МІНІСТЕРСТВО ОСВІТИ ТА НАУКИ УКРАЇНИ
ДЕРЖАВНЕ НЕКОМЕРЦІЙНЕ ПІДПРИЄМСТВО
«ДЕРЖАВНИЙ УНІВЕРСИТЕТ «КИЇВСЬКИЙ АВІАЦІЙНИЙ ІНСТИТУТ»
КАФЕДРА КОНСТРУКЦІЇ ЛІТАЛЬНИХ АПАРАТІВ

ДОПУСТИТИ ДО ЗАХИСТУ
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_____ Тетяна МАСЛАК
«____» _____ 2025 р.

КВАЛІФІКАЦІЙНА РОБОТА

ЗДОБУВАЧКИ ОСВІТНЬОГО СТУПЕНЯ «БАКАЛАВР»

ЗІ СПЕЦІАЛЬНОСТІ

«АВІАЦІЙНА ТА РАКЕТНО-КОСМІЧНА ТЕХНІКА»

Тема: «Кухонна секція модульної конфігурації для середньомагістрального літака місткістю 48 пасажирів»

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Київ 2025

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
STATE NON-COMMERCIAL COMPANY
"STATE UNIVERSITY "KYIV AVIATION INSTITUTE"
DEPARTMENT OF AIRCRAFT DESIGN

PERMISSION TO DEFEND
Head of the department,
PhD, associate professor
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"___" _____ 2025

QUALIFICATION PAPER

FOR A BACHELOR'S DEGREE

ON SPECIALITY

"AVIATION AND AEROSPACE TECHNOLOGIES"

Topic: "Kitchen section with modular configuration for medium-range aircraft with 48 passenger capacity"

Submitted by: _____ **Alina ANDREIEVA**

Supervisor:
Senior teacher _____ **Yurii VLASENKO**

Standards inspector
PhD, associate professor _____ **Volodymyr KRASNOPOLSKYI**

Kyiv 2025

ДЕРЖАВНЕ НЕКОМЕРЦІЙНЕ ПІДПРИЄМСТВО
«ДЕРЖАВНИЙ УНІВЕРСИТЕТ «КИЇВСЬКИЙ АВІАЦІЙНИЙ ІНСТИТУТ»

Аерокосмічний факультет
Кафедра конструкції літальних апаратів
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Освітньо-професійна програма «Обладнання повітряних суден»

ЗАТВЕРДЖУЮ
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«____» _____ 2025 р.

ЗАВДАННЯ

на виконання кваліфікаційної роботи здобувача вищої освіти

АНДРЕЄВОЇ АЛІНИ ВЯЧЕСЛАВІВНИ

1. Тема роботи: «Кухонна секція модульної конфігурації для середньомагістрального літака місткістю 48 пасажирів», затверджена наказом ректора від 17 березня 2025 року № 408/ст.
2. Термін виконання роботи: з 26 травня 2025 р. по 22 червня 2025 р.
3. Вихідні дані до роботи: кількість пасажирів 48, кількість екіпажу 5, маса комерційного навантаження 12,276 т, дальність польоту з максимальним комерційним навантаженням 2650 км, крейсерська швидкість польоту 835 км/год, висота польоту 11,5 км, габаритні розміри вантажної кабіни.
4. Зміст пояснювальної записки: вступ, основна частина, що включає аналіз літаків-прототипів і короткий опис проєктованого літака, обґрунтування вихідних даних для розрахунку, розрахунок основних льотно-технічних та геометричних параметрів літака, компонування пасажирської кабіни, розрахунок центрування літака, спеціальна частина, яка містить аналіз кухонної секції пасажирських літаків, розрахунок необхідного обладнання, аванпроєкт кухонної секції модульної конфігурації.

5. Перелік обов’язкового графічного (ілюстративного) матеріалу: загальний вигляд літака (А1×1), компонувальне креслення фюзеляжу (А1×1), складальне креслення кухонної секції (А1×1).

6. Календарний план-графік:

№	Завдання	Термін виконання	Відмітка про виконання
1	Вибір вихідних даних, аналіз льотно-технічних характеристик літаків-прототипів	26.05.2025	
2	Вибір та розрахунок параметрів проєктованого літака	27.05.2025 – 28.05.2025	
3	Виконання компонування літака та розрахунок його центрування	29.05.2025	
4	Розробка креслень по основній частині кваліфікаційної роботи	30.05.2025 – 31.05.2025	
5	Огляд літератури за проблематикою роботи. Аналіз варіантів компоновки кухонної секції пасажирських літаків	01.06.2025	
6	Розробка компоновки кухонної секції для проєктованого літака. Написання спеціальної частини	02.06.2025 – 03.06.2025	
7	Оформлення пояснювальної записки та графічної частини	04.06.2025	
8	Попередній захист кваліфікаційної роботи	05.06.2025 – 06.06.2025	
9	Подача роботи для перевірки на плагіат	09.06.2025 – 11.06.2025	
10	Виправлення зауважень. Підготовка супровідних документів та презентації доповіді	12.06.2025 – 18.06.2025	
11	Захист кваліфікаційної роботи	19.06.2025 – 22.06.2025	

7. Дата видачі завдання: 26 травня 2025 року

Керівник кваліфікаційної роботи _____ Юрій ВЛАСЕНКО

Завдання прийняла до виконання _____ Аліна АНДРЕЄВА

STATE NON-COMMERCIAL COMPANY

"STATE UNIVERSITY "KYIV AVIATION INSTITUTE"

Aerospace Faculty
Department of Aircraft Design
Educational Degree "Bachelor"
Specialty "Aviation and Aerospace Technologies"
Educational Professional Program "Aircraft Equipment"

APPROVED BY
Head of the department,
PhD, associate professor
_____ Tetiana MASLAK
"___" _____ 2025

TASK

for the bachelor degree thesis

Alina ANDREIEVA

1. Topic: "Kitchen section with modular configuration for medium-range aircraft with 48 passenger capacity", approved by the Rector's order № 408/ст from 17 March 2025.

2. Period of work: since 26 May 2025 till 22 June 2025.

3. Initial data: passenger number 48, flight crew number 5, payload 12.276 tons, flight range with maximum payload 2650 km, cruise speed 835 km/h, flight altitude 11.5 km, passenger cabin dimensions.

4. Content (list of topics to be developed): introduction, main part: analysis of prototypes and brief description of designing aircraft, selection of initial data, wing geometry calculation and aircraft layout, landing gear design, engine selection, center of gravity calculation, special part: analyze of kitchen section of passenger aircraft, calculation of necessary equipment, conceptual design of kitchen section of modular configuration.

5. Required material: general view of the airplane (A1×1), layout of the airplane

(A1×1), design of the kitchen section with modular configuration for medium-range aircraft with 48 passenger capacity (A1×1).

6. Thesis schedule:

№	Task	Time limits	Done
1	Selection of initial data, analysis of flight technical characteristics of prototypes aircrafts	26.05.2025	
2	Selection and calculation of the aircraft designed parameters	27.05.2025 – 28.05.2025	
3	Performing of aircraft layout and centering calculation	29.05.2025	
4	Development of drawings on the thesis main part	30.05.2025 – 31.05.2025	
5	Review of literature on the issue of the qualification work. Analysis of passenger aircraft kitchen section layout options	01.06.2025	
6	Development of the kitchen section layout for designed aircraft. Writing of a special part	02.06.2025 – 03.06.2025	
7	Explanatory note checking, editing, preparation of the qualification paper graphic part	04.06.2025	
8	Preliminary defense of the thesis	05.06.2025 – 06.06.2025	
9	Submission of the work to plagiarism check	09.06.2025 – 11.06.2025	
10	Making corrections, preparation of documentation and presentation	12.06.2025 – 18.06.2025	
11	Defense of the qualification paper	19.06.2025 – 22.06.2025	

7. Date of the task issue: 26 May 2025

Supervisor: _____ Yurii VLASENKO

Student: _____ Alina ANDREIEVA

РЕФЕРАТ

Пояснювальна записка кваліфікаційної роботи «Кухонна секція модульної конфігурації для середньомагістрального літака місткістю 48 пасажирів»:

62 с., 4 рис., 11 табл., 20 джерел

Дана кваліфікаційна робота присвячена розробці аванпроєкту пасажирського літака для середньомагістральних авіаліній, що відповідає міжнародним стандартам польотів, нормам безпеки, економічності та надійності, а також проєктування кухонної секції модульної конфігурації для конструкції літака, придатного для транспортування 48 пасажирів.

В роботі було використано методи аналітичного розрахунку, ґрунтуючись на існуючих компоновках побутового відсіку пасажирських літаків, комп'ютерного проєктування за допомогою CAD/CAM/CAE систем, ескізного проєктування розміщення обладнання у побутовому відсіку прототипа.

Практичне значення результату кваліфікаційної роботи полягає в підвищенні ефективності розміщення побутового обладнання пасажирського літака, базуючись на потребах пасажирів.

Матеріали кваліфікаційної роботи можуть бути використані в навчальному процесі та в практичній діяльності конструкторів спеціалізованих проєктних установ.

Пасажирський літак, компонування, центрування, кухонна секція, обладнання, потреби пасажирів під час польоту

ABSTRACT

Bachelor degree thesis "Kitchen section with modular configuration for medium-range aircraft with 48 passenger capacity"

62 pages, 4 figures, 11 tables, 20 references

This thesis is dedicated to preliminary design of middle-range passenger aircraft with 48 passenger capacity as well as design of kitchen section of modular configuration for the layout of aircraft, suitable for transportation of 48 passengers.

The design methodology is based on analysis, based on existing passenger aircraft galley configurations, engineering calculations to get the technical data of designed aircraft and computer based design using CAD/CAM/CAE systems. In special part kitchen section of passenger aircraft analysis is performed to estimate most efficient layout for designed prototype.

Practical value of the work is improving the effectiveness of passenger aircraft galley configuration, depending on passenger needs.

The materials of the bachelor's thesis can be used in the aviation industry and in the educational process of aviation specialties.

Passenger aircraft, cabin layout, center of gravity calculation, kitchen section, equipment, passenger needs during flight

Format	№	Designation	Name	Quantity	Notes
			General documents		
A4	1	KAI 25 01A 00 00 00 27 TW	Task for work	1	
	2	KAI 25 01A 00 00 00 27	Mid-range passenger aircraft	2	
A1		KAI 25 01A 00 00 00 27 GV	General view	1	
A1		KAI 25 01A 00 00 00 27 FL	Fuselage layout	1	
A4	3	KAI 25 01A 00 00 00 27 EN	Mid-range passenger aircraft	62	
			explanatory note		
			Documentation for assembly units		
A1	4	KAI 25 01A 00 00 00 27 AD	Design of kitchen section	1	

					KAI 25 01A 00 00 00 27 EN
	Sh.	№ doc.	Sign	Date	
Done by		Andreieva A.V			Kitchen section with modular configuration for medium-range aircraft with 48 passenger capacity
Supervisor		Vlasenko Y.V.			
St.control.		Krasnopolskyi V.S.			
Head of dep.		Maslak T. P.			

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CONTENT

INTRODUCTION

The world has always been a curiosity for people – someone travel to obtain inspiration, someone wants to see life of foreign, yet, so similar people, someone seek a better life. Reasons to travel can be numbered in dozens, but one thing is for sure – the bigger the destination, the more difficult is it to reach.

Nowadays, travelling by air routes becoming more and more popular as it can provide safe, comfort and time-saving. To get the best results, aircraft engineers seek ways to improve their design and provide new ideas. Very often passenger choose airline which, by their opinion, will provide the most safe and comfort atmosphere during flight, especially this statement can be seen when there is a far destination. Safety measurements, quality, options of service, location of household equipment must be attentively discussed and designed.

As student of Aviation and rocket-space technology major, for my qualification paper, I have chosen the way of combining best characteristics of three passenger aircraft to design a prototype, which will be suitable for transportation of 124 passengers, 12276 kg of payload mass, breaking down 2650 km distance from 2 up to 6 hours. I decided to name it AA 48-25, referring to characteristics of it. For special part, I designed kitchen sections for the base prototype and 48 passenger configuration one Efficient and quick food provision will be ensured by installed equipment and overall kitchen planning, which are highlighted by analysis, calculations and presented in the form of drawing.

1. PRELIMINARY DESIGN OF MID-RANGE AIRCRAFT

1.1. Analysis of prototypes and short description of designing aircraft

1.1.1. Statistic data of prototypes

Starting, I would like to present three passenger aircraft which I have chosen as a basis for AA P-25. Their performances are presented in the table 1.1., as well as resulting data of my prototype.

Embraer 195. Embraer 195 is a passenger turbofan aircraft designed for short and mid-range flights. It can transport from 120 to 132 passengers of two classes and is controlled by two pilots. Its efficient and low-cost performance ensures Embraer 195 popularity with regional airlines [10].

Antonov An-148. An-148 is a jet passenger aircraft designed for regional and short-range flights. It can perform flights on range up to 3500 km with a cruising speed of 800-870 km/h, and a maximum take-off weight of 43 tons. It is equipped with two Д-436-148 turbojet engines made by Motor Sich [11].

Airbus A220. Airbus A220 is a narrow-body jet passenger aircraft, designed to carry from 100 to 130 passengers and able to cruise at a maximum speed of 685 km/h. Its advanced design is known for its quiet operation and spacious cabin [12].

