasses ranges from 3,500 to 5,000 nmi with a single-class passenger capacity roughly between 220 to 250 [2]. Aircraft designed for this market are also often referred to as 'midsized' aeroplanes.

This section of the market is profitable but is traditionally difficult to design for. This is because MoM aircraft need to follow relatively long, thin routes and require higher passenger capacity than narrowbodies, but not quite high enough to justify the use of traditional wide body aircraft. Examples of aircraft which fall in the MoM are listed in Table 1. Two aircraft in this table were specifically designed for the MoM, namely the Boeing 757 and Boeing 767. Both aircraft are approaching retirement and are progressively being replaced on MoM routes by aircraft such as the Boeing 737 MAX and Airbus A321XLR. Repurposing the 737 and A321 for MoM routes involved extending the range capabilities of these traditional single-aisle aircraft to fit longer routes. On the other end of the MoM, the Boeing 767 is increasingly being replaced by larger aircraft, such as the Boeing 787 and Airbus A330neo. These aircraft offer improved fuel efficiency [3] on longer routes, but due to the increased dry mass are less efficient on MoM routes. Therefore, although the 737 MAX, A321XLR, 787, and A330neo address portions of the MoM design space, none of them were conceived specifically for MoM operations. Consequently, a gap remains between the range-extended narrowbodies and the widebodies that serve short and medium routes, motivating continued interest in purposely designed MoM concepts. This, in turn, represents both a challenging design task for students and a realistic opportunity for a dedicated aircraft with improved fuel burn performance.

Recognition of this design gap has prompted OEMs like Airbus and Boeing to actively re-explore the MoM market. As stated previously, the former has progressively evolved existing platforms such as the A320 and A330 families to provide coverage of this design space. Boeing has initiated studies conceptualising a clean-sheet design intended to replace both the 757 and smaller variants of the 767, known as the "New Midsized-Aircraft (NMA)" concept [2]. This market segment was therefore selected for the first aircraft for ENG5341, as it was deemed to offer a suitable educational milieu to expose final-year students to an aircraft design challenge that incorporates tight trade-offs between technical, economic, and sustainability factors.

Table 1: Comparison of different aircraft serving the MoM space.

Aircraft	Seats	Range [nmi]	MTOW [kg]	Cabin	EIS
Boeing 757-200 [4]	230	3,915	115,900	Single-aisle	1983
Boeing 767-200ER [5]	245	4,900	175,500	Twin-aisle	1984
Boeing 737 MAX 10 [6]	230	3,600	89,765	Single-aisle	2027 (expected)
Airbus A321XLR [7]	202	4,700	101,400	Single-aisle	2024
Airbus A330-800 [8]	257*	8,100	242,000	Twin-aisle	2020
Boeing 787-8 [9]	242*	8,000	227,900	Twin-aisle	2011

*Two-class seating configuration.

3. Concept Overview

The acknowledgement of the current MoM gap led to the design of the G-26 Mhòr[1], a rendering of which can be seen in Figure 1. The aircraft was designed for a single-class capacity of 245 passengers and a design range of 5,000 nmi. Traditional aircraft configurations are reaching the limits of their efficiency, so the G-26 was developed to incorporate several emerging technologies to significantly enhance efficiency beyond what is available today. These include a rear-fuselage-mounted boundary layer ingestion (BLI) propulsor driven by a superconducting electrical motor, ultra-high bypass ratio turbofan engines, which also produce the electrical power to drive the BLI fan motor, active laminar flow control, and maximum use of advanced composite materials. An elliptical fuselage is also incorporated to make the design competitive compared to longer-range narrowbodies in the MoM segment, offering aerodynamic and cabin-layout benefits discussed further in Section 4.4.2 and 4.4.3. This feature also adds to the novelty of the concept and offered students an additional feature with which to explore the design. To further enhance its sustainability, the G-26 design is intended to employ Sustainable Aviation Fuels (SAFs) as an energy source. These sustainability enablers are in line with general trends in the industry, where there is an overarching goal of reaching net zero carbon emissions by 2050 [10].

