

SAWE
CANADA CHAPTER

Technical
Conference **2014**
Kingston, Ontario

Synopsis
SAWE Aircraft Weight Estimating
Course and Participation at the 2014
SAWE International Conference

Robert Hargrave BSc
October 4, 2014

Introduction

Training

- Aircraft Weight Estimating and use of SAWE RP-08

General Conference

- Day 1 and Day 3 - Opening Session, Technical Tracks/Papers Presentations
- Day 2 - Airlines Affairs Workshop

Questions



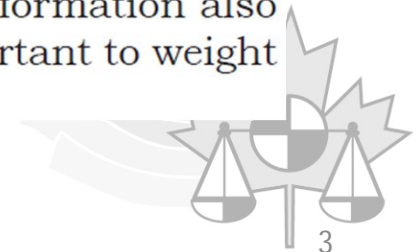


Aircraft Weight Estimating and use of SAWE RP-08: Weight and Balance Reporting Forms for Military Aircraft

Dudley Cate, SAWE Honorary Fellow, NAVAIR-Retired

SUNDAY, MAY 18, 2014. 8 AM – 5 PM RENAISSANCE III

The objectives of this one-day course are to provide an overview of weight estimating methods and the weight estimating process for aircraft and to provide insight into the weight and balance reporting formats and requirements of SAWE Recommended Practice 8. Included will be descriptions of the many types of aircraft estimating methods, together with their applicability and limitations. Many other weight estimating considerations also will be addressed, including impacts of new technologies, estimating prototypes and derivatives, sources of weight data and estimating methods, and dealing with estimating uncertainty. Estimating aircraft center of gravity location and moments of inertia will be briefly discussed. The portion of the course devoted to RP-08 will address the three major parts contained therein. The basic RP-08 concept of allocation by function will be explained, and the important RP-08 allocation instructions will be covered. The requirements for structural increments and design information also will be addressed, along with why inclusion of those data is so important to weight estimating and weight control.



TRAINING – SAWE Aircraft Weight Estimating and use of SAWE RP-08 (cont'd)

Estimating - Conceptual

- Primarily for Gross Weight estimating for early design phase
- Dependent on data from past aircraft
- Suggestions of techniques to develop first order relationships major structure
- Discussion included 5 general approaches to development gross weight relationships and the use of weight fractions in regards to preliminary component weights.
- Design Synthesis was mentioned as a process where parameters such as wing area, aspect ration, engine thrust or others may be used in a multi-disciplinary process to develop the weight relationships.
- The final conceptual method was Growth Factor where every increase in fixed weight is related to the Gross aircraft weight. A simple example related only the weights for structure, propulsion, fuel and payload. It was suggested that other factors can be further developed similar to the multi-disciplinary factors under design synthesis.

Key Take-Away

- Require resource data to be for similar family and design of aircraft.
- Expectation is that in all cases these are only estimates.
- Development of Weight Fractions holds special interest in looking at component breakdown.

References for Further Reading

- SAWE Book – Introduction to Aircraft Weight Engineering
- SAWE Paper 952 – The Growth Factor Concept 1973



TRAINING – SAWE Aircraft Weight Estimating and use of SAWE RP-08 (cont'd)

Estimating– Parametric (also called Statistical or Empirical)

- Develop mathematical relationship between weight of component and specific design parameters
- Discussed from simplest (wing weight based wing area) to more complex and multiple parameters
- Requirement for statistical fitting using simple or exponential curve fitting.
- Appropriate for early and later design phases
- Methods for development of relationships described

Key Take-Away

- Require resource data to be for similar family and design of aircraft.
- High level of analysis required
- Subject to large errors if actual design drivers not captured
- Problem with some existing statistical formula is the reference data is no longer available
- Wing area alone is not a key design driver for wing weight
- Validation and review of weight values required... as well as reference information to maintain trust...
- Structural increments a particular challenge

References for further reading

- SAWE Paper 2091 – Developing Highly Accurate Empirical Weight Estimating Relationships: Obstacles and Tactics, May 1973
- SAWE Paper 1901 – Derivation of a Fuselage Weight Estimating Relationship 1989
- SAWE Weight Engineer's Handbook p 16-7
- SAWE Paper 762 – Constraint Regression Analysis



TRAINING – SAWE Aircraft Weight Estimating and use of SAWE RP-08 (cont'd)

Estimating – Analytical (also called Semi-Analytical or Quasi-Analytical)

- Use the actual engineering for the design of the component to obtain the estimate
- Necessary elements include
 - Design form-fit-function
 - Sizing criteria from analysis, methods, definitions...
 - Reality adjustments to get from ideal weight to real-world weight
- Example of method for estimation of wing torque box
- Other papers for landing gear and fuselage
- Finite Element Model Analysis also is in this category with a number papers quoted

Key Take-Away

- More closely tied to actual engineering.
- Better for sensitivity and trade studies
- More complex and requires considerable design detail
- Validation not straightforward.