Table 1.1

Statistic data of prototypes

Name and dimensionality	Embraer 195	Antonov An-148	Airbus A220	AA 48-25
1	2	3	4	5
Max payload, kg	12276	9000	15150	12276
Crew, number of pilot	5 (2 pilots)	5 (2 pilots)	5 (2 pilots)	5 (2 pilots)
Wing loading, kN/m^2	5.33	8.086	6.11	5.33

Continuation of table 1.1

1	2	3	4	5
Passenger number	124	92	130	124
Flight range with max paylod, km	2650	3480	3970	2650
Cruise speed, km/h	829	870	871	835
Cruise altitude, km	12.5	12.2	12.5	11.5
Thrust/weight ratio N/kg	0.83:1	0.72:1	0.34:1	0.64:1
Pressure ratio	28:1	21:1	50:1	29:1
Bypass ratio	5:1	6.2:1	12:1	5.5:1
Approach speed, km/h	230	132.5	158	232.88
Landing speed, km/h	250	230	245	217.88
Speed of take-off, km/h	259.28	250.02	231.5	239.81
Take-off distance, m	1432	1730	1500	1522
Landing distance, m	1275	2100	1390	1177
MTOW Maximum Take Off Mass, kg	52290	43700	63700	54678
Landing mass, kg	45800	47000	58740	48623
Wing span, m	28.72	28.91	35.1	34
Sweepback angle at ¼ of the chord, °	23	24	25	24
Wing aspect ratio	15.13	11.2	11	8
Wing taper ratio	0.33	0.30	0.35	0.33
Fuselage length, m	38.65	29.13	34.9	38.53
Fuselage diameter, m	2.57	2.90	2.31	2.28
Fuselage fineness ratio	12.8	9.25	10.45	12.8
Cabin width, m	2.74	3.15	3.28	2.71

Ending of table 1.1

1	2	3	4	5
Cabin length, m	28.17	16.8	23.7	23.64
Cabin height, m	2	2	2.11	1.94
Horizontal tail span, m	12.08	10.6	16.26	16
Horizontal tail sweepback angle, °	35	32.6	35	32
Horizontal tail aspect ratio	5.6	3.94	5	5.6
Horizontal tail taper ratio	0.55	0.28	0.5	0.55
Vertical tail sweepback angle, °	40	30	35	34
Vertical tail aspect ratio	6.9	1.65	1.65	
Vertical tail taper ratio	0.35	0.35	0.35	0.35
Landing gear wheel base, m	7.9	10.5	8.9	7.77
Landing gear wheel track, m	6.35	5.75	6.75	5.439

Based on parameters of passenger aircraft mentioned above in column 2, 3 and 4, I obtained parameters for my prototype (column 5). By using these parameters, I can perform geometrical calculation of structural units and determine centering [1, 2, 3, 4, 9].

1.1.2. Statistic data and classification of designing aircraft according to the flight performances and layout

Statistic data is known now, but there are some points that need to be determined additionally. Based on obtained parameters, I classified my AA 48-25 so international organizations could accept it into the sky. Results are presented below in table 1.2.

Table 1.2

AA 48-25 classification

1. Purpose of the aircraft	Passenger aircraft
2. Speed of flight (Much number)	Subsonic M = 0.7848 Cruise speed = 835 km/h
3. Range of flight	Flight range 2650 km, mid-range aircraft
4. Flight duration	From 4 to 6 hours
5. ICAO category	Transport
6. FAA Airplane Design Group *(FAA Advisory Circular 150/5300-13)*[13]	III Wingspan = 34 m Tail height = 10.88
7. ICAO / EASA Aerodrome Reference Code *(ICAO Annex 14)*[14]	4C Field length = 1966 m Wingspan = 34 m
8. Aircraft Approach Category *(ICAO Doc 8168 PANS-OPS Vol 1)*[15]	B category Landing speed = 217.88 km/h = = 117.65 knots
9. Maximum take-off mass	Medium MTOW = 54678 kg
Aerodynamic scheme of the aircraft	
Monoplane or biplane	Monoplane
High/mid/low wing position	Low-wing
Swept or straight wing	Straight
Cantilever or braced	Cantilever
With or without winglets	With winglets
Type of the fuselage cross-section	Circular

Ending of Table 1.2

Wide-body or narrow-body	Narrow-body aircraft
T-type or conventional type of the tail unit	Fuselage mounted tail unit
Type of stabilizer: fixed or adjustable	Adjustable tail stabilizer
Type of landing gear scheme	Tricycle type with nose wheel
How many engines?	2
What type of engines?	Turbofan engines
Where the engines are located?	Under wing

This table also represents description of AA 48-25, written in more literature way. Now, shape of designing prototype acquires clearer lines.

1.2. Geometry calculations for the main parts of the prototype

1.2.1. Wing geometry calculation

The wing is the principal structural unit of an airplane and, without doubt, one of the most vital parts. Its main function is to provide lift and to support the airplane in the air, so engineers must perform such design that will be effective and reliable. The shape of the wing may be rectangular, triangular, elliptical and swept back, AA 48-25 has low-positioned rectangular one. Supercritical airfoil with relative thickness of 0.118 is taken.

The aspect ratio of a wing is the ratio of its span (the distance from one wingtip to the other) to its average chord (the width of the wing). It is a measure of how long and slender the wing is. Aspect ratio (λ_w) of the AA 48-25 wing is 8.

The taper ratio of a wing is the ratio of the tip chord length to the root chord length. It describes how the wing's width decreases from root to tip. Taper ratio (η_w) of the AA 48-25 wing is 2.5.

The sweepback angle is the angle between the wing and a perpendicular to the longitudinal axis of the airplane. Amount of the sweep back angle depends upon

the type of the airplane and its design. Sweep back angle of the AA 48-25 wing is 24 degrees.

The wing area is the total surface area of both wings, including the area covered by flaps, ailerons, and other high-lift devices. Area of AA 48-25 wing can be expressed as next equation:

$$S_{wing} = \frac{m_0 \cdot g}{P_0} = 145\,\text{m}^2,$$

where m_0 – take off mass of the aircraft,

g – gravitational acceleration,

P_0 – wing loading at cruise regime of flight.

The wing span is the distance from one wing tip to the other, measured across the aircraft. Wing span of AA 48-25 can be expressed as:

$$l_{wing} = \sqrt{S_{wing} \cdot \lambda_w} = 34\,\text{m}.$$

The root chord is the distance from the leading edge to the trailing edge of the wing at its attachment to the fuselage. Root chord of AA 48-25 can be expressed as:

$$C_{root} = \frac{2 \cdot S_{wing} \cdot \eta_w}{(1+\eta_w) \cdot l_{wing}} = 6.09\ \text{m}.$$

The tip chord is the chord length at the furthest edge of the wing, near the wingtip. Tip chord of AA 48-25 can be expressed as:

$$C_{tip} = \frac{C_{root}}{\eta_w} = 2.44\,\text{m}.$$

The on board chord refers to the chord length measured at a specific spanwise location on the wing, typically somewhere between the root and the tip. This helps describe the wing's shape at different points. On board chord for trapezoidal shape wing of AA 48-25 can be expressed as:

$$C_{board} = C_{root} \cdot \frac{1-(\eta_w - 1) \cdot D_f}{\eta_w \cdot l_{wing}}\ \text{m}.$$

The internal structure of a wing is made up of spars, stringers or stiffeners, ribs. The spars and stringers run span-wise, that is along the length of the wing

from the fuselage to the tip of the wing. Some designs have one spar and some have two. In general, wing construction is based on one of three fundamental designs: monospar, multi-spar and box-spar type. Spars are the principal structural members of the wing. They run parallel to the lateral axis, toward the tip of the wing, and are usually attached to the fuselage.

Relative coordination (for a wing with two spars) of the spar's position is equal:

$$x_{1spar} = 0.2 \cdot C_{root} = 0.423,$$

$$x_{1spar} = 0.2 \cdot C_{tip} = 1.282,$$

$$x_{2spar} = 0.6 \cdot C_{root} = 1.27,$$

$$x_{2spar} = 0.6 \cdot C_{tip} = 3.847.$$

The mean aerodynamic chord is the average chord length of the wing that takes into account variation of chord width along the span. It represents a single chord for aerodynamic calculations and is particularly useful for balancing and stability analysis. Mean aerodynamic chord of AA 48-25 definition:

$$b_{MAC} = \frac{2}{3} \cdot \frac{C_{root}{}^2 + C_{root} \cdot C_{tip} + C_{tip}{}^2}{C_{root} + C_{tip}} = 4.16\,\text{m}.$$

It can also be expressed graphically which is shown in fig. 1.1.

In order to control the airplane while in flight, it is necessary to equip it with movable control surfaces or airfoils. The primary group includes ailerons, elevators and rudder. Ailerons are movable control surfaces attached to the trailing edge of both wings. They are interconnected in the control system to operate simultaneously in opposite directions.

To determine AA 48-25 ailerons design, calculation of next formulas can be applied:

Ailerons span

$$l_{aileron} = \frac{(0.3..0.4) \cdot l_{wing}}{2} = 5.95\,\text{m}.$$

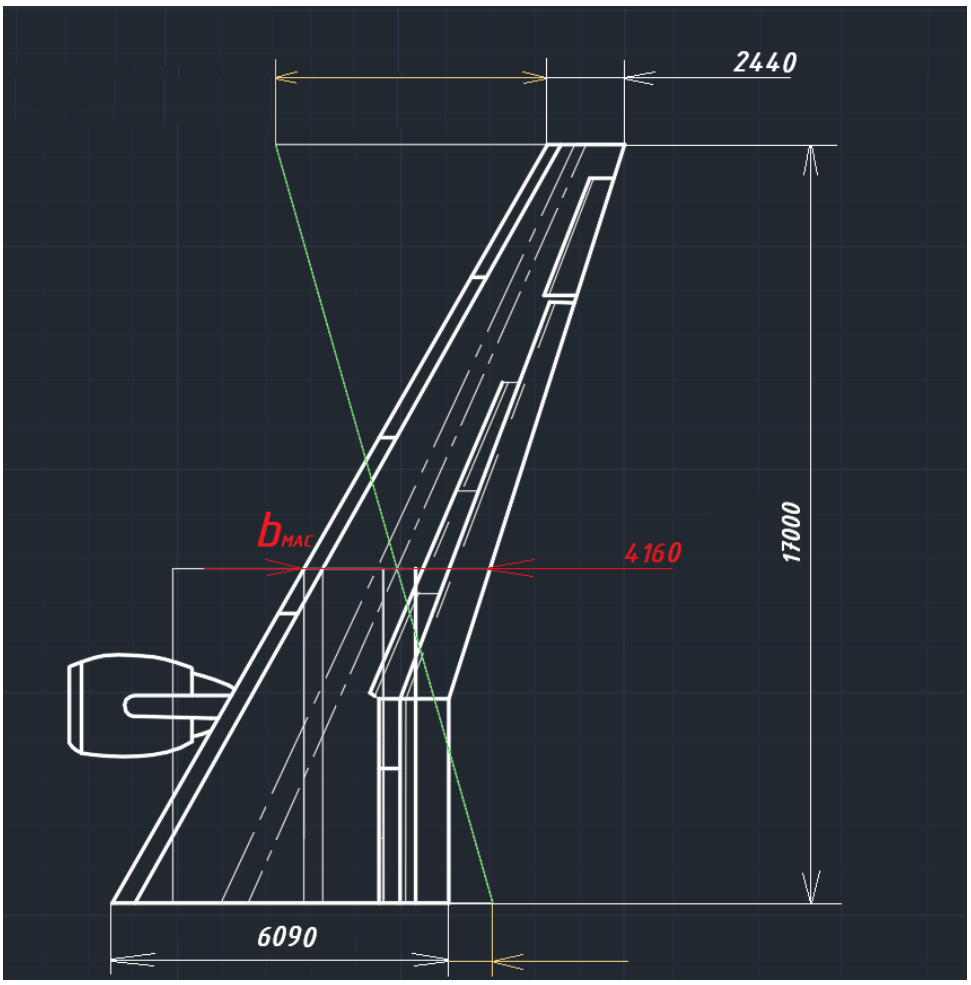

Fig. 1.1. Mean aerodynamic chord of AA 48-25 definition

Ailerons chord

$$C_{aileron} = (0.22..0.26) \cdot C_{tip} = 0.586\,\text{m}.$$

Aileron area

$$S_{aileron} = \frac{(0.05..0.08) \cdot S_{wing}}{2} = 4.35\,\text{m}^2.$$

Inner axial balance of ailerons

$$S_{innaxial} = (0.3..0.31) \cdot S_{aileron} = 1.305\,\text{m}^2.$$

Area of aileron's trim tabs

$$S_{trimtabs} = (0.04..0.06) \cdot S_{aileron} = 0.261\,\text{m}^2.$$

Range of aileron deflection:

- upward $\delta_{\text{aileron}} \geq 25^{\circ}$
- downward $\delta_{\text{aileron}} \geq 15^{\circ}$

High-lift Device Coefficient: 0.93 → Double slotted flaps with fixed deflector and with slats.

Double slotted flaps with deviated after flap and with variable deflectors are high-lift devices that consist of Double-Slotted Flap (includes two flap segments with a gap between them to allow airflow to re-energize and reduce boundary layer separation, improving lift), Deviated After Flap (the second segment, after flap) can be independently adjusted to optimize the flap's aerodynamic performance for different flight phases) and Variable Deflectors (small auxiliary surfaces attached near the flap gaps or trailing edges that can adjust their angles to further control airflow and reduce drag or increase lift).

Relative coordination of high-lift devices on the wing chord:

$$C_f = (0.28..03) \cdot b_{MAC} = 1.206.$$

1.2.2. Passenger cabin calculation

Now that we determined geometrical parameters of a wing, we can move on to another important part for AA 48-25, a certain part that combines all other structures and without which any aircraft can't perform its operation – cabin, passenger one specifically. I calculated such design that will provide safe, spacious, comfort and reliable flight for 48 passengers.

The fuselage is the main structure or body of the fixed-wing aircraft. It provides volume for payload (passengers and cargo), overall structural integrity, allows possible attachment of landing gear, power plant and antennas, optimize or compromise access, minimize weight, drag and maximize volume.

Length of the AA 48-25 fuselage

$$FR = \frac{L_{fus}}{D_{fus}}; L_{fus} = FR \cdot D_{fus} = 38.56\,\text{m},$$

where FR – fuselage fineness ratio,

D_{fus} – fuselage diameter.

Length of forward part

$$L_{fwd} = FR_{np} \cdot D_{fus} = 3.82\,\text{m},$$

where FR_{np} – fuselage nose part fineness ratio.

Length of the tail part:

$$L_{tailpart} = FR_{tp} \cdot D_{fus} = 9.93\,\text{m},$$

where FR_{tp} – fuselage nose part fineness ratio.

Aircraft cabin is the section of an aircraft in which passengers, cargo, or both are accommodated. Most modern commercial aircraft are pressurized, as cruising altitudes are high enough such that the surrounding atmosphere is too thin for passengers and crew to breathe. Also, as I speak about passenger cabin, efficient and thoughtful seat arrangement has to be performed as it is not only a walking space. Aisle permits to provide services to passengers and plays an important role during emergencies. AA 48-25 cabin includes only one class of division. Based on that, I determined some parameters and characteristics (table. 1.3 and table 1.4).