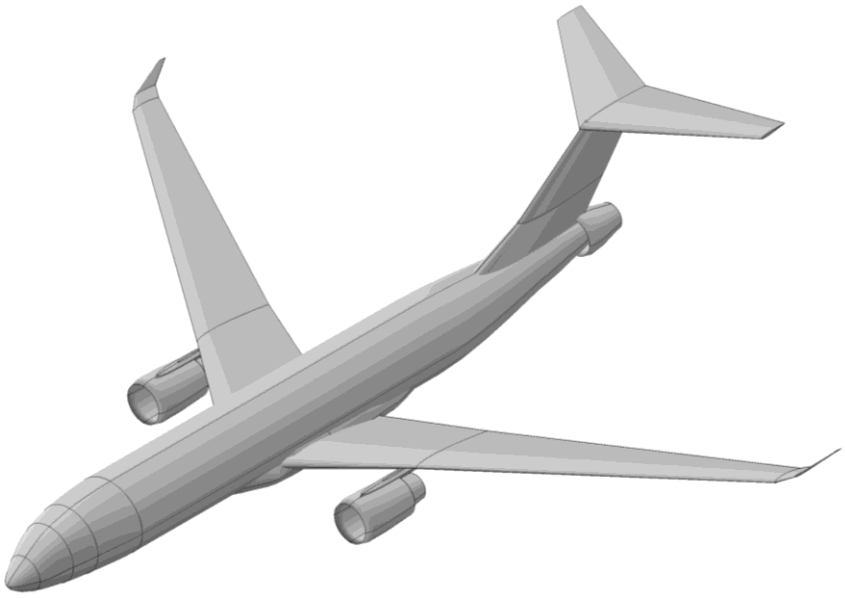


Figure 1: Conceptual geometry of the G-26 Mhòr (rendering performed using NASA OpenVSP [11]).

[1] Mhòr is a Scottish Gaelic word meaning ‘large.’

Incorporating these technologies also created unique opportunities for students to learn about a wide range of key emerging aeronautical advances, while tackling an industrially relevant design challenge. The G-26 also acts as an effective baseline design with plans for future development focusing on the evolvability of the aircraft, and potential aircraft families which can branch from it. Indeed, some of the students were tasked to design variants of the aircraft to maximise its commercial value. This enabled us to strengthen learning surrounding the economic factors that need to be considered when designing large transport aircraft.

4. Conceptual Design Methodology

This section describes the sizing methodology and key design decisions for the conceptual design of the G-26. The objective of the sizing process was not to produce a fully optimised configuration, but rather a credible baseline that is suitable for further refinement by student groups in an educational environment. The process was initiated with the definition of top-level aircraft requirements (TLARs), followed by the selection of a suitable reference aircraft. The Aircraft Conceptual Design Calculator (ACDC) tool was developed to support the conceptual design of the G-26 and will be discussed further in section 4.2. ACDC was calibrated against reference aircraft with a 3% degree of accuracy, after which the most appropriate reference was selected and modernised to 2035 standards to function as the baseline aircraft. Building on this baseline, a series of design features were implemented to develop a novel configuration that incorporates emerging aerodynamic and propulsion technologies that would help meet the TLARs. Each major design decision was evaluated in terms of operational performance, aerodynamic efficiency, and structural feasibility, while also considering the constraints imposed by the educational context of the programme.

4.1 Design Requirements

The design requirements for the G-26 were established to define a representative MoM aircraft suitable for an Entry-into-Service (EIS) target of 2040. Derived from the market analysis presented in Section 2, the requirements balance commercial viability, anticipated technological developments, and the educational objectives of ENG5341. Collectively, they define a design space that is representative of future midsized commercial transport aircraft while remaining sufficiently constrained to provide a feasible conceptual design challenge. The design requirements were:

- Passenger capacity of 245 in a high-density single class configuration.
- Design payload of 35,000 kg.
- Design range of 5,000 nmi.
- Cruise performance evaluated at a speed of Mach 0.8 at an altitude of 35,000 ft.

In addition to commercial considerations, the TLARs were selected to provide an appropriate level of engineering complexity for a one-semester multidisciplinary aircraft design exercise. The design specification booklet intentionally requires students to balance aerodynamic efficiency, structural weight, propulsion integration, airport compatibility, and environmental performance while remaining within the scope of a final-year MEng design project.

4.2 Conceptual Aircraft Design Tool Overview

As introduced previously, the Aircraft Conceptual Design Calculator (ACDC) is a MATLAB-based tool developed for aircraft conceptual design at the University of Glasow, the foundations of which are built on classical aircraft conceptual design approaches described by Roskam [12], Raymer [13], Howe [14], Gudmundsson [15], Torenbeek [16], and Jenkinson [17]. It employs a modular architecture that supports parametric modelling of aircraft configurations. An overview of this tool is provided in Figure 2. Initial estimates for mass fractions, aerodynamic efficiency and propulsion characteristics were scaled from the reference aircraft in the ‘Quick Sizing Initiator’ before being fed into the ‘Component Sizing’ loop

that uses empirical equations from the cited literature. The 'Pre-processing' modules include aerodynamics, mass, and performance estimation, using a modified Breguet range formulation. While the simplified process limits fidelity at the beginning, it ensures transparency, traceability, and accessibility for student teams, which was a key requirement for the programme. Additionally, the modular architecture allows for a clear design process and has the adaptability to be reconfigured with additional modules that may be needed in future iterations of the course.