References for further reading

- SAWE Book – Introduction to Aircraft Weight Engineering (Wing Torque Box Example)
- SAWE Papers – FEM – 1271, 1414, 1451, 1524, 2089, 2112, 3421 and likely others



TRAINING – SAWE Aircraft Weight Estimating and use of SAWE RP-08 (cont'd)

Estimating – Challenges

- New configurations including blended wing-body or oblique wing, new criteria such as increased crashworthiness and the technologies for new materials and more-electric systems, limited history... no easy answer on weight.
- Look for technical support from material experts
- Use actual data when available
- Use cautions on design criteria... be aware of minimum gage requirements
- In case of composites ensure any weight is realistic not just based on unidirectional sample
- Extensive realization list of challenges for composite

Key Take-Away

- New and different can easily be a weight increase
- Assumptions must be carefully reviewed and validated

References for further reading

- SAWE Book – Introduction to Aircraft Weight Engineering
- SAWE Paper 1871 – Technological Forecast of VSTOL Weight Empty Fraction in the Year 2020 – Sikorsky Aircraft 1989 (Delphi Technique)



TRAINING – SAWE Aircraft Weight Estimating and use of SAWE RP-08 (cont'd)

Other Topics

- References were quoted for further reading
 - Estimating Airframe Unit Weight
 - Estimating aircraft inertias
 - Estimating Risk and Uncertainty and alignment with program milestones
 - Data base issues.... Fewer programs
 - Develop your own methods

Key Take-Away

- Many other resources available to review in support to weight estimates and analysis
- Challenges on data base information... need to consider same level of maturity
- Would recommend this course to anyone who needs to create reporting for aircraft or to evaluate weight related design parameters

References for further reading

- SAWE Journal Vol 37 No 3 April 1978 – Quick MP Estimating Relationships
- SAWE Book – Introduction to Aircraft Weight Engineering
- Roskam – Airplane Design Part V Chapter 8 and 10
- SAWE Papers 78, 78A, 2459, 3006
- For Risk SAWE Paper 3415 and also included in RP7 Course



TRAINING – SAWE Aircraft Weight Estimating and use of SAWE RP-08 (cont'd)

SAWE Recommended Practice 8 (RP-8)

Weight and Balance Data Reporting Forms for Aircraft

- The purpose of the RP8 is to provide a standard structure for reporting the aircraft weight breakdown
 - Specifically required for US military contracts as the standard for regular monthly reporting....and has been used for many commercial aircraft at least as assigned coding.
 - Replacement for last MIL-STD-1374A issued 1977
 - There is work being done to update this standard
 - Full report includes geometry and design data
 - There is a level of reporting for structural increments

Key Take-Away

- Good guiding statements on roll up of weights by function
- Much is still subject to interpretation
- Primary function is to put data into a standard call out format
- Reporting for structural increments, geometry and design data not generally applied

References for further reading

- SAWE RP8
- SAWE Paper 3030 – Changes from MIL-STD-1374A to RP* and RP8A



Opening Session
Monday, May 19, 2014
8:00 a.m.
RENAISSANCE V



Speaker: Roberto Ramirez, P.E.
Space Shuttle Endeavor Transport Project

Roberto Ramirez, P.E., is a Senior Project Manager with Cordoba Corporation, a premier civil engineering, construction management, program management, and transportation planning firm. In 2012, he was recognized by Engineering News-Record as one of the Top 25 Newsmakers of the year for his work in successfully delivering the Space Shuttle Endeavour to its new home at the California Science Center. As Senior Project

Manager, Ramirez worked in collaboration with over a dozen agencies throughout the 18-month planning process for the shuttle's transport. On the day of the move, he worked around the clock to assure the shuttle arrived safely and without incident. Ramirez was responsible for verification of the transport route, as well as identifying and coordinating all of the temporary clearance work needed along the 12-mile urban corridor for the historic move.