Table 1.3

Recommended split of passengers seats in economy class

Number of seats in one row, m	Seats possibilities	Number of aisles, width of the aisle, mm	Width of armrest in mm, number of armrests in a row	Fuselage diameter (with passengers seats), m
4	2+2	1×430	45 (3+3)	2.85

Table 1.4

Characteristics of passenger cabin

Name, size	Passenger saloon type
	Economy class
1	2
Distance between the armrests, mm	440
Armrest width, mm	45

Ending of Table 1.4

1	2
Height of the seat cushion above the flour, mm	440
Height of armrest above floor	605
Height of the seat, mm	1 145
Seat pitch, t, mm	810
Angle of the chair back deflection	25
Seat width, mm	490
Width of the block from two chairs, b, mm	1 000
Width of the aisle, b aisle, mm	480
Mass of one chair, kg	7
Mass of the block from two chairs, kg	14

Cabin width

$$B_{cabin} = n_2 \cdot b_2 + n_{aisle} \cdot b_{aisle} + 2\delta + 2\delta_{wall} = 2714\,\text{mm},$$

where $n_2; n_3$ – blocks of seats number with 2 or 3 seats in a cross section,

$b_2; b_3$ – blocks of seats width of 2 or 3 seats,

n_{aisle} – aisles number,

b_{aisle} – aisle width,

δ – distance between external armrests to the decorative panels,

δ_{wall} – wall width.

Width of aisle is determined by §25.815 of FAR [16].

AA 48-25 is narrow-body aircraft with number of seats in one row less than 6.

Cabin height can be expressed as

$$H_{cabin} = 1.48 + 0.17 \cdot B_{cabin} = 1.94\,\text{m}.$$

Cabin length

$$L_{cabin} = L_1 + (N-1) \cdot L_{seat} + L_2 = 23635\,\text{mm},$$

where L_1 – span from the wall to the back of the seat in first row,

L_2 – span from the back of the seat in the last row to the wall.

The baggage compartment is a space for storing verified passenger luggage and cargo for transportation. Given the fact that the unit of load on floor K = 400..600 kg/m^2, the area of AA 48-25 baggage compartment is defined as

$$S_{cargo} = \frac{M_{bag}}{0.4 \cdot K} + \frac{M_{cargo\&mail}}{0.6 \cdot K} = 14.88\,\text{m}^2,$$

where M_{bag} – passengers baggage mass,

$M_{cargo\&mail}$ – additional cargo and mail mass that can be taken onboard.

There is also a regulated mass quantity that defines how much baggage one passenger can take on board for free:

$$M_{bag} = m \cdot n_{pas}; m = \frac{M_{bag}}{n_{pas}} = 10\,\text{kg},$$

where n_{pass} – passenger number.

Baggage compartment volume is equal

$$V_{cargo} = v \cdot n_{pass} = 24.8\,\text{m}^3.$$

The galley is the aircraft kitchen, used for food and drinks storage, preparation and serving. It contains equipment for heating, water supply and waste storage. Buffets are less common design structure, but it may be found in premium cabins or on long-range flights. In any way, buffets are not used in case of AA 48-25. According to the international standards, the volume of the galleys should be about 0.1 cubic meters per passenger, so the volume of my prototype galley must be

$$V_{galley} = 0.1 \cdot n_{pass} = 12.4\,\text{m}^3.$$

Total area of galley floor:

$$S_{galley} = \frac{V_{galley}}{H_{cab}} = 6.39\,\text{m}^2.$$

The number of galleys I choose according to the original aircraft and it is equal 3.

The lavatories are compact, self-contained facilities designed for passenger hygiene and comfort. Their design ensures maximizing of hygiene, conservation space, and meet safety regulations while being easy to maintain during flight operations.

Number of lavatory facilities is determined by the number of passengers and flight duration (t = 2..4 hours - one toilet for 50 passengers):

$$t = \frac{Range_{flight}}{V_{cruise}} + 0.5 = 3.67\,\text{h},$$

$$N_{lavatory} = \frac{N_{passenger}}{40} = 3.1,$$

which is > 4.

The number of lavatories I choose according to the original airplane and it is equal 3. Area of one lavatory:

$$S_{lav} = 1.5\,\text{m}^2.$$

1.2.3. Tail unit design calculation

Tail section or empennage is one of the principal structural units of the aircraft and the element of airplane airframe. Tail assembly consists of a tail cone, fixed surfaces, and movable surfaces. One is vertical and the other one is horizontal.

The front part is fixed and helps to stabilize the aircraft. The rear part is a movable surface made in the form of a flap that helps to direct an aircraft direction during flight. The vertical surface is called fin, it provides directional stability and control of the aircraft in flight. The horizontal surface is known as the stabilizer.

The longitudinal stability, also called pitch stability, refers to the aircraft stability in its plane of symmetry about the lateral axis (the axis along the wingspan). Static moments of my prototype tail are determined within specific range, presented in table 1.5. AA 48-25 longitudinal stability can be expressed as:

$$m_x^{Cy} = x_{CG} - x_F < 0$$

Table 1.5

Range of AA 48-25 tail unit static moments

Airplane type	A_{htu}	A_{vtu}	L_{htu}/b_{mac}, and L_{vtu}/lw
Mid-range passenger, turbo jet engine	0.65..0.8	0.08..0.12	2.5..3.5

Now, let's determine AA 48-25 tail unit geometrical parameters. As I don't have much given data about this section, graphical method will take place. By using known wing-to-tail unit proportions, we can define arms of horizontal tail and vertical tail unit (fig. 1.2). With obtained parameters, it is possible now to calculate area of horizontal and vertical tail unit:

$$S_{HTU} = \frac{b_{MAC} \cdot S_{wing}}{L_{htu}} = 22.6\,\text{m}^2,$$

$$S_{VTU} = \frac{l_{wing} \cdot S_{wing}}{L_{vtu}} = 34.13\,\text{m}^2.$$

Horizontal stabilizer is the main structural component, mounted horizontally to the fuselage, providing stability against pitch (up and down) motions. On its surface there is an elevator (movable control surface, hinged to the trailing edge of the horizontal stabilizer, used to and provide pitch control) and trim tabs (small adjustable surfaces attached to the trailing edge of the elevator to relieve control pressure).

Vertical stabilizer is the main movable vertical surface mounted to the rear of the fuselage, providing stability against yaw motions. On its surface there is a rudder (movable control surface hinged to the trailing edge of the vertical stabilizer used provide yaw control) and trim tabs (similarly to those on the horizontal stabilizer, these small adjustable surfaces on the rudder relieve control pressure).

The primary control surfaces of an aircraft tail include rudder and elevator. The construction of the control surfaces is similar to the stabilizers, however, the movable surfaces usually are lighter in construction.

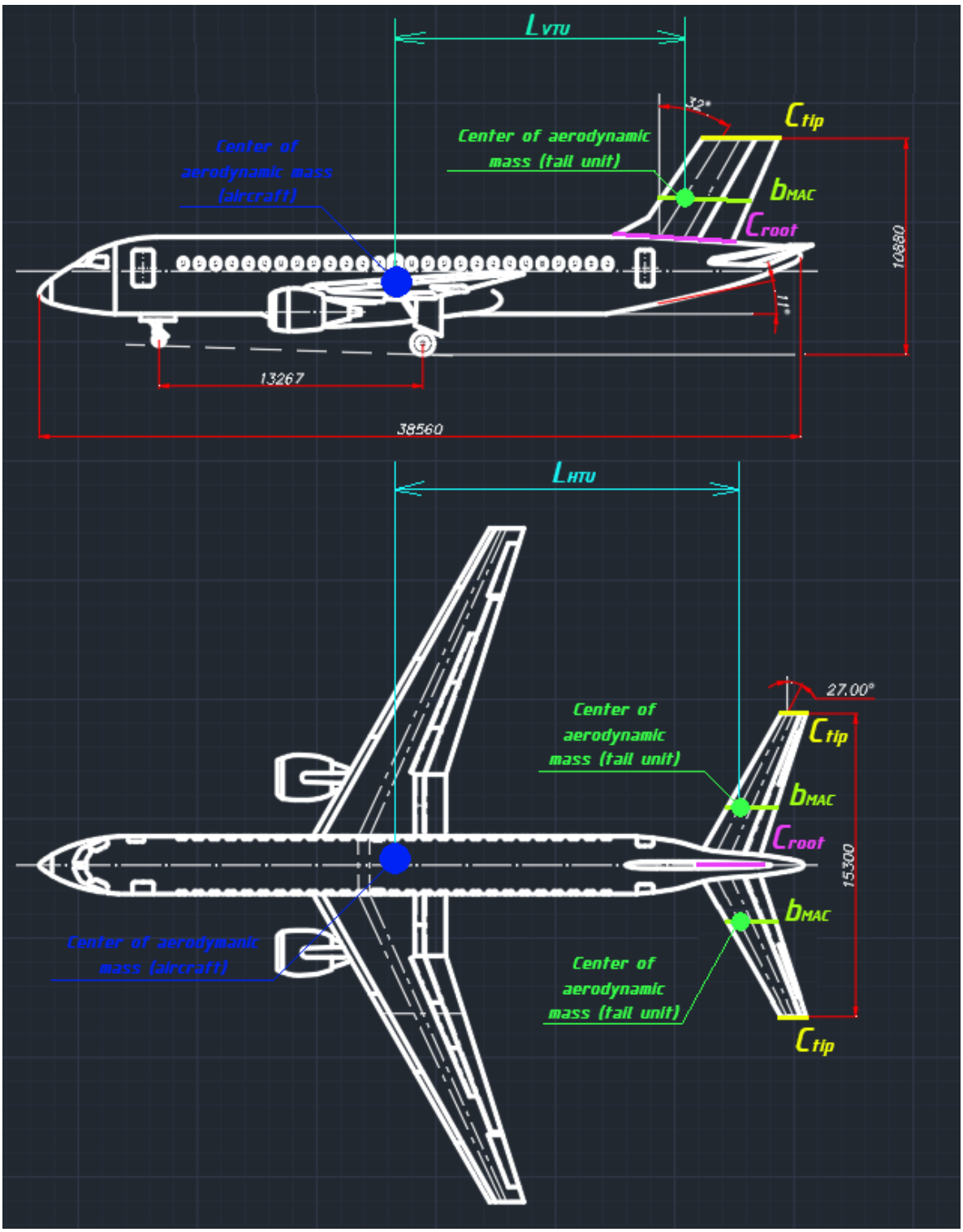

Fig. 1.2. Graphical determination of HTU and VTU arms

Let's calculate area of AA 48-25 tail control surfaces:

$$S_{elevator} = (0.3..0.4) \cdot S_{HTU} = 6.78\,\text{m}^2,$$

$$S_{rudder} = (0.2..0.22) \cdot S_{VTU} = 7.5\,\text{m}^2.$$

Aerodynamic balance refers to the design techniques used to reduce the control forces required to operate an aircraft's control surfaces (like ailerons, elevators, and rudders). It ensures smoother handling and minimizes the pilot's effort, especially at higher speeds. Mach number is the ratio of an object's speed to the speed of sound in the surrounding medium.

We can determine area of AA 48-25 aerodynamic balance. As in prototype initial data Cruising Mach Number equals 0.78480, M ≥ 0.75

$$S_{abelevator} = (0.18..0.2) \cdot S_{elevator} = 1.35\,\text{m}^2,$$

$$S_{abrudder} = (0.18..0.2) \cdot S_{rudder} = 1.5\,\text{m}^2,$$

$$S_{trimtabs} = (0.8..0.12) \cdot S_{rudder} = 0.75\,\text{m}^2.$$

Finally, let's calculate AA 48-25 tail unit span and height. These parameters describe geometrical sizes along axis x and axis y of the airplane tail unit. They can be found according to next equations:

$$l_{HTU} = (0.32..0.5) \cdot l_{wing} = 15.3\,\text{m},$$

$$h_{VTU} = (0.13..0.165) \cdot l_{w} = 5.1\text{m}.$$

1.2.4. Landing gear design

The landing gear (LG) or undercarriage is one of the main structural units of the airplane. The landing gear provides support for the airplane during static and ground maneuvering conditions. Structurally it reacts to the airplane loads on three axes and the component forces that are generated during its motion.

The landing gear usually consists of the main and auxiliary units. The main landing gear is attached near the center of gravity of an airplane and forms its principal support. The auxiliary landing gear forms an additional support and, as it is far away from the center of gravity of the machine and less loaded, it is made comparatively light.

AA 48-25 has tricycle type landing gear with nose wheel. In this configuration, the wheels aft of the aircraft center of gravity is very close to it (compared with forward gear) and carries much of the aircraft weight and load;

thus is referred to as the main wheel; two main gears are in the same distance from the center of gravity in the x-axis and the same distances in y-axis (left and right sides); thus both are carrying the same load. The forward gear is far from CG (compared with main gear); hence it carries much smaller load.

In this paragraph, I determined some of AA 48-25 landing gear parameters.

Distance from the center of gravity to the main LG

$$B_m = (0.15..0.20) \cdot b_{MAC} = 0.707 \text{ m}.$$

Wheel base is the distance between main gear and nose gear (from side view). AA 48-25 wheel base can be found by performing next calculations

$$B = (0.3..0.4) \cdot l_f = (6..10) B_m; B = 13.267 \text{ m}.$$

The nose gear is a common dual-wheel type which retracts forwards and up into the nose gear well. The distance from the center of gravity to the nose LG:

$$B_n = B - B_m = -13.32 \text{ m}.$$

Wheel track is the distance between two main gears (left and right) from front view. If a gear is expected to carry high load, it may have more than one wheel. In general, the landing gear weight is about 3 % to 5 % of the aircraft take-off weight. AA 48-25 wheel track can be found by performing next calculations

$$T = (0.7..1.2) \cdot B \le 12 = 0.7 \cdot 15.421 = 10.795 \text{ m}.$$

One of the functions of aircraft landing gear is to absorb the landing shocks during landing operation. We can find the load on the wheel for main landing gear and nose one

$$F_{main} = \frac{(B - B_m) \cdot m_0 \cdot 9.81}{B \cdot n \cdot z} = 127949.871 \text{ kg/m}^2,$$

$$F_{nose} = \frac{B_m \cdot m_0 \cdot 9.81 \cdot K_g}{B \cdot z} = 196733.579 \text{ kg/m}^2,$$

where n, z – number of supports and wheels on one leg,

K_g – 1.5..2.0 – dynamics coefficient.

Now that I obtained values for loading on wheels, I can choose pneumatics from the catalogue [8]. Before applying my results, I have to convert it into another metric system

$$F_{main} = 127949.871\,\text{kg/m}^2 = 28764.275\,\text{lbs},$$

$$F_{nose} = 196733.579\,\text{kg/m}^2 = 44227.468\,\text{lbs}.$$

It can be seen that pneumatics choice has to ensure strength to withstand such big rated loads. Fortunately, there are existing models to meet requirements of my case (table 1.6).

