

Airship Design Consultancy

Scope of Services



Airship Design Consultancy

Scope of Services

1 General

Tensys Dynamics Ltd. was established in 2001 in order to make use of the existing analytical and patterning tools provided by the inTENS software in wider fields, particularly that of airship fabric structure design. An expansion of capabilities means that Tensys Dynamics can now offer consulting services covering a wide range of airship design topics, and other similar high-performance tension structures. If required, where the necessary skills are not available in house, a suitably skilled team can be assembled on a project basis. This facility permits organisations with an interest in a particular programme access to many years of high-performance tension structure experience, without needing to locate individual specialised engineers, or commit to a large, permanent design staff.

The specific skills and capabilities offered by Tensys Dynamics are outlined below; these fall into three main areas, envelope and envelope system design, general airship design consultancy, and design and analysis of other high-performance tension structures.

2 Envelope Fabric Structure Design

Tensys Dynamics are able to design conventional airship envelopes if required; many years of airship design experience, allied to the capabilities of inTENS, will permit a reliable and optimised design. However, when vehicle designers move away from conventional hull forms towards lifting body and other non-symmetric shapes, the particular capabilities provided by Tensys Dynamics become crucial. It is not possible to define an equilibrium inflated form using conventional aerospace design software. It is also difficult to carry out analyses of non-linear, large deflection structures such as airship envelopes. Translation of a complex three-dimensional loaded form into two-dimensional unloaded cutting patterns presents major problems using conventional software. Solutions to all these problems are provided by Tensys Dynamics.

As inTENS was developed specifically to analyse membrane structures, it is fundamentally well suited to the problems of airship envelope design. The hull structure, with its reinforcements and attachments, can be accurately modelled, and subjected to realistic applied loads. Additions to the software have enabled the modelling of the behaviour of closed gas cells, with unit lift assigned as required to model differential gas pressure and overall vehicle lift; further additions are being undertaken to permit the modelling of ballonets within the envelope. This will enable optimisation of ballonet forms, and modelling of deformed ballonet shapes under varying fills and flight conditions.

Once the form has been modelled and analysed, it may be patterned using inTENS. Options within the software permit geodesic seam lines to be produced on the surface, and then spaced to match the fabric width. This process defines panels with essentially straight centrelines, thus minimising fabric wastage, and reducing the complexity of the panel forms. Recent updates to the software permit patterning of the form continuously from nose to tail, allowing more accurate and simpler disposition of fabric compensations. Ballonets and other fabric components can also be patterned accurately.

3 Envelope Systems Design

3.1 Pressure System

A successful envelope pressure management system is key to the correct functioning of non-rigid, or pressure stabilised, airships. This system, including the overall system architecture, and also components such as blowers, scoops, ducting and air distribution trunking, air valves and helium valves must be designed as an integrated whole, the performance of which is matched to the required vehicle performance. Tensys Dynamics can offer considerable experience in the overall design of such systems, and in the design of their component parts. System performance estimation and Computational Fluid Dynamics modelling can be carried out to suit the system design to the vehicle level design requirements, and to optimise size and configuration. Formulation and execution of pressure system test plans can also be offered.

3.2 Suspension System

The system that supports and restrains the payload module is another fundamental part of non-rigid airship design; Tensys Dynamics can offer much experience in the field of suspension system design. This system can be modelled as part of the overall envelope Finite Element model, ensuring that load transfer, interfaces and clearances can be thoroughly and continuously checked. Fabric elements of the system such as catenary curtains and load patches can be designed and then patterned as part of the overall envelope design and patterning task. Non-fabric items, such as cables and fittings, are included in the Finite Element model, and their detail design can be undertaken using the loading data obtained from the overall model.

4 General Airship Design Consultancy

Drawing on the wide experience available to Tensys Dynamics, a range of general airship design consultancy services can be offered. Packages can be tailored to specific projects, with additional relevant specialists being retained as required to extend the core skills offered. The background of the core staff and the available consultants covers a wide range, from passenger certified production airships, to Hybrid Air Vehicle and high altitude airship design.

4.1 Vehicle and System level design, modelling, feasibility and trade studies

Many airship projects never proceed beyond the feasibility study stage, and many such studies are carried out by personnel with limited airship experience. As real airship design experience is not widely available, this is perhaps to be expected. However, Tensys Dynamics can offer a wide range of conceptual design, modelling and estimation skills, drawing on experience gained in a wide range of airship projects over many years. This knowledge can be made available to those proposing airship related projects, or to those reviewing such proposals. Aerodynamic analysis, including Computational Fluid Dynamics simulation, can be carried out to permit hull form and vehicle configuration optimisation. Performance estimation and modelling of the complete vehicle can then be carried out with increased accuracy.

Projects can be carried out to whatever stage is required, from outline studies, to detailed design proposals.

4.2 Detail design

If required, complete detail design packages can be provided, including specifications to civil aerospace or military standards, and engineering drawings. During this stage of a project the following services can be provided as required:

- Preparation and management of test plans, particularly fabric development, characterisation and qualification testing

- Design for, and consultancy on, Airworthiness Authority certification programmes, with particular emphasis on the certification of aerospace fabric structures

Design for production, including cost and schedule estimation, drawing on many years experience with construction and maintenance of commercial production airships

Structural design, including:

Composite structures: including payload module, empennage and nose reinforcement design and analysis; design for production

Metallic structures: including propulsion unit and undercarriage support frame design and analysis; design for production

Mechanical Systems design, including:

Propulsion system design, including power plant selection and installation design

Pressure system component design, including air and helium valve design

Undercarriage design

5 Other High-performance Tension Structure Design Activities

Tensys Dynamics possesses a combination of analytical and practical skills in the design and construction of high-performance tension structures. These have been developed mainly in the architectural and lighter-than-air fields, but are applicable to a wide range of design problems which fall outside the experience of mainstream engineering. For example, Tensys Dynamics is at present involved in projects covering sail design, air cushion landing system design, and the design of very large kites; all of these projects raise issues concerning the design and operation of high-performance fabric structures which are not amenable to solution by conventional methods.

By drawing on the skills within the Tensys Dynamics team, as well as those of the consultants and sub-contractors available to Tensys Dynamics, specialised groups can be assembled to undertake particular tasks. This can include manufacture of test pieces and prototypes if required.

6 Further Information

For further information on the services offered by Tensys Dynamics and their application to your project please contact :

Luke Brooke E luke.brooke@tensys.com

or David Wakefield E david.wakefield@tensys.com

Tensys Dynamics

T +44 (0)1225 321950

F +44 (0)1225 321969

March 2003