Mr. Ramirez will open our conference with a presentation about the Space Shuttle Endeavor Transport Project which involved moving Space Shuttle Endeavor along a 12-mile route from LAX to its current home at the California Science Center and also discuss future plans for the Endeavor display.



Day 1 – Opening Session (Cont'd)



Technical Tracks



Werner Massinger
AIRBUS Defence & Space

Monday, May 19, 2014
9:50 a.m. – 5:10 p.m.
PLENARY SESSION TECHNICAL TRACKS
RENAISSANCE V



Patrick Mitchell
The Boeing Company



The ***Integrated Product Design*** track covers aspects of Mass Properties Engineering as they relate to optimizing a technical design, with special emphasis on software and tools that coordinate and share information across disciplines.

The ***Product Lifecycle Management*** technical track explores the issues in consideration of mass properties control at all stages of a program, from initial concept through operational maintenance in the field. The intent of this track is to give engineers means to ensure successful weight and mass properties management.

The ***Land Vehicle Technology*** track covers aspects of Mass Properties Engineering for land vehicles and systems ythat operate in a ground based environment..

The ***System Verification*** track covers aspects of Mass Properties Engineering as they relate to the actual measurement and determination of mass properties data.

Two complete days of plenary sessions will give us very good opportunities to explore the latest state of the art in our disciplines.



Day 1 – Technical Tracks/Papers

Time	Presentation	Time	Presentation
9:50 -10:20	3629 <i>Mysterious Art of Weight Estimation of Large Civil Aircraft</i> - Judi Cheeseman, Airbus	2:20 - 2:50	3612 <i>Measurement of the Mass Properties of a Light Aircraft</i> - P.Apollonio, SmartMechanical_Company, Italy M.Gobbi, G.Mastinu, G.Previati, Politecnico di Milano (Technical University), Italy
10:20 - 10:40	Vendor Presentation: ALTAIR Engineering Vendor Presentation: The Boeing Company	2:50 - 3:20	Coffee Break
10:40 - 11:10	3618 <i>Building SAWE Capability as an ANSI Accredited Standards Developer</i> - Jeff Cerro, NASA	3:20 - 3:50	3613 <i>Development of a Conceptual Flight Vehicle Design Weight Estimation Library and Documentation</i> - Andrew S. Walker, Graduate Student, University of Texas at Arlington
11:10 - 11:30	Vendor Presentation: i.e. Solutions Vendor Presentation: AIRBUS	3:50 - 4:10	Vendor Presentation: Intercomp Vendor Presentation: Northrop Grumman
11:30 - 12:00	3615 <i>Application of a Flexible Wing Modeling and Physical Mass Estimation System for Early Aircraft Design Stages</i> - Felix Dorbath, German Aerospace Center (DLR)	4:10 - 4:40	3630 <i>Design Patterns in Object Oriented Programming</i> - Sal Rosal, Northrop Grumman
12:00 - 1:30	Lunch	4:40 - 5:10	3622 <i>How to Implement the Special Requirements for Managing Mass Properties in Transportation industries</i> - Claudia Rosenberger, usb GmbH
1:30 - 2:00	3614 <i>A Method for Assessing Mass Data Quality Throughout the Product Development Process</i> - Parviz Haghdoost, VEME Engineer		
2:00 - 2:20	Vendor Presentation: GEC Vendor Presentation: Huntington-Ingalls Industries		



Day 3 – Technical Tracks/Papers

Technical Tracks



Werner Massinger
AIRBUS Defence & Space

Wednesday, May 21, 2014
8 a.m. – 10 a.m.
TECHNICAL FORUM
RENAISSANCE V



Patrick Mitchell
The Boeing Company

THE ROLE OF MASS PROPERTIES ENGINEERING



Miguel Mascaray
SAWE VP Technical Director



Robert Zimmerman
SAWE International President

Time	Presentation
8:00 - 10:00	<p><i>Why Mass Properties Engineers Matter</i> - Robert Zimmerman, SAWE International President</p> <p>Followed by an Open Debate on the role of Mass Properties Engineering in the Product Design Cycle</p>



Day 3 – Technical Tracks/Papers (Cont'd)

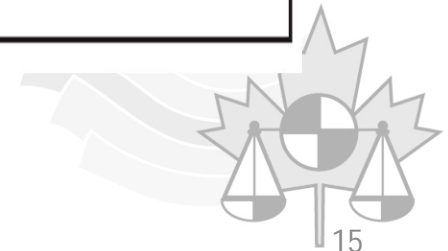
PLENARY SESSION I
10:40 a.m. – 12:00 p.m.
RENAISSANCE V