Table 1.6

Selection of tires based on rated loads

	Size	Ply rating	TT or TL	Rated speed (mph)	Rated load (lbs)	Trademark	Part №	Weight (lbs)
1	2	3	4	5	6	7	8	9
Main LG	37×13.0-12	26	TL	225	29300	Flight Leader	373K62-3	111.2
Nose LG	H44.5×16.5 -21	28	TL	225	44700	Flight Leader	441K82-1	189

Now that I chose tires, I gained more information about their characteristics. It is possible to calculate the rate of wheel loading for main landing gear and nose landing gear:

$$\frac{29300 - 28764.275}{29300} \cdot 100\% = 1.828\ \%,$$

$$\frac{44700 - 44227.468}{44700} \cdot 100\% = 1.057\ \%.$$

By obtained results, which are less than 5 %, it can be clearly seen that chosen tires are suitable for my prototype.

Geometrical and physical parameters calculated in this part ensure that AA 48-25 landing gear will be strong enough, efficient and reliable. Choice of

pneumatics I did in accordance to the existing list, with taking rated load parameter a bit bigger that I calculated to ensure that it will perform the best of itself even during emergencies.

1.2.5. Choice and description of power plant

AA 48-25 is a twin-engine turbofan aircraft, just like its main prototype Embraer 195. Its power plant system is designed to provide reliable, cost-effective propulsion for short to medium-range flights, with excellent performance in challenging environments, including hot-and-high conditions and unpaved runways. Table 1.7 shows general description of the chosen power plant.

Table 1.7

AA 48-25 power plant data

	Type	Configuration	Material	Power output
Main engines	General Electric CF34-10E	Twin turbofan engines mounted under the wings	Titanium, nickel alloys, superalloys with thermal barrier coatings	84.5 kN per engine
APU	Hamilton Sundstrand APS 2300	Tail cone part	Lightweight alloys and heat-resistant components	Electrical: 90-115 kVa Pneumatic: Bleed air sufficient for engine start and ECS operation

AA 48-25 power plant consists of two General Electric CF34-10E engines that are known for efficiency, low noise and durability [17]. Auxiliary power unit, for which Hamilton Sundstrand APS 2300 is used, fully completes propulsion scheme.

Choice of materials maximizes strength of power plant structure, provides heat resistance and ensures reliability during different flight conditions. Overall system is optimized to perform highly efficient characteristics, save fuel and reduce maintenance.

1.3. Determination of the aircraft center of gravity

The center of gravity (CG) is the point on an aircraft where its total weight is considered to act. It is an important factor for stability, control, and performance, as it influences how the aircraft responds to pilot inputs and external forces.

The position of the CG is typically expressed as a percentage of the mean aerodynamic chord or in relation to a reference element (the nose or a specific point on the aircraft). Proper CG positioning ensures the aircraft is balanced and operates safely. Both lateral and longitudinal balances are important, but the primary point is longitudinal balance. So, let’s find CG parameters for AA 48-25.

1.3.1. Determination of centering of the equipped wing

The wing center CG is the point where the total weight of the wing structure, including all its components (spar, ribs, fuel, flaps, and other systems), is considered to act. Wings also often accommodate fuel tanks which must be accounted during stability calculations.

The wing equipment affects the overall aircraft CG and must be carefully considered in design to ensure proper balance and stability. It typically lies along the chord line of the wing, closer to the root than the tip, as the root carries most of the structural weight.

Here I used Microsoft Excel software, applying formulas on statistic weight fractions for principal items to determine masses, CG coordinates and mass moment applied on the wing (table 1.8) (Appendix B).

Table 1.8

Equipped wing masses

№	Object name	Mass		CG coordinates, m	Moment of mass, kg·m
		Unit mass, %	Mass, kg		
1	Wing (structure)	0.1219	6667	1,872	12480,42
2	Fuel system, 80-100%	0.0050	271	1,498	405,33
3	Control system, 30%	0,0022	120	2,496	298,88
4	Electrical equipment, 20%	0,0067	364	0,416	151,49
5	Anti-icing system, 70%	0,0034	184	0,416	76,43
6	Hydraulic system, 30%	0,0058	315	2,496	786,10
7	Power plant	0,0931	5091	-1,700	-8653,89
8	Equipped wing without landing gear and fuel	0,2380	13011	0,426	5544,76
9	Nose landing gear	0,0086	472	-11,800	-5566,79
10	Main landing gear	0,0345	1887	2,100	3962,80
11	Fuel for flight	0,1906	10423	1,248	13008,24
12	Reserve fuel	0,0354	1933	1,456	2814,25
13	Total equipped wing	0,5071	27726	0,713	19763,27

1.3.2. Determination of centering of the equipped fuselage

The fuselage CG is the point where the total weight of the fuselage, including its structure, systems, payload (passengers, cargo), and any onboard equipment, is considered to act. As well as wing, it contributes significantly to the overall aircraft CG. Proper positioning ensures balance and stability during flight.

It is typically located along the fuselage's longitudinal axis, varying based on payload and interior layout. It is usually near the center of the passenger cabin in airliners. The placement of passengers, cargo, and fuel within the fuselage influences its CG and must be carefully managed to keep it within allowable limits.

Here I used Microsoft Excel software, applying formulas on statistic weight fractions for principal items to determine masses, CG coordinates and mass moment applied on the fuselage (table 1.9) (Appendix C).

Table 1.9

Equipped fuselage masses

№	Object name	Mass		CG coordinates, m	Mass moment, kg·m
		Unit mass, %	Total mass, kg		
1	2	3	4	5	6
1	Fuselage	0,1259	6885	19,265	132630,03
2	Horizontal tail unit	0,0157	858	36,540	31367,57
3	Vertical tail unit	0,0156	852	34,825	29666,83
4	Radiolocation equip.	0,0033	180	0,540	97,44
5	Dashboard and instrument equipment	0,0058	317	2,000	634,26
6	Aeronavigation equip.	0,0050	273	3,500	956,87
7	Radio equipment	0,0025	137	3,000	410,09
8	Fuel system, 0-20%	0,00055	30	17,15	515,75
9	Control system, 70%	0,0051	279	21,192	5921,00
10	Electrical system, 80%	0,0233	1275	19,265	24554,09
11	Hydraulic system, 70%	0,0134	735	17,150	12603,06
12	Anti-icing system, 30%	0,0014	79	35,760	2815,61
13	Air-conditioning sys.	0,0192	1050	17,339	18202,26
14	Emergency equipment	0,0033	180	19,500	3510,00
15	Tools	0,0011	60	19,500	1170,00

Ending of table 1.9

1	2	3	4	5	6
14	Water and liquid	0,0034	186	24,000	4464,00
15	Lavatory 1	0,0016	90	4,300	387,00
16	Lavatory 2	0,0016	90	31,800	2862,00
17	Lavatory 3	0,0016	90	32,500	2925,00
18	Wardrobe	0,0015	80	32,400	2592,00
19	Galley 1	0,0005	30	5,800	174,00
20	Galley 2	0,0009	50	31,600	1580,00
21	Baggage/Cargo eq.	0,0003	17	19,500	331,50
22	Interior panels, lining and insulation	0,0085	465	17,339	8058,29
23	Passengers' seats 1	0,0159	868	19,500	16926,00
24	Pilots' seats	0,0007	40	2,600	104,00
25	Flight attendants' seats	0,0002	12	12,500	150,00
26	Non-typical eq.	0,0031	170	19,500	3305,29
27	**Equipped fuselage without commercial load**	0,2812	15377	20,089	308913,94
28	Passengers 1	0,1361	7440	19,500	145080,00
29	Passengers' baggage	0,0227	1240	19,500	24180,00
30	Cargo, mail	0,0454	2480	19,500	48360,00
31	On board meal	0,0023	124	19,500	2418,00
32	Flight attendants	0,0027	150	12,500	1875,00
33	Crew	0,0026	140	2,600	364,00
34	**Totally equipped fuselage**	0,4929	26951	19,709	531190,94

Ending of table 1.10

1	2	3	4	5	6
35	Checking	0,99997761	-1,22422		

Now that I obtained centering for fuselage and passenger cabin, I can move on to the CG calculation of other structural units and additional masses, such as baggage and fuel. Table 1.10 shows results for positioning of these objects.

Table 1.10

Calculation of the CG positioning variants

Object	m_i	X_i, м	kgm
Eq. wing without LG and fuel	13011	18,842	245152,29
Nose LG (ext.)	472	6,616	3121,31
Main LG (ext.)	1887	20,516	38715,21
Fuel for flight	10423	19,664	204966,14
Reserve fuel	1933	19,872	38410,50
Equipped fuselage	15377	19,709	303074,81
Passengers	7440	19,500	145080,00
On board meal	124	19,500	2418,00
Passengers baggage	1240	19,500	24180,00
Cargo, mail	2480	19,500	48360,00
Flight attend	150	12,500	1875,00
Crew	140	2,600	364,00
Nose LG (retr.)	472	5,747	2711,02
Main LG (retr.)	1887	20,516	38715,21

I also defined CG positioning variants for different retraction positions of landing gear. Results are shown in table 1.11.

Table 1.11

Airplanes CG position variants

№ v/p	Object	Mass, m_i, kg	Mass moment m_iX_i	Center of mass $X_{цм}$	Centre of gravity position, %
1	Take off mass (LG ext.)	54677	1055717,26	19,308	21,44
2	Take off mass (LG.retr.)	54677	1055306,97	19,301	21,26
3	Landing weight (LG ext.)	44130	848333,12	19,224	19,41
4	Ferry version (without payload, max fuel, LG retr.)	43243	833393,97	19,272	20,58
5	Parking version (without payload, without fuel for flight, LG ext.)	30747	590063,62	19,191	18,63

The empty weight and the empty weight center of gravity (EWCG) are calculated for each aircraft using a set of weigh scales, the manufacturer defined reference data, the arms, as listed on the aircraft Type Certificate Data Sheet, for each weighing point. The empty weight of the aircraft is simply the sum of the weights from each of the weighing points. It is calculated using the calculated moments for each of the weighing points, the calculated empty weight and the appropriate formula for the aircraft type as specified in the Aircraft Flight Manual (AFM). On small airplanes, CG location is identified as being a specific number of inches from the datum and the center of gravity range is identified the same way.

In conclusion, this project part was dedicated to center of gravity calculations for AA 48-25 structural units, internal additional masses and cases when landing gear is either retracted or extended. Now that I obtained this data, I ensured stable and controlled behavior of designing prototype in flight.

Conclusion to the main part

In the main part, I performed research and analysis of three passenger aircraft data – Embraer 195, Antonov An-148 and Airbus A220. This information became a base for designing of my prototype. Best characteristics were taken to design a safe, reliable and efficient passenger aircraft that will meet requirements of international associations and will be attractive choice for aviation companies.

Using informational basis mentioned above, I also calculated geometrical dimensions for my AA 48-25. This will ensure detailed and logical design of the structural units – wings, fuselage, tail unit and landing gear. By taking into account physical quantities, I chose the most efficient landing gear from the known manufacturer to ensure safe landing even in the case of emergency. Determination of power plant also took place in this part. AA 48-25 is a turbofan aircraft, just like its main prototype Embraer 195. To not deviate far from design, I decided to take the same power plant for my prototype, as it is powerful enough and mostly work under same characteristics.

Moreover, I determined center of gravity position for my aircraft – a specific point, where all of aircraft weight is considered to act. This criterion is a non-removable part and must be calculated to ensure stability, control and performance during flight.

I understood principles of aircraft design, determined geometrical characteristics and functions of structural units, calculated centering, important for balance. Hope that my AA 48-25 will make its best to perform as a mid-range aircraft and will stand in a row next to its prototypes.

Graphical schemes of center of gravity calculations for wing and fuselage will be presented in Appendix B and C respectfully.

2. AIRCRAFT KITCHEN SECTION OF MODULAR CONFIGURATION

2.1. Introduction. Description of passenger aircraft galley

2.1.1. General information

One of the main factors on which passenger would choose an airline and which aircraft to fly is the rate of comfort they can be provided with. Options of services are usually determined by air transportation companies themselves, as well as the variety of meals and drinks. Task for designers in all of this is to perform configurations that will accommodate all necessary equipment and ensure quick serving.

Passenger aircraft kitchen section is an onboard area, used for contamination, preparation and serving of meals and drinks. Its location depends on number of passengers and class, but usually it is in the front part and/or rear part of the cabin. Kitchen section is a highly-organized environment that contains a range of equipment that can be used for heating, water supply and waste contamination purposes. Frame is usually constructed from lightweight, fire-resistant and corrosive-resistant materials to ensure safety and to meet the requirements of aviation standards. Kitchen section is also integrated with aircraft electrical and water systems.

2.1.2. Embraer 195

Embraer 195 is a passenger aircraft that can accommodate around 120 passengers. Its passenger cabin also places a kitchen section which is located at the forward and rear part. It is equipped with ovens, coffee makers, water heaters, refrigerators trolleys, storage units and waste compartments.

Main considerations of Embraer 195 galley design are safety and hygiene. Its frame is made from lightweight, fire-resistant and corrosive-resistant materials, just

like the usual passenger galleys. All equipment is secured with latches and attachment pins to prevent its movement during turbulence or emergencies.

2.1.3. Conclusion

Embraer 195 has a modular and cost-saving kitchen section design, which can provide food for up to 124 passengers. Its flexible configuration is efficient to serve in short-range and middle-range flights and can be attractive choice for modern airlines. Layout and options of services can vary depending on flight time, range and country passengers are flying to.

Galley, usually located at the rear part of passenger cabin, is equipped with ovens, warming units, coffee makers, refrigerated compartments, and storage cabinets for meals, drinks, and service items (fig 2.1, fig 2.2).

Fig. 2.1. Embraer 195 front galley [18]

Fig. 2.2. Embraer 195 aft galley [18]

AA 48-25 kitchen section design will has similar features and equipment to the Embraer 195, as the flight performance characteristics are practically the same. Passengers that would potentially choose this aircraft will experience comfortable flight with variety of serving options, while crew of the AA 48-25 will work with ergonomic design.

2.2. Analysis of passenger aircraft kitchen sections

2.2.1. An-148-100

2.2.1.1. Description

Antonov An-148-100 is a jet aircraft, designed for passenger, passenger-cargo and cargo transportation for regional and short-haul flight airlines. Designed by ANTONOV Company, it comes in different configurations and can accommodate from 68 to 85 passengers. It can operate in a variety of climates and from airports with limited infrastructure, making it suitable for both commercial and governmental use.