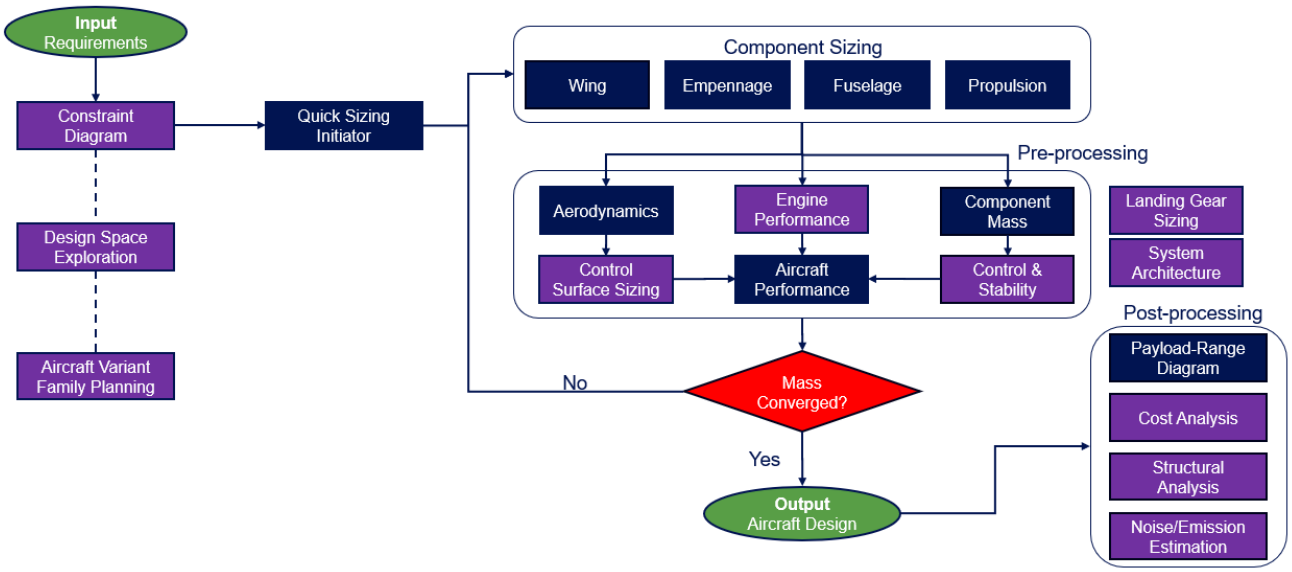


Figure 2: University of Glasgow Aircraft Conceptual Design Calculator (ACDC) tool.

4.3 Baseline Aircraft Selection and Calibration

The first step in the conceptual design process was to calibrate the tool against an appropriate set of reference aircraft, which as mentioned earlier in Section 2, were the Boeing 757 and Boeing 767. Upon modelling the two aircraft using the ACDC, the results were compared against publicly available information, the results of which are documented in Table 2.

Table 2: Comparing results of ACDC modelling of 767 and 757 against reference data.

Parameter	Unit	767-200ER		Δ Literature vs ACDC	757-200		Δ Literature vs ACDC
		Literature [5,17]	ACDC		Literature [4,17]	ACDC	
MTOW	kg	175,500	175,449	-0.03%	115,666	115,748	+0.07%
OEW	kg	82,962	82,928	-0.04%	62,114	62,479	+0.59%
MPL	kg	34,972	34,972	0.00%	21,346	21,346	0.00%
$M_{fuel,max}$	kg	57,566	57,549	+0.03%	32,206	31,932	-0.88%
S	m^2	283.3	283.2	+0.03%	185.2	182.4	+0.07%
L/D_{cruise}	-	18.1	17.7	-2.21%	17.0	16.4	-3.53%
SLST	kN	467.0	466.9	-0.03%	444.8	445.1	+0.07%

With the results from the ACDC being within the acceptable degree of accuracy, the next step was to select which among the two aircraft could serve as the reference for the G-26's design. The 757 is a lighter narrowbody with a lower frontal area and smaller fuselage diameter. However, as established in Section 2.1, the lower end of the MoM space is already well served by new narrowbodies such as the

737 MAX 10 and A321XLR, which occupy a similar seat-count and range bracket to the 757. Targeting a 245-passenger, 5,000 nmi design point therefore favours a reference aircraft closer to the upper end of the MoM space, where the market gap remains more weakly addressed. A 757-derived configuration capable of reaching this higher payload and range would also require a fineness ratio far outside the optimal range, leading to comparatively greater skin friction drag and higher structural weight, due to increased bending loads [18]. In contrast, the lower fineness ratio of the 767 allows for the required cabin volume to be achieved with a more favourable balance between fuselage length, wetted area, and structural efficiency, providing a better platform for integrating the future technologies proposed for the G-26 in order to meet the established TLARs.