Time	Presentation
10:40 - 11:10	3616 <i>Methodology for Lightweight Design of Stiffened Skin in Advanced Aerospace Structures</i> - August Noevere, Student, Georgia Institute of Technology
11:10 - 11:30	Vendor Presentation: <i>usb GmbH</i> Vendor Presentation: <i>Space Electronics</i>
11:30 - 12:00	3620 <i>Inertia Uncertainty Coordinate Transformation</i> - Adam Tahir and John Nakai, The Aerospace Corporation
12:00 - 1:30	Lunch

PLENARY SESSION II
1:30 p.m. – 5:30 p.m.
RENAISSANCE IV

Time	Presentation
1:30 - 2:00	3627 <i>Multifidelity and Parametric Overall AC Mass Model: Fit for Purpose Mass Models for Overall Aircraft Design</i> - A. Rodriguez, S. Lanzan, Airbus
2:00 - 2:20	Vendor Presentation: <i>Textron</i> Vendor Presentation: <i>Stanley Vidmar</i>

Time	Presentation
2:20 - 2:50	3628 <i>Control Surfaces – Mass Properties and Control</i> - R.Zawadzki, J. San Pedro, Airbus
2:50 - 3:30	Coffee Break
3:30 - 4:00	3623 <i>Special Requirements for Managing Mass Properties in Rail Transportation</i> - Kirstin Toepfer, Bombardier
4:00 - 4:30	3624 <i>A Unique Method of Measuring Moments of Inertia and Centre of Gravity</i> - James Watson, Cranfield Impact Centre
4:30 - 5:00	3626 <i>Beyond Quasi-Analytical Methods for Structural Weight Estimation of Lifting surfaces</i> - Ali Elham, University of Delft
5:00 - 5:30	Technical Presentation <i>The Power of Relationships: How a Relational Database Can Enhance Your Data Management</i> - Jerry Fleck, i-e Solutions



Day 1 and 3 – Technical Tracks/Papers (Overview and Notes)

Key Take Away on Papers

- Focus was on papers related to weight estimation
- Many of the details resounded the discussion in the estimating course
- Special caution on derivative aircraft versus new design as must ensure to apply correct physics on the change and often more stringent on cost
- Multi-disciplinary optimization is new.... NO STATICS
- Weight control needs to start early as design freedom reduces as time progresses
- Extremely important to apply physics based methods that include the weight drivers

The Role of Mass Properties Engineering

- For more experienced, it was about doing the weight and balance tracking and supporting the trade study efforts to maintain good control and taking the opportunity to draw on the knowledge of new material and processes to make a lighter and more efficient product.
- For the new Mass Properties Engineers, it was about finding the resources and experience needed as guidance to perform a reporting function that they may not have done before.



AIRLINE AFFAIRS WORKSHOP

RENAISSANCE III



John Craig
Airbus



Rob Gilchrist
The Boeing Company



Jag Grewal
British Airways

The Airline Affairs workshop seeks to engage airlines in the important technical area of mass properties. It will provide the opportunity for airlines and aircraft manufacturers to engage in dialogue on weight and balance issues of common interest.

A major topic of discussion at this workshop will be the discussion of a consensus response to the Federal Aviation Administration’s (FAA) draft Advisory Circular (AC) 120-27F “Aircraft Weight & Balance Control” published for comment on November 7, 2013. The emphasis of this revision was to eliminate the standard crew, passenger, and baggage weights from the existing AC, and to require the airlines to establish these weights with individual and discrete airline surveys. The SAWE volunteered to lead an industry solution in the establishment of these weights, in lieu of surveys by each US airline.