2.2.1.2. Statistic data

Designed for quick service on regional and short-haul flights, An-148-100 galley allows the cabin crew to efficiently prepare and serve snacks, drinks, and light meals while maintaining safety and hygiene standards.

Galley is divided into front one and rear one. Front galley located at the front household compartment. It contains half-trolleys, containers, and ovens with remote controllers, coffee maker, table, waste container, water basin and mirror. Rear galley located at the rear household compartment. It contains the same equipment as front galley does with an exception for number of units.

All galley equipment is located in the structural frames and tightly fixed with locks. If the flight will take place above the water (big lake/sea/ocean), an emergency boat will be installed instead of a couple half-trolleys. Water provision of galleys is provided from aircraft water tank. Choice of meals and drinks, serving time and on-board snack options are determined by the customer needs [5].

2.2.2. An-74TK-300Д

2.2.2.1. Description

Antonov An-74TK-300Д is a jet aircraft, designed by ANTONOV Company for passenger-cargo transportation. It maintains strong characteristics of the An-74 aircraft line, including short takeoff and landing performance and the ability to operate from unprepared or icy runways, making it ideal for use in distant or extreme environments. The aircraft is configured to carry up to 52 passengers, or a mix of cargo and passengers, and can be quickly reconfigured between roles.

2.2.2.2. Statistic data

Taken configuration of An-74TK-300Д has two galleys and is suitable for accommodation of 24 passengers.

Front galley is installed in the front household compartment by the starboard side. Here, waste container, convection oven with remote controller, galley sink,

water heater, mirror, shelf, tabletop and trolley are here. Refrigerator is accommodated by the port side in the household closet.

Rear galley is installed in the rear household compartment by the port side. Waste container, water basin, water heater, coffee maker, convection oven, closet, service panel, trolley and refrigerator can be found here [6].

2.2.3. An-158

2.2.3.1. Description

Antonov An-158 is a passenger turbofan aircraft, modernized version of Antonov An-148. It is designed to perform short-range and middle-range flights and can accommodate up to 99 passengers. An-158 can fly by a maximum range of 2500 to 3000 km, depending on payload, making it suitable for regional airlines and government transportation operations.

2.2.3.2. Statistic data

At the fundamentals of An-158 and, mentioned, An-148 galley design there were put instructions about organization of passenger food provision on civil aircraft and industry standards. An analysis was performed, which resulted in three possible configurations for An-158 galley. Types of equipment mainly do not differ from mentioned passenger aircraft – containers, half-trolleys, closet, coffee makers, but, performing re-accommodation of it, benefits can be found.

Changing configuration and re-assembly of equipment can result in increasing of trolley number that can be taken on board (without taking in account front galley), creation of place, suitable for emergency boat installation, extend closet space, decrease mass of sanitary equipment and even increase number of seating [7].

2.2.4. Conclusion on all analyzed prototypes

A lot of modern airlines take part in a competition to attract attention and take more people on their board. Quality of service is one of the most important criteria

for passengers when they are choosing what aircraft to fly and what airline is to spend money on. Usually, airlines decide what services they want provide for passengers on their own. It differs by number of reasons, for example: country passengers are flying to, cultural aspects and class (first, business, economy).

Equipment installed on passenger aircraft galley usually is the same, with difference only in manufacturer and some functions. It is practically the same as there is on home kitchens, however, the task become more difficult as functions have to be performed in flight, at the altitude usually 10-12 km.

Designers perform configurations of aircraft galley, pursuing to the most efficient one. Analyzing layout and features, they can introduce more than 180 options, even affecting important data of passenger aircraft, such as number of seating. Galley re-configuration also can result in changes of water supply mechanisms, waste basins and location of flight attendant seat.

Taking into account information about mentioned passenger aircraft, specifically about their kitchen section, I can perform efficient and right configuration for my AA 48-25 aircraft.

2.3. Prototype kitchen section design (124 passengers)

2.3.1. Description and statistic data

Now that I analyzed galley designs of passenger aircraft, I know fundamentals of its design choices and can perform configuration for AA 48-25.

Number of passengers must be taken into account – 124. Just like the main prototype, my designing aircraft need accommodation of two galleys, let’s assume one will be located at the front part and the other will be located at the rear part of passenger cabin.

AA 48-25 can perform flights from 2 to 6 hours. That means flight attendants have to provide all passengers with cold and hot drinks, light breakfast or dinner, and if the flight will take long 6 hours without stopovers – hot meals. If a stopover will take place, passengers have to be provided with cold meals or light breakfast

or dinner, everything by their choice. In any case heating, water supply, storage, transportation and water contamination equipment has to be installed.

Heating and water supply equipment. Kitchen section is equipped with heating devices to prepare and to serve meals and drinks for passengers and crew during flight. Primary heating equipment includes ovens (with remote controller or control panel), water heaters and coffee makers.

Oven is used for heating and storing meal on aircraft. There are two types of ovens – convection and induction, which differ only in time of heating. Despite electrical operational nature, each oven consists of frame, door, steam outlet, lock, control module, folding handle, pallets and power supplies. Oven attachment is performed onto the kitchen section frame. Control can be provided by control panel or remote controller, mounted separately. On the back of the stove there is an electrical connector for connection to the aircraft's electrical system. Control panel has a command board, where operational buttons are accommodated.

Kitchen section accommodates thoughtfully designed water supply system, used for water storage for drinks and meals and for hygienic purposes. System usually consists of pressurized water tanks, water line, filters and taps. Supply is performed from the aircraft center water tank. Galley is equipped with hot and cold dispensers that provide water to the heaters and coffee makers. Materials used for water supply systems must be lightweight and with a high corrosion resistance.

Water heater is used for water heating and keeping it in such temperature state for a period of time. It has the appearance of a rectangular shell that consists of tank and a lid, attached with locks, and with a tap on front. Water heater electrical supply is performed through the fuse from the aircraft bus.

Coffee maker is used for coffee preparation and serving during flight. It has a modular construction, elements and materials of which ensure reliable and convenient usage. It can be easily attached by installation of connection pin. Coffee maker consists of a shelf, control panel, teapot fixing handle and a tap with hot water.

Storage and transportation equipment. Kitchen section storage equipment is designed to ensure safety and efficient service during flight. It includes containers, mobile trolleys (full-type or half-type), compartments, shelfs, drawers, racks and of course, refrigerators. Each unit is installed on locks and connection pins, ensuring that all products will remain on stable place and liquids won't spill. Storage equipment is made from lightweight, fire-resistant and strong materials to keep products fresh and in good condition. Primary storage and transportation equipment consists of trolleys and refrigerators.

Container is a riveted box with a door on the front side. Lateral, upper, lower sides and door have special installations that provide strengthening. Container has handles for transportation and door opening. It can accommodate from eight to ten trays with dishes.

Trolley is also a riveted box, but with shelfs and small wheels. It can be performed in half-form and a full-form. Front side of half-trolley have door with a handle, full-trolley have such handles on both front and back sides. Inside trolleys there are installations for equipping it with boxes or trays. Having easy and efficient design, trolley serves as the main kitchen section transportation equipment in flight.

Refrigerator is used for food and drinks storage, ensuring their freshness. It has installations inside, used for shelves and trays support. Temperature control is performed by electrical module. Refrigerator control panel is installed on the front side. Electrical power supply is performed through the aircraft main bus.

Waste contamination equipment. Kitchen section waste contamination equipment is used for the final step in passenger meal and drinks supply operation. It is an important unit to ensure hygiene and to keep passenger cabin clean. Waste contamination system consists of bins and sealed trash compartments, which are built-in into kitchen section and. They are made of corrosive-resistant and strengthened materials that ensure prevention of biohazard and smell leakages.

Now that it is more clear what equipment is installed in kitchen sections and what are certain devices for, I will determine similar ones for AA 48-25. To

prepare and serve meal and drinks for passenger taking into account that flight can last from 2 to 6 hours, there have to be

1. Water heater (1)
2. Water basin (2)
3. Coffee maker (3)
4. Oven (with a control panel) (2)
5. Refrigerator (1)
6. Trolley (5)
7. Table (1)
8. Storage (4)
9. Waste compartment (2)

Configurations of AA 48-25 galleys, used for serving operations for 124 passengers with all necessary equipment is presented on drawings (Appendix D).

2.3. Prototype kitchen section design (48 passengers)

2.3.1. Description and statistic data

For the special part of my qualification work I have chosen design of kitchen section of modular configuration that will meet the requirements for providing 48 passengers with meals and drinks during flight. As the base aircraft and my prototype both designed to accommodate 124 passengers on board, I must divide seating configuration. This will lead to re-configuration of my prototype from economy aircraft to business jet aircraft, and its name will be updated – AA 48-25-B.

Passenger cabin dimensions are not changed, however, length between seats are increased. New business class cabin is divided into two parts, between which another household compartment with a lavatory and galley is installed. Now, number of kitchen section is 3. AA 48-25-B configuration is still comfortable both for passengers and crew. Its central galley layout is presented in Appendix E.

Now, let's move on to the kitchen section determination. In previous part I explained which equipment has to be installed, but as the class changed, expectations from service must meet higher requirements. As the flights will take from 2 to 6 hours, flight attendants have to serve cold and hot drinks, cold and hot meals and if there will not be any stopovers – cold meals along with hot meals. If a stopover will take place, flight attendants have to serve cold meals and drinks. So, let's conclude what equipment needs to be installed

1. Water heater (2)
2. Water basin (3)
3. Coffee maker (4)
4. Oven (with a control panel) (4)
5. Refrigerator (2)
6. Trolley (7)
7. Table (2)
8. Storage (6)
9. Waste compartment (3)

Design will use same equipment, only with difference in device quantity. To make serving operation quicker, I decided to install additional water heater, coffee maker, water basin of course, two more ovens with control panels, one more refrigerator, two more trolleys, table waste compartment and two more storage compartments.

Buying a ticket on AA 48-25-B aircraft, passengers expect higher quality of service and bigger variety of meals and drinks. One of the best examples of service is provided on board of Emirates Airlines. During flight, passengers that chose to fly in business class experience up to five dishes and have possibility to drink best coffee and tea. My prototype kitchen section design meets such configuration to enable provision of similar service – with variety of dishes and features of destination country culture.

Configurations of AA 48-25-B galleys, used for serving operations for 48 passengers with all necessary equipment is presented on drawings (Appendix D, Appendix E).

Conclusion to the special part

Aircraft kitchen section, also known as galley, is a compact yet highly functional space used for storage, preparation and serving of drinks and meals during flight. It includes equipment, such as heaters, ovens, water supply equipment, storages, refrigerators, trolleys, waste compartments and is typically located at the front part and/or at the rear part of passenger cabin. All of kitchen section components must be tightly fixed to the frame to prevent mess during takeoff, landing, turbulence and emergencies. Galley is built from lightweight, fire resistant and corrosive-resistant materials and is integrated to the electrical and water supply system of an aircraft.

In the special part of this work, I had the task to design kitchen section of modular configuration that would be suitable for providing service to 48 passengers. As my main prototype has passenger capacity of 124, I had to make another one configuration – business jet AA 48-25-B. Geometrical characteristics were not modified; however, I presented new seating scheme and additional galley configuration (Appendix E).

I searched for existing passenger aircraft kitchen sections and performed an analysis to specify common equipment [19, 20]. Based on Embraer 195 galley, I made one for my AA 48-25-B with all necessary devices. Hope that my prototype kitchen section planning will perform its best and will meet the highest standards of ergonomy and efficiency.

Two prototype kitchen sections layout drawings along with business jet passenger cabin design will be presented in Appendix D, Appendix E.

GENERAL CONCLUSIONS

Starting, my task was to perform design of mid-range passenger aircraft and a kitchen section, suitable to perform serving operations for 48 passengers. I met problem of passenger capacity difference, but it was not difficult to overcome it – economy class-oriented aircraft AA 48-25 obtained a business jet configuration AA 48-25-B.

Main part is built of description and calculation part. Firstly, I found a prototype passenger aircraft that is operating in real time, and two more similar aircraft. Their statistic data was applied in the computer program installed in the university – that is how I get a new one data for my own design. This is where shape of designing prototype started to acquire clearer lines. For logical design, I calculated geometrical parameters from known parameters and given equations, determined landing gear pneumatics and power plant. Final part is about center of gravity calculation, performance of which ensures that AA 48-25 will be stable on the ground and in flight.

Special part was dedicated to the kitchen section. On major-related practice, I found information about construction of galley and common equipment installed. This information was beneficial for the description and calculation of necessary devices for AA 48-25 galley. However, the task was not completed – I had to design kitchen section for aircraft on which 48 passengers would fly. So, to solve this problem, I designed a new configuration with more extended seating and additional household compartment located at the center of cabin – AA 48-25-B, which is a business jet aircraft.

This qualification work completes my bachelor studies on aviation and aerospace technologies. I understood design principles of passenger aircraft and its kitchen section. I'm sure my AA 48-25 and its configuration AA 48-25-B will

meet all necessary requirements to be accepted into the sky.

Prototype wing and fuselage center of gravity calculation along with kitchen section designs are presented in Appendix B, C, D, E.