The next step was to 'modernise' the reference aircraft design to establish a realistic 2035 baseline, in order to obtain the appropriate benchmark for the design of the G-26. This was achieved by applying four technologies that are expected to be mature by the target EIS: an increase in the aspect ratio of the wing, an increase in the bypass ratio of the engines, extensive use of composites in the manufacture of aircraft structures, and the introduction of active laminar flow control:

- The high aspect-ratio wing contributes towards the desired lift-to-drag ratio and again creates a challenge for students, requiring a balance of improving the aerodynamic performance of the aircraft while also considering both the structural implications of a high wingspan as well as compatibility with existing airport infrastructure. The students also had to consider the limitations of a high wingspan with respect to the ICAO Aerodrome Code D, similar to that of the legacy 767, without compromising aerodynamic performance. If the students had wished to extend the wing, they would have had to implement foldable wingtips.
- The high bypass ratio turbofan engines lower fuel consumption and noise emissions. The subsequent larger dimensions and mass of the engines will introduce additional integration challenges, including increased structural loading on the wing and pylon, and reduced ground clearance. These integration challenges create a valuable environment for the students working on the wing, propulsion systems, and landing gear to carefully coordinate and assess design trade-offs. These engines will also provide electrical power for other systems such as the BLI propulsor, forming part of a hybrid turbo-electric architecture proposed for the G-26.
- The reference 767 was the first Boeing commercial aircraft to commit composite materials from initial production, with Kevlar/graphite assemblies used in secondary structure such as the elevators, rudders, ailerons and spoilers [19], as well as hybrid assemblies with metal fasteners in the cowling of the nacelle, wing-body fairings, empennage fairings and main landing gear doors [20]. Increasing the use of composites in key structural components will not only bring about savings in weight and fuel but also allow the aircraft to take on a more unconventional fuselage shape.
- Since skin-friction drag represents a significant portion of the total drag of modern transport aircraft, a key challenge for the students when designing the wing and other lifting surfaces was to extend laminar boundary-layer coverage as an effective means of reducing parasite drag [13]. The resulting requirement for extensive laminar flow coverage also introduced important design considerations relating to surface finish, contamination control, high-lift device integration, and control-surface design.

By feeding the resulting geometric, aerodynamic, weights, and propulsion parameters into the ACDC tool, the baseline '767-2035' was obtained. This 2035 technology-advancement step was benchmarked against the equivalent improvements reported for the NASA/Boeing SUGAR Free and Refined SUGAR concepts relative to their own reference aircraft [21], confirming that the magnitude of the conventional technology advancement applied in ACDC was consistent with independently published N+3 studies. A comparison of this baseline with the reference 767-200ER is shown in Table 3.

Table 3: Comparing results of ACDC modelling of the 767-2035 baseline against the reference 767-200ER and NASA SUGAR studies.

Parameter	Unit	767-200ER (reference)	767-2035 (baseline)	Δ Reference vs Baseline	Δ SUGAR Free vs Refined SUGAR [21]
MTOW	kg	175,500	138,137	-21.3%	-24.4%
OEW	kg	82,962	67,991	-18.0%	-18.9%
MBF	kg	57,566	35,175	-38.9%	-44.2%
AR	-	8	11	+37.5%	+11.7%
L/D_{cruise}	-	17.7	21.8	+23.2%	+21.6%
$TSFC_{cruise}$	kg/s/N	1.671e-05	1.439e-05	-13.9%	-20.0%

The smaller MTOW reduction relative to the SUGAR benchmark is mainly attributable to a more conservative TSFC improvement: Refined SUGAR assumed a flat 20% TSFC reduction, whereas the 767-2035 baseline's -13.9% improvement was derived by scaling from NASA STARC-ABL data [22]. Since TSFC is a first-order driver of block fuel and MTOW through the Breguet range relationship, this propagated directly to a smaller reduction in fuel mass and MTOW relative to SUGAR.

4.4 Selection and Integration of Novel Technologies

Having established a representative 2035 baseline, the next step was to evaluate the emerging technologies that were capable of further improving aerodynamic efficiency, fuel consumption, and overall aircraft performance. Only technologies considered sufficiently mature or representative of future transport aircraft were selected, while concepts introducing excessive technical uncertainty or complexity were excluded to maintain the educational objectives of the programme. The selected technologies and their influence on the conceptual design are discussed in the following sections.

