Turbine Design Webinar

Webinar Description

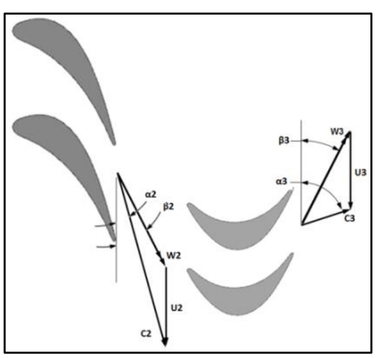
The turbine design webinar begins with a basic review of aero/thermo fundamentals then advances through more in-depth technical material that is essential for both beginners and advanced attendees. Course material has been collected from 40 years of turbine design practice and over 50 technical references. Worked problems and Q & A problems are used to reinforce key material. This training can provide attendees with answers to their basic aero/thermo design questions as well as advanced topics. It can also provide an opportunity to discuss any specific technical issues.

Days 1 & 2 – details on page 2

The first two days of training provide a solid introduction into turbine aero/thermo design and analysis methods for relatively new engineers to the field. The presentation material also serves as a good technical refresher for the more experienced turbine engineer.

This part of the program will enable you to:

- Evaluate and prioritize the key factors affecting a turbine's performance level
- Work through the basic relations involved in properly sizing a flow path for good efficiency
- Decide important blade manufacturing tolerances
- Consider basic stress & vibration failure criteria
- Step through the complete process of stage sizing, performance analysis & detailed blade design
- Scale designs for other operating conditions or for different frame sizes.
- Examine blade profile design methods and follow a step-by-step software demo of airfoil construction



Days 3, 4 & 5 – details on pages 2 & 3

Days 3, 4 & 5 (1/2 day) offer more in-depth material on special topics important to turbine aero/thermo design:

- Multi-stage turbine considerations, wetness and erosion, axial thrust calculations
- The application of sizing strategies and performance analyses are further illustrated using software demos
- Comparison of design techniques for three different stage types: Curtis, High-Pressure & Low-Pressure
- Analysis of supersonic nozzles and blades
- Exhaust diffusers, hood losses and design methods
- Testing and instrumentation considerations
- Hand Calculation Method for Stage Sizing
- Transfer of axial turbine skills to radial turbines and methods for designing radial components
- Wrapup session to summarize key takeaways

Presenter

John Perera is a specialist in turbine design and analysis and has been consulting as PerAero Turbine Designs since 2007. His experience began at Ebara Elliott Energy where he advanced through engineering R&D responsibilities to become the technical lead for aero development of steam turbines, turbochargers and hot gas expanders. John continued broadening his experience as the Associate Director of Turbine Aerodynamics at Concepts NREC where he added design expertise for turbopumps, waste heat recovery expanders and microturbines. He also conducted turbine design seminars and software training worldwide for university students and turbomachinery engineers.

Since 2007, PerAero Turbine Designs has consulted for more than twenty turbomachinery companies on:

- Turbine aero/thermo design and analysis for new power generation products and aftermarket repairs
- Rerates and redesigns of existing equipment
- Software development, training webinars/seminars

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Day 1

1) Turbine Applications & Construction Features

- Turbine Applications & Cycles
- Steam Turbine Constructions
- Aero & Mechanical Components

2) Fundamentals of the Expansion Process

- Fluid Properties / Mollier Chart
- Available Energy versus Used Energy
- Velocity Triangles & Energy Conversion
- Choked Flow

3) Basic Considerations in Stage Design

- Stage Loading & Velocity Ratio
- Impulse versus Reaction
- Nozzle and Blade Losses
- Stage Parasitic Losses

4) Steam Path Sizing & Scaling Methods

- Specific Speed / Specific Diameter
- Flow Factor / Loading Coefficient
- Radius Ratio / Aspect Ratio
- Scaling Methods

Day 2

5) *Blade Mechanical Design & Manufacturing*

- Blade Stress & Vibration Basics
- Failure Criteria & Evaluation Diagrams
- Manufacturing Considerations & Tolerances

6) *Nozzle & Blade Loss Analysis*

- Profile Loss Component
- Secondary & Leakage Loss Components
- Deviation Angle

7) *Turbine Design Cycle Steps*

- Important Considerations
- Overview of Design Cycle Steps
- Preliminary Design – Meanline (1D) Analysis
- Detailed Design – Throughflow (2D) Analysis
- Blade Profile Geometry
- Application Curves

8) *Blade Profile Design & 3D Stacking*

- Profile Design Goals
- Radial Equilibrium & Advanced Stacking Methods
- Profile Construction Demo/Evaluating Loadings

Day 3

9) Multi-Stage Turbines

- Special Considerations
- Stage Carryover Energy
- Part Load Operation, Wetness & Erosion
- Axial Thrust Calculations

*10) Multi-Stage Sizing Demo***

- ***Aeolus*** Steam Path Sizing with Demo
- ***Aeolus*** Performance Analysis with Demo

11) Specific Stage Designs: Curtis, HP & LP

- Curtis Stage Characteristics & Components
- HP Stage Advanced Designs
- LP Stage Considerations & Advanced Designs