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Appendix

Appendix A

Performed by: Andreieva Alina
Supervisor: Vlasenko Yurii

PRELIMINARY DESIGN OF THE AIRCRAFT
INITIAL DATA AND SELECTED PARAMETERS

Passenger Number	124
Flight Crew Number	2
Flight Attendant or Load Master Number	3
Mass of Operational Items, kg	947.59
Payload Mass, kg	12276.00
Cruising Speed, km/h	835.00
Cruising Mach Number	0.7848
Design Altitude, km	11.50
Flight Range with Maximum Payload, km	2650.00
Runway Length for the Base Aerodrome	2.20
Engine Number	2
Thrust-to-weight Ratio in N/kg	3.4100
Pressure Ratio	29.00
Assumed Bypass Ratio	5.50
Optimal Bypass Ratio	5.50
Fuel-to-weight Ratio	0.2510
Aspect Ratio	8.00
Taper Ratio	0.33
Mean Thickness Ratio	0.111
Wing Sweepback at Quarter Chord, deg	24.0
High-lift Device Coefficient	0.930
Relative Area of Wing Extensions	0.010

Wing Airfoil Type - Supercritical
Winglets - Installed
Spoilers - Installed

Fuselage Diameter, m	3.01
Finess Ratio	12.80
Horizontal Tail Sweep Angle, deg	27.0
Vertical Tail Sweep Angle, deg	32.0

CALCULATION RESULTS

Optimal Lift Coefficient in the Design Cruising Flight Point	0.38676
Induce Drag Coefficient	0.00905

ESTIMATION OF THE COEFFICIENT $D_m = M_{critical} - M_{cruise}$

Cruising Mach Number	0.78480
Wave Drag Mach Number	0.79243
Calculated Parameter D_m	0.00763

Wing Loading in kPa (for Gross Wing Area):

At Takeoff	3.899
At Middle of Cruising Flight	3.508
At the Beginning of Cruising Flight	3.751

Drag Coefficient of the Fuselage and Nacelles	0.00682
Drag Coefficient of the Wing and Tail Unit	0.00908

Drag Coefficient of the Airplane:

At the Beginning of Cruising Flight	0.02644
At Middle of Cruising Flight	0.02582

Mean Lift Coefficient for the Ceiling Flight	0.38676
Mean Lift-to-drag Ratio	14.98120
Landing Lift Coefficient	1.532
Landing Lift Coefficient (at Stall Speed)	2.297
Takeoff Lift Coefficient (at Stall Speed)	1.924
Lift-off Lift Coefficient	1.405
Thrust-to-weight Ratio at the Beginning of Cruising Flight	0.64
Start Thrust-to-weight Ratio for Cruising Flight	2.853
Start Thrust-to-weight Ratio for Safe Takeoff	2.73
Design Thrust-to-weight Ratio Ro	2.967
Ratio $D_r = R_{cruise} / R_{takeoff}$	1.045

SPECIFIC FUEL CONSUMPTIONS (in kg/kN*h):

Takeoff	36.0362
Cruising Flight	57.8587
Mean cruising for Given Range	58.8359

FUEL WEIGHT FRACTIONS:

Fuel Reserve	0.03535
Block Fuel	0.15528

WEIGHT FRACTIONS FOR PRINCIPAL ITEMS:

Wing	0.12193
Horizontal Tail	0.01585
Vertical Tail	0.01558
Landing Gear	0.04314
Power Plant	0.09310
Fuselage	0.12591
Equipment and Flight Control	0.13996
Additional Equipment	0.01212
Operational Items	0.01733
Fuel	0.19063
Payload	0.22451

Airplane Takeoff Weight, kg	54678
Takeoff Thrust Required of the Engine, kN	81.11

Air Conditioning and Anti-icing Equipment Weight Fraction	0.0240
Passenger Equipment Weight Fraction (or Cargo Cabin Equipment)	0.0184
Interior Panels and Thermal/Acoustic Blanketing Weight Fraction	0.0085
Furnishing Equipment Weight Fraction	0.011
Flight Control Weight Fraction	0.0073
Hydraulic System Weight Fraction	0.0192

Electrical Equipment Weight Fraction	0.0333
Radar Weight Fraction	0.0033
Navigation Equipment Weight Fraction	0.0050
Radio Communication Equipment Weight Fraction	0.0025
Instrument Equipment Weight Fraction	0.0058
Fuel System Weight Fraction	0.0055
Additional Equipment:	
Equipment for Container Loading	0.0091
No typical Equipment Weight Fraction (Build-in Test Equipment for Fault Diagnosis, Additional Equipment of Passenger Cabin)	0.0031

TAKEOFF DISTANCE PARAMETERS

Airplane Lift-off Speed, km/h	239.81
Acceleration during Takeoff Run, m/s^2	2.34
Airplane Takeoff Run Distance, m	943
Airborne Takeoff Distance, m	578
Takeoff Distance, m	1522

CONTINUED TAKEOFF DISTANCE PARAMETERS

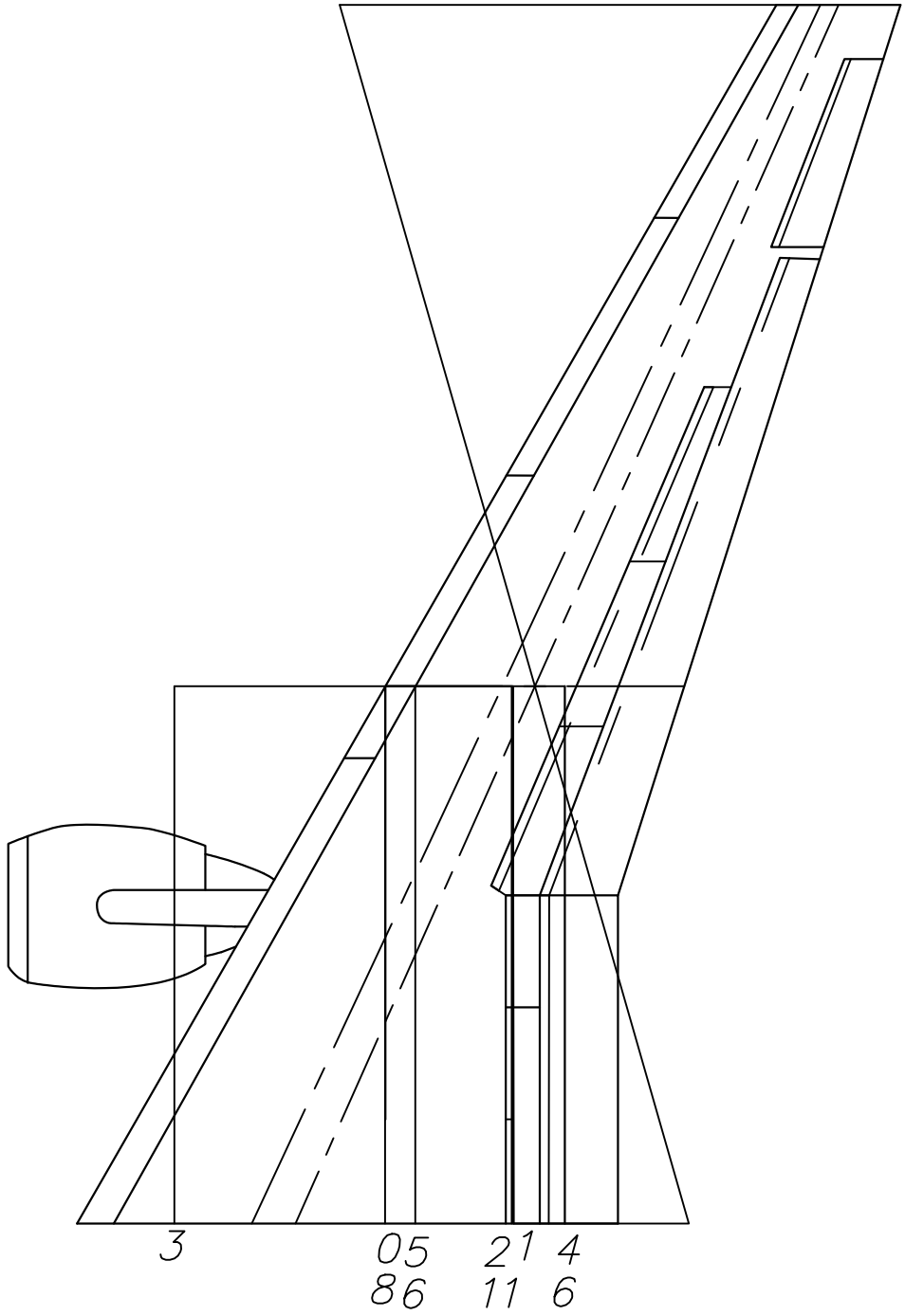
Decision Speed, km/h	227.82
Mean Acceleration for Continued Takeoff on Wet Runway, m/s^2	0.34
Takeoff Run Distance for Continued Takeoff on Wet Runway, m	1473.74
Continued Takeoff Distance, m	2052.12
Runway Length Required for Rejected Takeoff, m	2126.22

LANDING DISTANCE PARAMETERS

Airplane Maximum Landing Weight, kg	48623
Time for Descent from Flight Level till Aerodrome Traffic Circuit Flight, min	22.2
Descent Distance, km	51.54
Approach Speed, km/h	232.88
Mean Vertical Speed, m/s	1.90
Airborne Landing Distance, m	510
Landing Speed, km/h	217.88
Landing run distance, m	668
Landing Distance, m	1177
Runway Length Required for Regular Aerodrome, m	1966
Runway Length Required for Alternate Aerodrome, m	1672

ECONOMICAL EFFICIENCY

THESE PARAMETERS ARE NOT USED IN THE PROJECT



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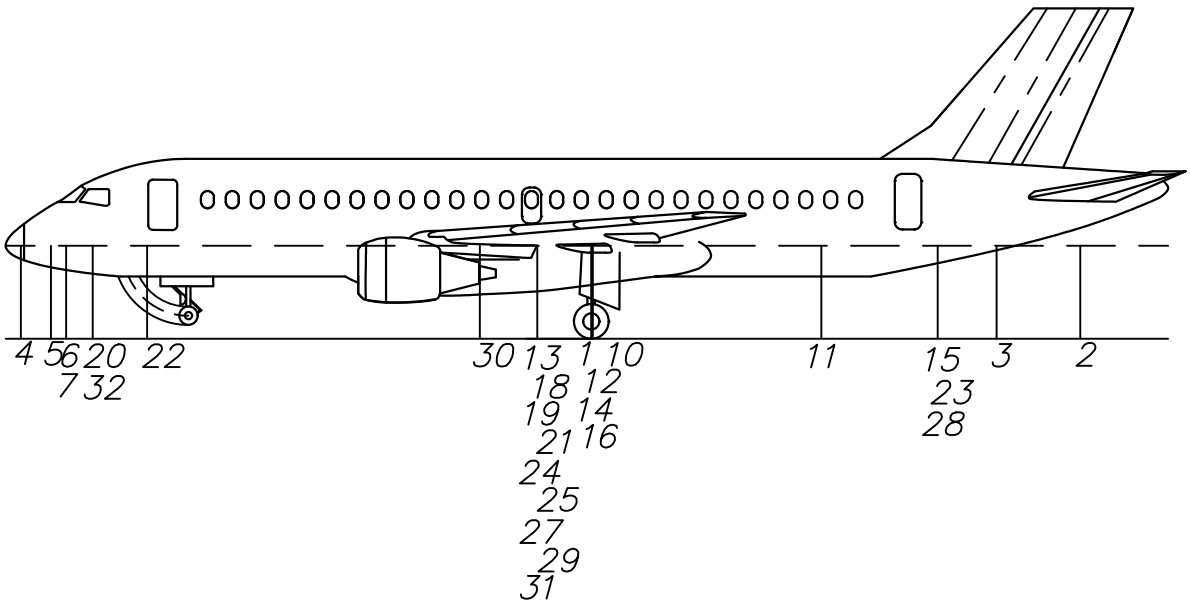
Ch.	Sheet	Document #	Sign.	Date	Center of gravity of the wing	Letter / Weight / Scale: 1:100
Done by		Andreieva A.V.				
Supervisor		Vlasenko Y.V.				Sheet 1 / Sheets 4
St. conrtol		Krasnopolskyi V.S.			Appendix B	Ba-134-21-1-0C
Head of dep.		Maslak T.P.				



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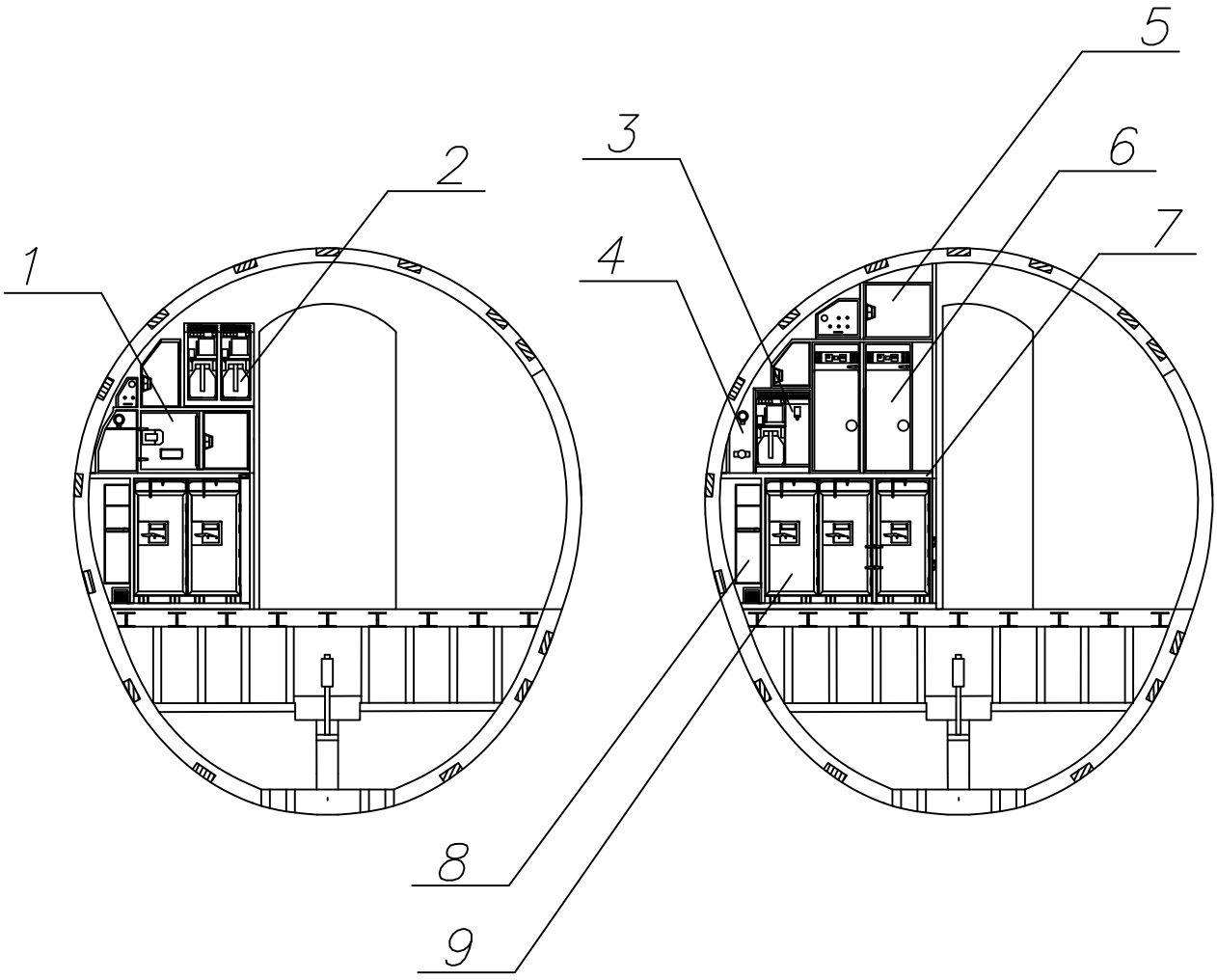
Done by		Andreieva A.V.				
Supervisor		Vlasenko Y.V.				
						Sheet 2 / Sheets 4
St. conrtol		Krasnopolskyi V.S.			Appendix C	Ba-134-21-1-0C
Head of dep.		Maslak T.P.				