4.4.1 Propulsion Technologies

Early in the design, the implementation of dual-fuel engines was investigated as a means of enabling the introduction of liquid hydrogen as a fuel source and allow for the potential future development of a fully hydrogen fuelled variant, while retaining compatibility with conventional aviation fuels. Such an approach would provide a pathway towards lower carbon emissions and align with the long-term industry sustainability goals. However, preliminary assessment of such an implementation concluded that the additional complexity associated with fuel storage, safety requirements, and the engine integration would significantly increase the scope of the design to an extent that was not appropriate for a one-semester project. Instead, a conventional Sustainable Aviation Fuel (SAF) architecture was retained, and other aspects of the design were balanced to provide an appropriate technical challenge.

A rear, fuselage-mounted BLI propulsor was introduced to improve overall aircraft efficiency at cruise by recovering kinetic energy from the fuselage boundary layer, contributing towards the high lift-to-drag ratio requirement. Boundary layer ingestion presents unique challenges, including flow distortion and integration complexity, but the technology has the potential for a 5–13% reduction in propulsive power required and a 12–36% reduction in fuel consumption[2] [23]. Because the ingested boundary layer flow is reaccelerated within the propulsor, conventional thrust-drag bookkeeping breaks down under strong aerodynamic coupling, meaning this benefit is best understood as a propulsive efficiency gain rather than a drag reduction [23]. For the G-26 BLI system, L/D and thrust specific fuel consumption (TSFC) were scaled to match the relative improvements achieved on the NASA STARC-ABL BLI propulsor [22],

[2] Higher values corresponding to more unconventional aircraft configurations.

with the aft-mounted propulsor assumed to provide one-third of the cruise thrust requirement following the STARC-ABL architecture, and underwing engines correspondingly downsized [24].

Additionally, the incorporation of BLI influences the design of other aircraft components. The rear-mounted arrangement creates the necessity for a T-tail configuration to provide the necessary clearance for the propulsor. Consequently, students working on the design of the empennage must address traditional T-tail considerations, including increased structural loading on the vertical tail and susceptibility to deep stall, while also evaluating the aerodynamic interactions between the tail surfaces and the BLI propulsor. This creates a highly integrated design environment in which decisions made by one team directly affect the work of others, and simulates the reality of aircraft design in industry, pushing students to maintain a consistent communication network with their peers.

4.4.2 Aerodynamic Technologies

For the conceptual design, the aircraft surface areas covered by active laminar flow control were assumed from literature: from 30% of the wing chord to close to 50% of the empennage chord and 10% of the fuselage length [13]. These assumptions brought forward considerations in the design of the high-lift devices and control surfaces and were treated as an enabling technology for achieving the target requirements. These technologies primarily reduce skin-friction drag and therefore influence the aircraft zero-lift drag coefficient, with assumptions in laminar flow fraction taken from Raymer [13], allowing for reductions in fuel consumption while maintaining the required mission performance.

The elliptical fuselage featured in the G-26 provides the benefits of a twin-aisle cabin with faster turnaround times, but with less unused space [25]. This has the advantage of reducing profile drag while also adding a small lift contribution from the fuselage, thereby improving the overall aerodynamic efficiency of the aircraft. The structural implications of this non-circular cross-section are discussed in Section 4.4.3.

4.4.3 Structural Implications

The main technical challenge of a non-circular cross section relates to the pressurisation cycles of the aircraft, which can lead to excessive fatigue concerns. To mitigate such issues, the G-26 makes full use of composite materials, which are less prone to fatigue.

Non-circular fuselages inherently incur a structural weight penalty compared with circular designs, as cabin pressurisation loads cannot be resisted through hoop tension alone and instead generate additional bending and local stress concentrations. This penalty was quantified using a semi-analytical method in which an elliptical shell is sized around the perimeter against an assumed design stress [26], referenced directly against the 767-200ER's own cross-section. This yielded a mass increase of approximately 6.12%, applied as a calibration factor to the fuselage mass estimate.

5. Results

Building on the 2035 technology-advanced baseline (767-2035, Cir. Fus.), two further design changes were applied: the elliptical fuselage cross-section (767-2035, Eli. Fus.) and the rear-mounted BLI propulsor, leading to the final G-26 configuration. This isolates the BLI system's effect and allows benchmarking against difference between the NASA N3CC to STARC-ABL, since the two concepts share a common airframe and technology baseline and differ only in the turboelectric BLI propulsor [22]. This comparison is shown in Table 4.

The resulting configuration, depicted in Figure 3, satisfied the top-level requirements, achieving the design range of 5,000 nmi with a payload of 35 tonnes at a maximum take-off mass of around 133 tonnes. The propulsion system, consisting of two ultra-high bypass ratio turbofans and the BLI propulsor, provides a total cruise thrust of approximately 76 kN. The BLI fan is powered by a 5.27 MW

superconducting motor and accounts for one third of total cruise thrust. At cruise conditions (Mach 0.8 at 35,000 ft), the aircraft is expected to have a lift-to-drag ratio of about 22.6. The combined effect of active laminar flow control, the elliptical fuselage configuration, and the BLI system is an overall 28% increase in cruise L/D relative to the reference 767-200ER, which, along with a weight reduction of 24% and an engine efficiency improvement of 24%, leads to a 50% reduction in block fuel (MBF) compared with the reference aircraft. A comparison with the reference aircraft is given in Table 5 and the payload-range performance is provided in Figure 4.