12) Supersonic Stages

- Expanding Nozzles
- Supersonic Blades
- Supercritical Turbines

Day 4

13) Diffusers & Exhaust Hoods

- Pressure Recovery with Diffusers
- Exhaust Losses & Hood Design

14) Testing & Instrumentation

- Flow & Power Measurement
- Instrumentation & Uncertainties
- Performance Mapping & Correction Curves

15) Hand Calculation Method for Stage Sizing

- Hand Calculation Steps
- Example Worked Problem

16) Summary of Key Material Presented

- Energy Transfer, Power & Efficiency
- Stage Reaction
- Blade Losses & Leakages
- Blade Profile Design
- Blade Stress & Vibration

*** the Aeolus design & analysis system is used to demonstrate basic design considerations and strategies*

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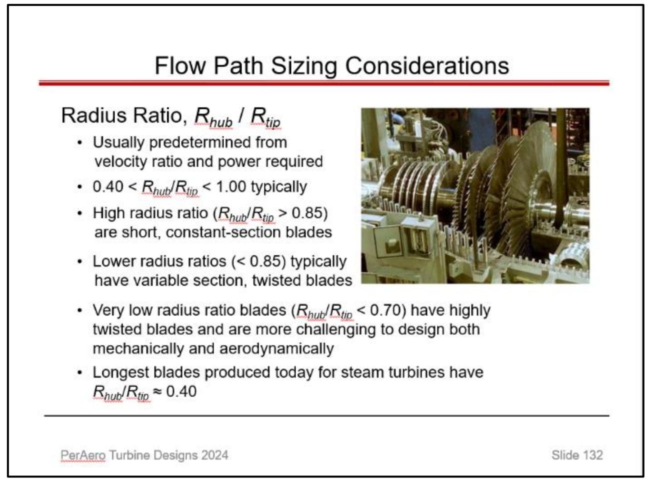
Day 5 (1/2 day)

17) Introduction to Radial Turbine Design

- Component Descriptions
- Comparisons with Mixed Flow & Axial Turbines
- Sizing & Design Goals
- Preliminary Design Software Demo

18) Detail Design of Radial Turbine Components

- Loss Calculations, Volute Design
- Nozzle Design + Demo
- Impeller & Diffuser Design + Demo



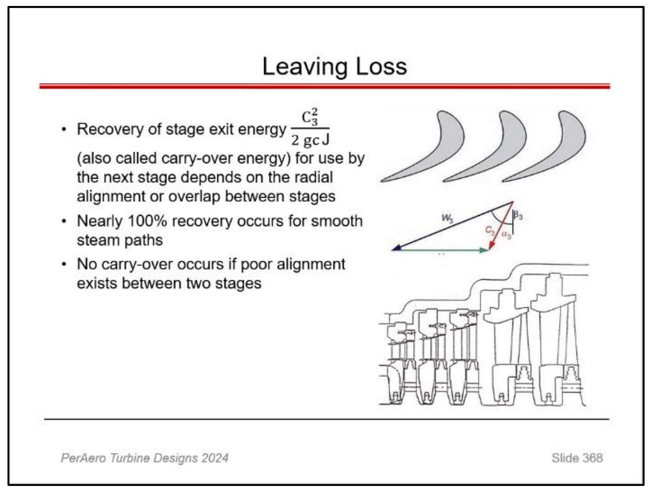
Webinar Costs

Any number of webinar days can be selected from 1 to 4½. Total cost is $2,400 per day for up to 15 attendees.

Cost for additional attendees can be quoted.

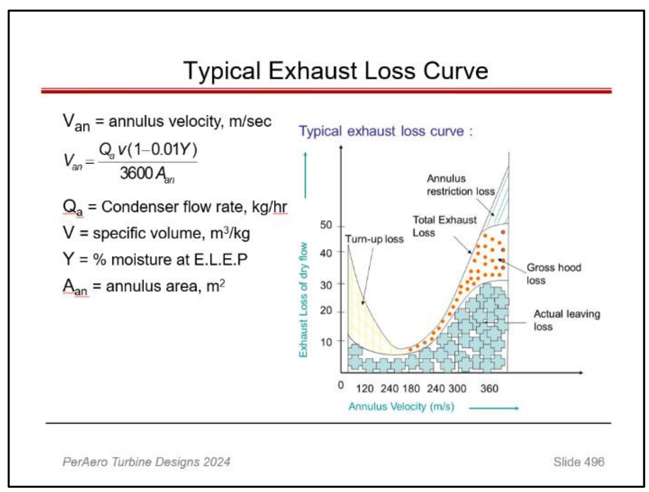
Agenda can be customized by selecting specific sessions.

Four copies of all presented material are included (about 700 slides). Additional copies are available for purchase. One copy of the reference textbook is also provided: *Turbine Aerodynamics: Axial-Flow and Radial-Inflow Turbine Design and Analysis* by R. H. Aungier



Each webinar day typically runs from 9:00am to 4:30pm and is divided into 4 sessions with time allocated for Q&A and worked problems.

A 25% pre-payment is billed prior to the scheduled webinar start date with the remaining balance due after completion. The pre-payment is non-refundable for cancellations that are not rescheduled.



Contact John Perera at jperera@peraero.com for details.