Формат	Зона	Поз.	Marking	Object	Q.	Notes
		1	KAI 25 01A 25 30 10	Refrigerator	1	
		2	KAI 25 01A 25 30 20	Coffee maker	3	
		3	KAI 25 01A 25 30 30	Water heater	1	
		4	KAI 25 01A 25 30 40	Water basin	2	
		5	KAI 25 01A 25 30 50	Storage comp.	4	
		6	KAI 25 01A 25 30 60	Oven (with c.p.)	2	
		7	KAI 25 01A 25 30 70	Table	1	
		8	KAI 25 01A 25 30 80	Waste comp.	2	
		9	KAI 25 01A 25 30 90	Trolley	5	

KAI 25 01A 00 00 00 27

Ch.	Sheet	Document #	Sign.	Date
Done by		Andreieva A.V.		
Supervisor		Vlasenko Y.V.		
St. conrtol		Krasnopolskyi V.S.		
Head of dep.		Maslak T.P.		

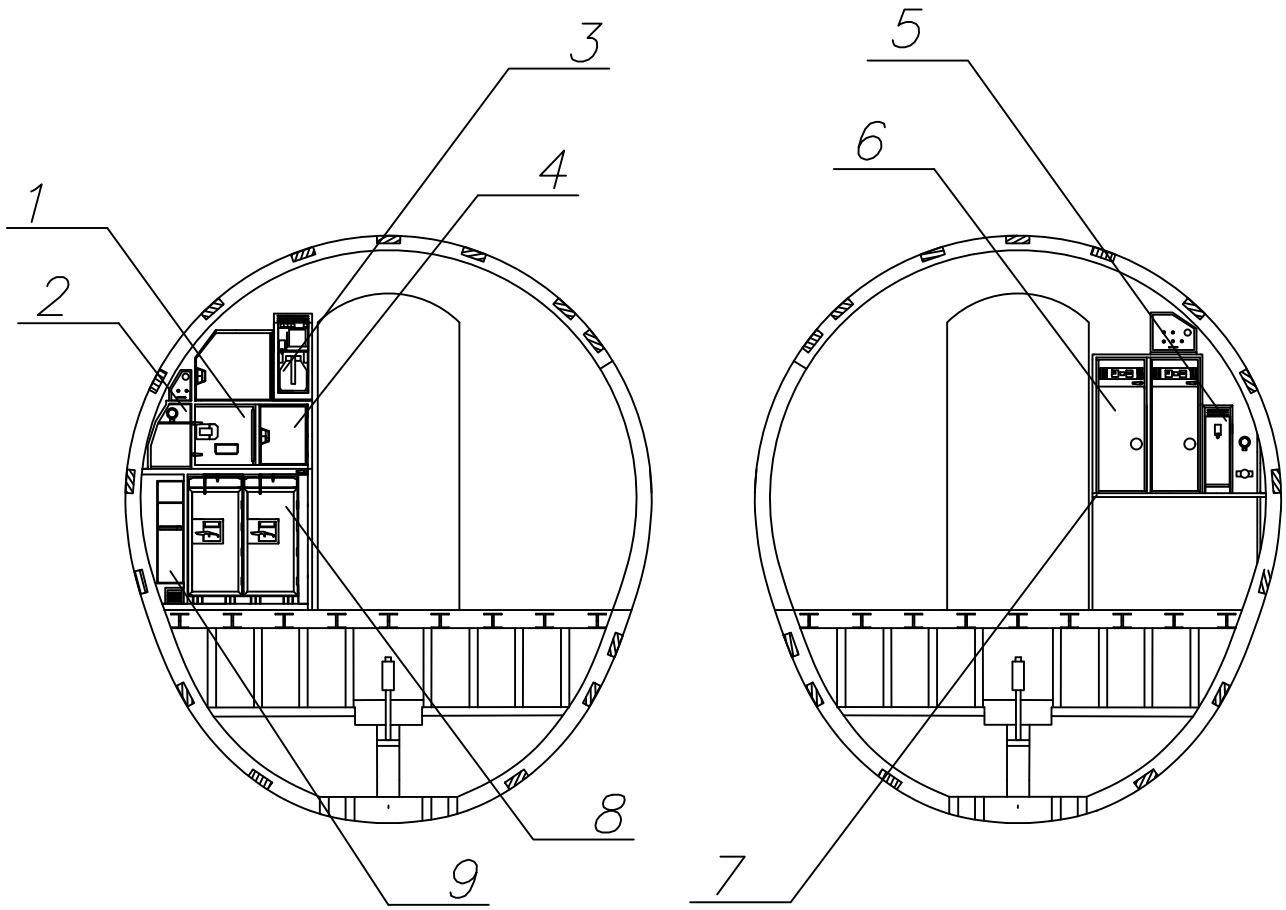
Front and rear kitchen section

Letter	Weight	Scale
		1:50

Sheet 3 | Sheets 4

Appendix D

Ba-134-21-1-0C



Формат	Зона	Поз.	Marking	Object	Q.	Notes
		1	KAI 25 01A 25 30 10	Refrigerator	1	
		2	KAI 25 01A 25 30 40	Water basin	1	
		3	KAI 25 01A 25 30 20	Coffee maker	1	
		4	KAI 25 01A 25 30 50	Storage comp.	2	
		5	KAI 25 01A 25 30 30	Water heater	1	
		6	KAI 25 01A 25 30 60	Oven (with c.p.)	2	
		7	KAI 25 01A 25 30 70	Table	1	
		8	KAI 25 01A 25 30 90	Trolley	2	
		9	KAI 25 01A 25 30 80	Waste comp.	1	

Ch.	Sheet	Document #	Sign.	Date
Done by		Andreieva A.V.		
Supervisor		Vlasenko Y.V.		
St. conrtol		Krasnopolskyi V.S.		
Head of dep.		Maslak T.P.		

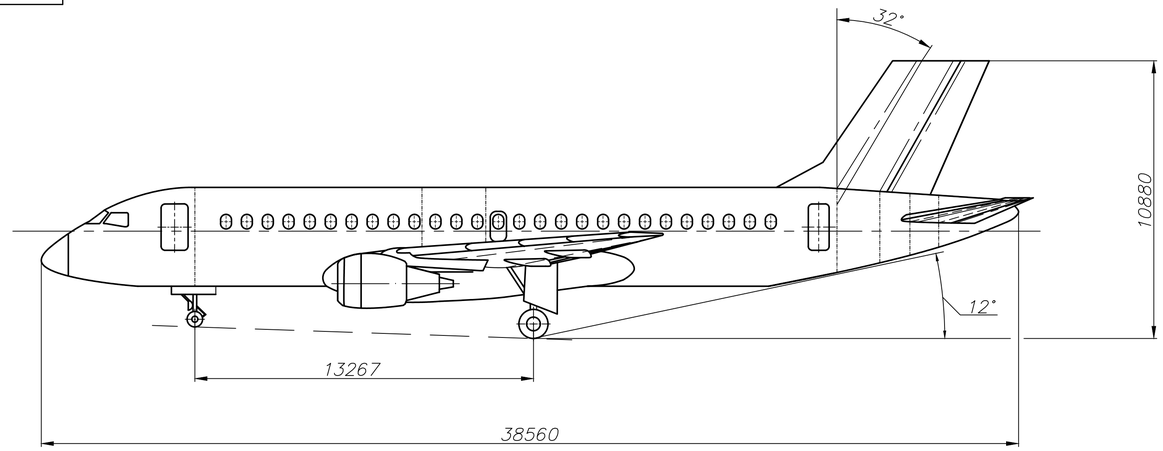
KAI 25 01A 00 00 00 27

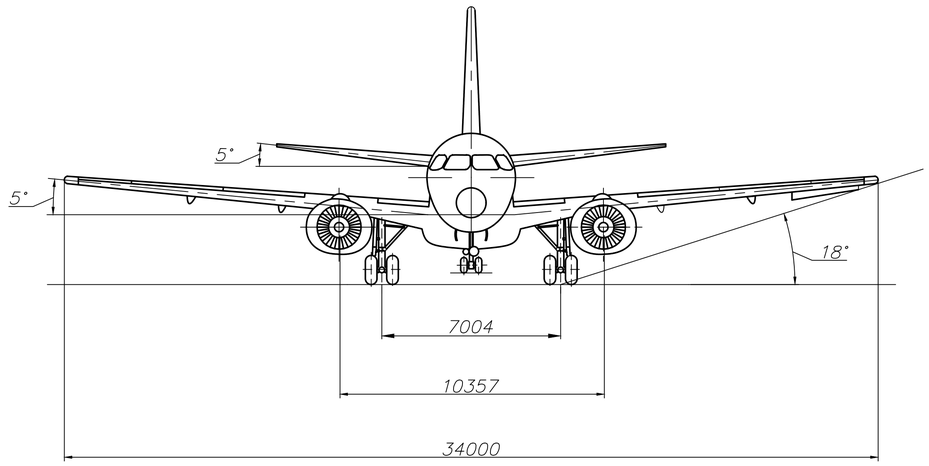
Center kitchen section (AA 48–25–B)

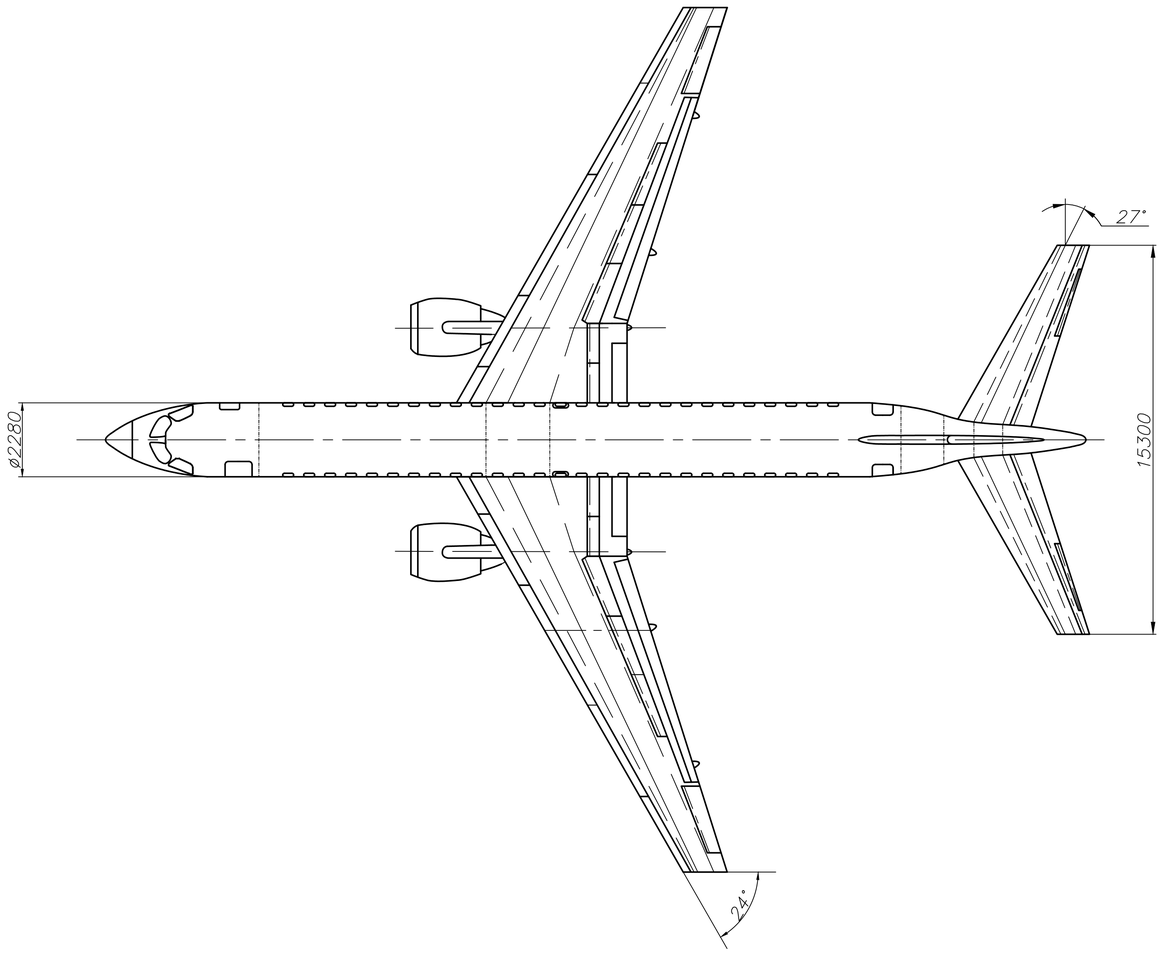
Letter	Weight	Scale
		1:50
Sheet 4		Sheets 4