Table 4: Comparison between the 767-2035 circular fuselage, 767-2035 elliptical fuselage, and G-26 Mhòr and NASA's STARC-ABL.

Parameter	**Unit**	**767-2035 (Cir. Fus.)**	**767-2035 (Eli. Fus.)**	**G-26 Mhòr**	**Δ 767-2035 Eli. Fus. & G-26**	**Δ N3CC & STARC-ABL [22]**
MTOW	kg	138,137	137,723	133,248	-3.2%	-3.8%
OEW	kg	67,991	67,763	68,348	+0.9%	-1.6%
MBF	kg	35,175	33,214	28,411	-14.5%	-15.2%
L/D_{cruise}	-	21.8	21.8	22.6	+3.7%	+4.0%
$TSFC_{cruise}$	kg/s/N	1.439e-05	1.439e-05	1.268e-05	-11.8%	-11.8%

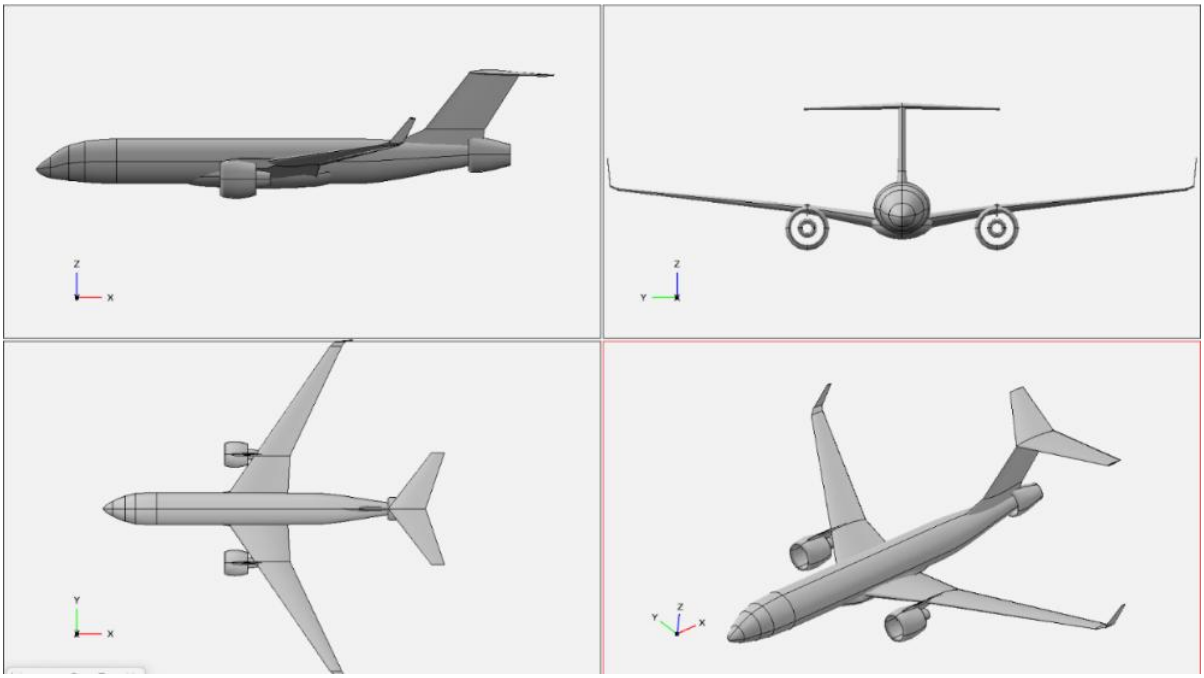


Figure 3: Three views of the G-26 Mhòr (generated with NASA OpenVSP [11]).

Table 5: Comparison of G-26 with the Boeing 767-200ER reference aircraft [5].