Appendix E

Ba–134–21–1–0C



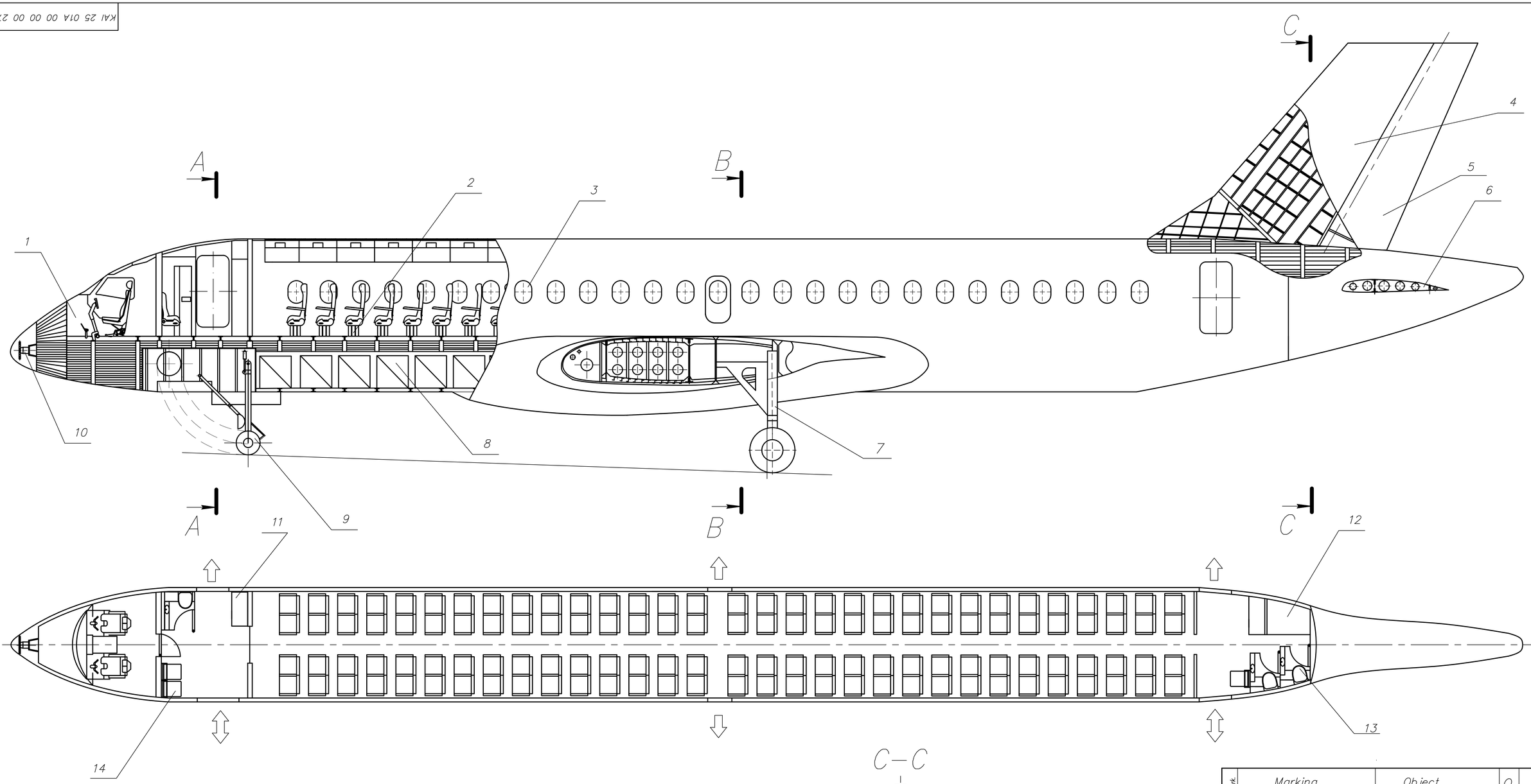


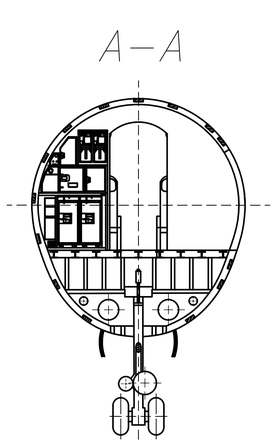


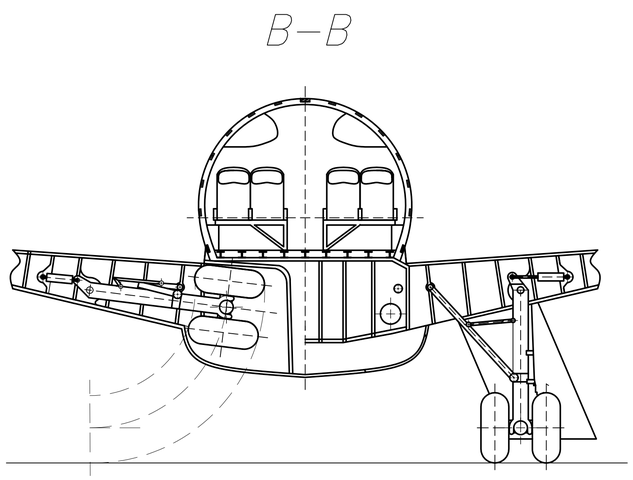
№	Main data	Mark.	Units	Q.
1	Takeoff weight	$m_{takeoff}$	kg	54678
2	Payload	m_p	kg	12276
3	Empty weight	m_{empty}	kg	28000
	Geometrical parameters			
1	Wing span	L_{wing}	m	34
2	Wing area	S	m^2	145
3	Length	L_a	m	38.56
4	Height	h	m	10.88
5	Root chord	b_{root}	m	6.09
6	Tip chord	b_{tip}	m	2.44
7	Mean aerodynamic chord	b_{mac}	m	4.16
8	Aspect ratio	λ	—	8
9	Taper ratio	η	—	2.5
10	Quarter-chord sweep angle	°	—	25
	Flight performance			
1	Cruise speed	V_{cruise}	km/h	835
2	Flight range	L	km	2650
3	Length of airfield	$L_{airfield}$	m	2200
4	Takeoff speed	$V_{takeoff}$	km/h	239.81
5	Takeoff roll	L_{roll}	m	943
6	Takeoff distance	$L_{t.dist.}$	m	1522
7	Landing speed	$V_{landing}$	km/h	217.88
8	Landing roll	$L_{l.roll}$	m	668
9	Landing distance	$L_{l.dist.}$	m	1177
	Power unit			
1	Number of engine	n	numb.	2
2	Required takeoff thrust	$P_{.o}$	kWt	162.22
3	Specific fuel consumption	γ	kg/kWh	0.389
4	Type of engine	CF34-10E		

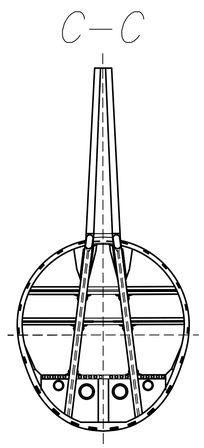
			KAI 25 01A 00 00 00 27 GV	
Ch.	Sheet	Document №	Sign.	Date
Done by		Andreieva A.V.		
Supervisor		Vasenko Y.V.		
St. conrtol		Krasnopolskyi V.S.		
Head of dep.		Maslak T.P.		
Middle-range passenger aircraft			Letter: q	Weight: 28 t
			Scale: 1:100	
			Sheet 1	Sheets 3
			Ba-134-21-1-0C	

KAI 25 01A 00 00 00 27 FL









Mark.	Marking	Object	Q.	Notes
1	KAI 25 01A 25 10 00	Cabin of crew	1	
2	KAI 25 01A 25 20 00	Passenger seat	124	
3	KAI 25 01A 56 00 00	Passenger window	27	
4	KAI 25 01A 55 00 00	Fin	1	
5	KAI 25 01A 55 40 00	Rudder	1	
6	KAI 25 01A 27 40 00	Horizontal tail	1	
7	KAI 25 01A 32 10 00	Main L.G.	1	
8	KAI 25 01A 50 10 00	Cargo compartment	1	
9	KAI 25 01A 32 20 00	Nose L.G.	1	
10	KAI 25 01A 34 00 00	Radiolocation equip.	1	
11	KAI 25 01A 25 30 00	Buffet	2	
12	KAI 25 01A 92 05 00	Closet	1	
13	KAI 25 01A 25 20 00	Toilet	3	
14	KAI 25 01A 25 00 00	Seat of attendants	3	

Ch.	Sheet	Document #	Sign.	Date
Done by		Andreieva A.V.		
Supervisor		Vlasenko Y.V.		
St. conrtol		Krasnopolskyi V.S.		
Head of dep.		Maslak T.P.		

KAI 25 01A 00 00 00 27 FL

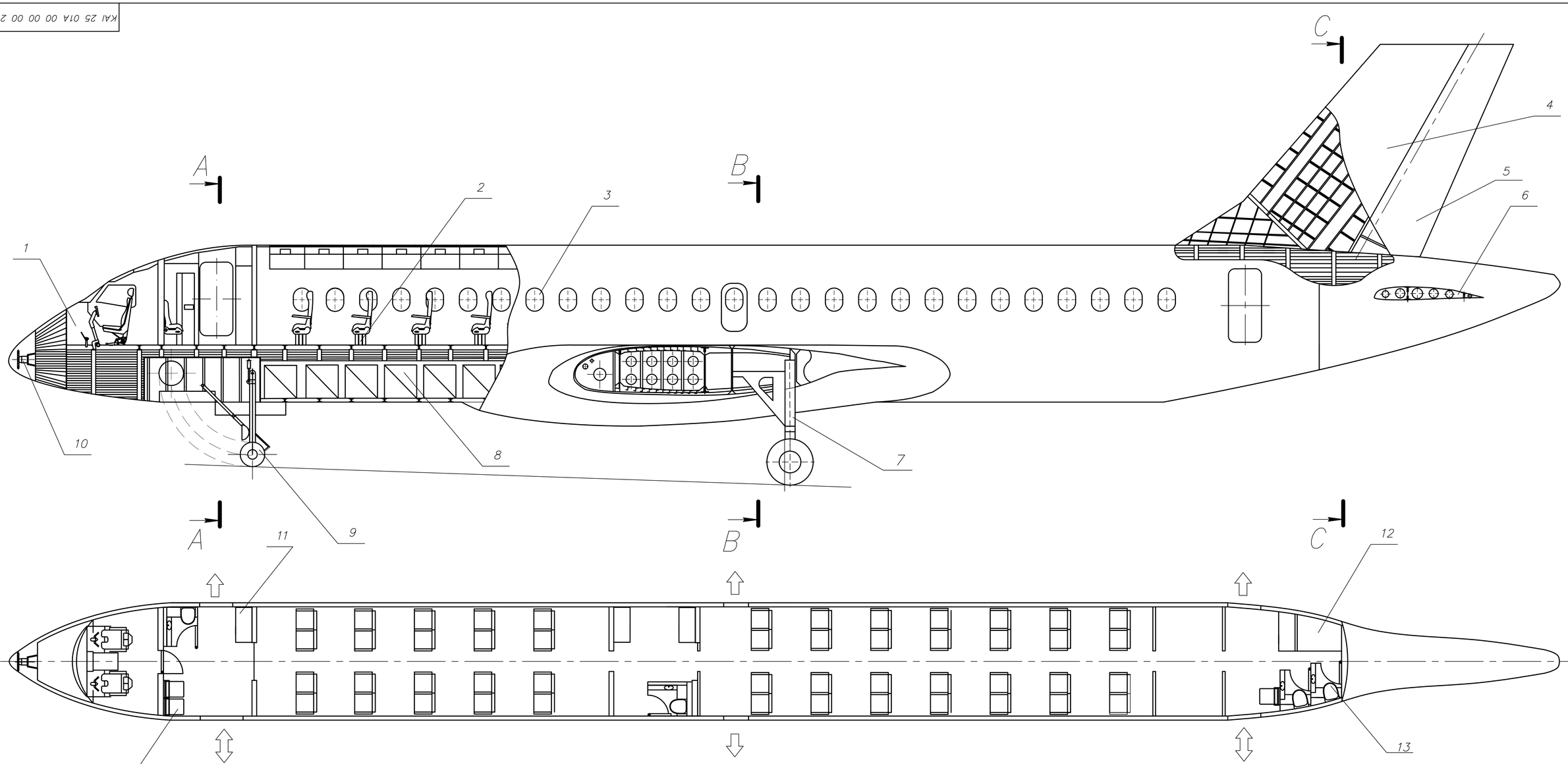
Passenger cabin

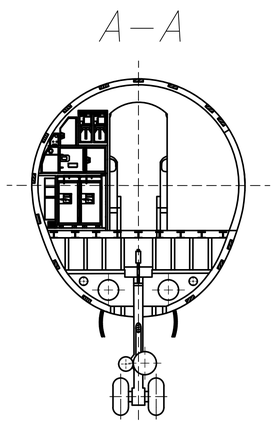
Letter	Weight	Scale
q	54 t	1:50

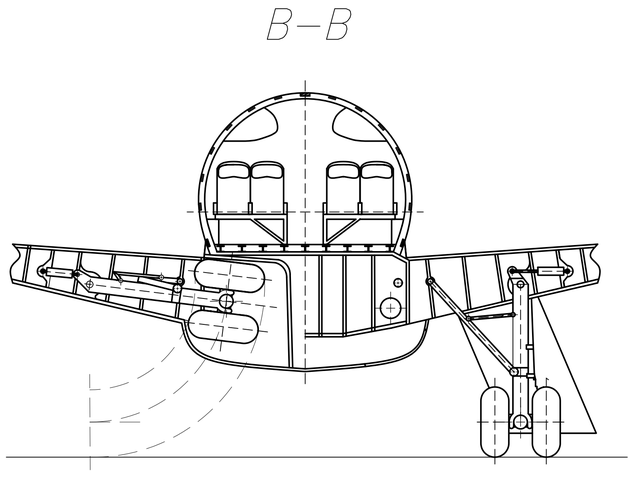
Sheet 2 | Sheets 3

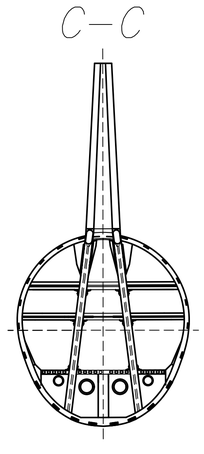
Ba–134–21–1–AO

KAI 25 01A 00 00 00 27 FL









Mark.	Marking	Object	Q.	Notes
1	KAI 25 01A 25 10 00	Cabin of crew	1	
2	KAI 25 01A 25 20 00	Passenger seat	124	
3	KAI 25 01A 56 00 00	Passenger window	27	
4	KAI 25 01A 55 00 00	Fin	1	
5	KAI 25 01A 55 40 00	Rudder	1	
6	KAI 25 01A 27 40 00	Horizontal tail	1	
7	KAI 25 01A 32 10 00	Main L.G.	1	
8	KAI 25 01A 50 10 00	Cargo compartment	1	
9	KAI 25 01A 32 20 00	Nose L.G.	1	
10	KAI 25 01A 34 00 00	Radiolocation equip.	1	
11	KAI 25 01A 25 30 00	Buffet	2	
12	KAI 25 01A 92 05 00	Closet	1	
13	KAI 25 01A 25 20 00	Toilet	3	
14	KAI 25 01A 25 00 00	Seat of attendants	3	

Ch.	Sheet	Document #	Sign.	Date
Done by		Andreieva A.V.		
Supervisor		Vlasenko Y.V.		
St. conrtal		Krasnopolskyi V.S.		
Head of dep.		Maslak T.P.		

KAI 25 01A 00 00 00 27 FL

Passenger cabin

Letter	Weight	Scale
q	54 t	1:50

Sheet 3 | Sheets 3

Ba–134–21–1–AO