Parameter	**Unit**	**G-26 Mhòr**	**767-200ER**	**Δ**
PAX	--	245	245	--
EIS	--	2040	1984	--
R	nmi	5,000	4,900	+2.0%
MTOW	kg	133,248	175,500	-24.1%
OEW	kg	68,348	82,962	-17.6%
MBF	kg	28,411	57,566	-50.6%
TSFCcruise	kg/s/N	1.268e-05	1.671e-05	-24.1%
L/Dcruise	--	22.6	17.7	+27.7%
Primary Structure	--	Composite	Aluminium	--

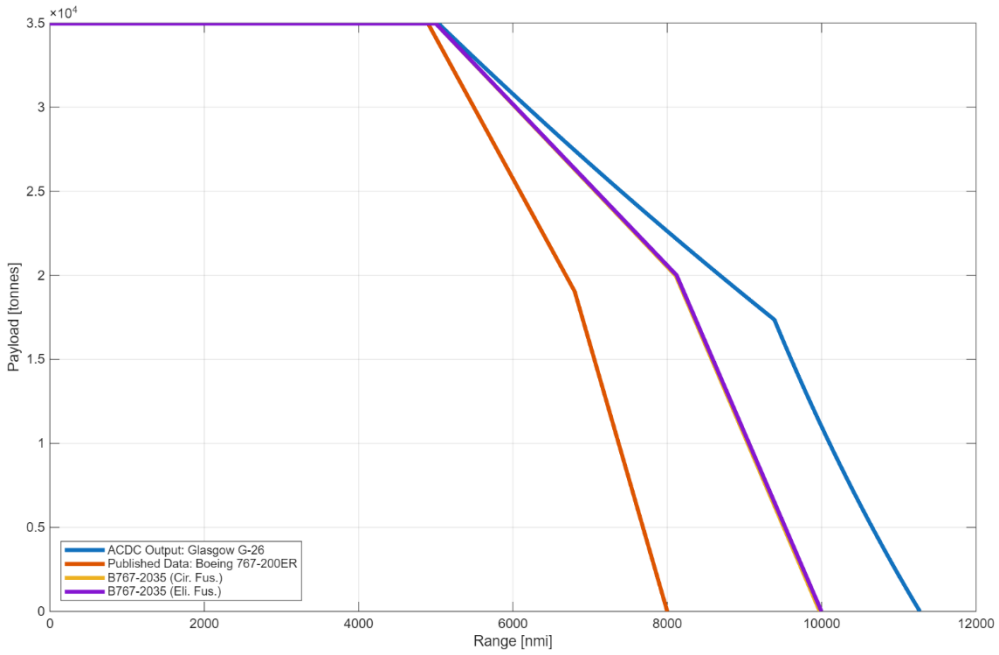


Figure 4: Payload-Range diagram of the G-26 against the reference B767-200ER [5,27].

These results demonstrate that the integration of the selected emerging aerodynamic and propulsion technologies yielded substantial efficiency gains. The 50% fuel consumption reduction is consistent with the compounded fuel-burn reductions independently reported for the SUGAR Free/Refined SUGAR [21] and N3CC/STARC-ABL [22] comparisons (a combined ≈53% reduction).

6. Course Delivery and Educational Outcomes

The central aim of the conceptual design of the G-26 baseline was to balance technical realism with pedagogical utility, and it was therefore intentionally developed to a level of completeness for overall system-level analysis, while leaving key areas under-defined to allow student groups the opportunity to refine it further. Specific decisions were made in preparation for the ENG5341 course delivery to support the distribution of work across the cohort of students to allow them to complete their analysis within a single academic semester. These were as follows:

- High-level geometry, mass breakdown, and performance targets were fixed to provide a common set of requirements for the entire cohort to work on.
- The detailed definition of subsystems such as flight control, propulsion systems, secondary power systems, avionics, and so forth, were left for the students to define.
- The novel technologies, such as the superconducting BLI system, active laminar flow, and elliptical fuselage structures, were included to create focused technical challenges.

The course was delivered from January to March 2026 and was taken by sixty final-year MEng Aeronautical Engineering and Aerospace Systems students at the University of Glasgow. The students were organised into component-specific teams, known as Integrated Product Teams (IPTs), each responsible for refining different aspects of the G-26 design. The IPTs were further divided into sub-specialisms (groups of three to six students each), mimicking an industrial development programme, while retaining feasibility in an educational setting. The IPT structure can be seen in Figure 5.

Overall, the course was delivered successfully, with the students producing a comprehensive and refined design, ready for an industry-like preliminary design review. A rendering of the final design can be seen in Figure 6. The preliminary design delivered by the students will form the subject of a detailed follow-on paper.

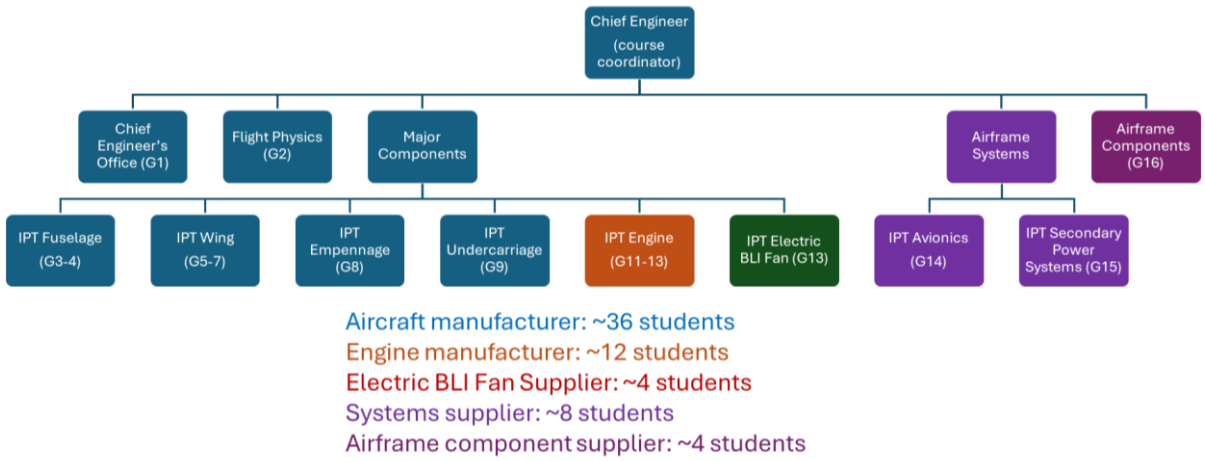


Figure 5: The work breakdown structure for the G-26 airliner development programme. The different colours indicate different 'organisations.' 'G' indicates the group number. IPT = Integrated Product Team (note that some IPTs consist of several groups).

As would be expected, some challenges were encountered during the delivery of the course. The most significant ones can be summarised as follows:

- There was a mismatch in the quantity and/or fidelity of the starting point information available to different groups. The students were told that this is to be expected on a programme such as this and that assessment would take place with these factors in mind. Despite setting the scene in this manner, the uncertainty in some of the tasks still initially led to some anxiety in those with a less clear starting point. However, our experience was that these students often performed very well, initiating communication with other groups early on to elicit requirements and eventually producing excellent designs. For future iterations of the course, it will be endeavoured to provide a more balanced starting point.
- Related to the point above, some students chose tasks that were significantly more complex than others. Again, the experience was that these students often excelled at these, once given proper direction. In addition, it was made clear that more would be expected of those who were given 'simpler' tasks. Providing tasks of similar complexity is difficult to achieve in a programme such as this and, for future iterations, more time will be spent to articulate the scope for each task ahead of the delivery of the course, although this does require more upfront work.
- As with any complex aerospace programme, ensuring the overall group works effectively as a team proved to be a challenge. Although some students were appointed IPT 'systems engineers,' as well as appointing an overall system engineer for the programme, it was often clear that multiple branches of the design were being pursued simultaneously at times, with key interfaces not always being controlled effectively. To address this issue, weekly reporting sessions were established, where the systems engineers presented their status to the whole class to ensure consistency. In the future, it will be attempted to create some implementation of a 'digital twin' of the design, i.e. a version-controlled virtual aircraft, which would function as a single point of truth for the students to continuously refer to.
- Despite two instructors with different expertise (one on aircraft design and one on avionics) being involved with the delivery of the course, providing consistent feedback and assessment proved difficult because of the diverse specialisms involved in the programme. To address this, several colleagues across the school of engineering were consulted to address problems in technical areas where the main instructors lacked expertise.



Figure 6: Fusion 360 rendering of the G-26 Mhòr at the PDR stage. Render by Gwilym Watson.

7. Conclusions

The conceptual design for the G-26 Mhòr, a 245-seat Middle-of-the-Market commercial transport aircraft, was presented. This aircraft was used as a baseline design for a new, project-based MEng course at the University of Glasgow. In this course, students were tasked with refining the G-26 design to an early-detailed stage as a group, mimicking an industrial aircraft development programme.

The conceptual sizing was performed by employing standard textbook and analysis methods, together with state-of-the-art projections from the literature for the advanced technologies incorporated by the design (BLI, elliptical fuselage cross section, advanced composites, laminar flow control, and so forth). The result was a conceptual design for a MoM aircraft that offers an approximately 50% reduction in mission fuel burn, compared with the selected reference aircraft (the Boeing 767-200ER).

The design enabled a successful delivery of the MEng course, which was held for the first time in the first half of 2026. The students successfully advanced the design to a state ready for the equivalent of an industrial preliminary design review. During the delivery of the course, certain challenges, such as differing levels of task complexity and design consistency across student groups had to be managed. The preliminary design delivered will form the subject of a follow-on paper.

Future work will involve developing new industrially relevant conceptual designs for the course. Particular attention will be given to delivering designs that offer equal levels of complexity and starting information for the different student groups, where possible. Advanced digital tools will also be fielded to help students maintain system interfaces and design consistency.

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9. Data Availability Statement

Data from this study are available upon request.

10. Copyright statement

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