Day 2 – Airline Affairs Workshop (Cont'd)

At this year's Airline Affairs session, Lyle Gillman will lead a discussion about the draft AC120-27F. He will present:

- 1) Where have we been?
 - a. An historical look at the AC120-27 and SAWE's role in the past revisions
 - b. Discussions from the meeting in Texas in Nov 2013 where the FAA introduced the draft AC120-27F
 - c. A copy of the draft AC120-27F
 - d. Responses to draft AC120-27F (including the SAWE response, the A4A response, and the Boeing response) to the draft AC120-27F
- 2) Where are we now?
 - a. Waiting for the FAA reaction to the comments received
 - b. JAR Ops equivalent actions and reactions
- 3) Where are we going?
 - a. What happens if SAWE is part of an industry solution to the determination of standard crew, passenger, and baggage weights?
 - b. How does SAWE lead this project?
 - c. Who is the leader?
 - d. How do we ensure the standard gathering of quality data?
 - e. Who does the survey and who gathers the data?
 - f. How do we encourage airline participation in the SAWE and the survey work?
 - g. How is this all paid for?
 - h. How do we document the results? It would be appropriate to make this an ANSI standard.
 - i. What is the future for subsequent work on standard crew, passenger, and baggage weights?

We will also discuss current and future standards development opportunities for the commercial airline industry. This is an open forum for all attendees so please bring your own discussion items. We invite and welcome all participants.



Day 2 – Airline Affairs Workshop (Attendees)

Name	Company
Jag Grewal	British Airways
John Craig	Airbus
Paul Link	Virgin America
Charles Ostick	Alaska Airlines
Nathan Hewitt	Gulfstream
Robert Hargrave	Bombardier
Thomas Greiner	Gulfstream
Robert Kelbe	Cirrus Aircraft
Clint Bower	Intercomp
Pat Mitchell	Boeing
George Lindberg	GEC
Sven Lanzas	Airbus
Liz Cercado	Boeing
Patrick Brown	
Bill Campisteguy	Boeing
Michel Heese	KLM
Kristine Henning	Delta Airlines
Aaron Klein	Boeing
Robert McIntosh	Boeing
Lyle Gillman	Boeing
Robert Gilchrist	Boeing
Farid Farizy	Gulfstream



Day 2 – Airline Affairs Workshop (Overview and Notes)

Airlines Affairs

- Good discussion with representation of number of OEM and airline representation within the Room
- Primary focus was on the FAA proposed update of AC 120-27F
- Document previously included 3 methods to determine weights for Crew, bags and passengers either by actual measurement, statistical or using standard weights. This update removed the standard weights.
- Amongst group in room, there had been multiple discussions with FAA on this topic
- Specific reason for change was not explained
- Based on working group effort started last fall, SAWE International had proposed to FAA that they were prepared to look at creating standard weight reference
- Presently awaiting response from FAA
- Much of workshop was spent on looking at what would be required for SAWE to undertake the effort of creating a standard weights and what would be needed to meet the challenge.
- if passenger surveys were required, cooperation with the airlines would be beneficial and likely required.

Next steps

- On June 11, 2014, SAWE learned that the FAA will be updating the draft AC120-27F to use ...“the latest NHANES Data for standard <passenger> weights, the other options will also still remain the same. Once the changes have been completed it will go out for public comment again.”.
- Will pick up on review when drafted document is available
- Do lunch and learn type presentation on impact of these weight standards



Day 1 to 3 – The Complete General Schedule

General Schedule		
Friday, May 16, 2014		
5PM - 11:30PM	Hospitality Suite*	Roselli (3rd Floor)
Saturday, May 17, 2014		
7AM - 5PM	Registration Desk	2nd Floor Vestibule
8AM - 5PM	Board of Directors Meeting (Breakfast/Lunch/Breaks Included)	Naples I & II First Floor
8AM - 5PM	SAWE RP7: Mass Properties Management and Control for Military Aircraft - Dudley Cate	Sicilian A
8AM - 5PM	Measurement of Mass Properties - Jerry Pierson	Sicilian B
10AM - 10:30AM	Morning Break	Sicilian A & B
12PM - 1PM	Lunch	Instructor Choice
3PM - 3:30PM	Afternoon Break	Sicilian A & B
5PM - ???	Los Angeles Angels Baseball	Hotel Lobby
6PM - 11:30PM	Hospitality Suite	Roselli (3rd Floor)
Sunday, May 18, 2014		
7AM - 6PM	Registration Desk	2nd Floor Vestibule
8AM - 5PM	Aircraft Weight Estimating and SAWE RP8: Weight & Balance Reporting Forms for Aircraft - Dudley Cate	Renaissance III
8AM - 5PM	Principles of Weight Management and Weight Estimating Methods for the Offshore Oil Industry - Dave Bennett	Sicilian A
8AM - 5PM	Aircraft Weight and Balance - Tom Oole	Sicilian B
9:15AM - 4PM	California Science Center	Hotel Lobby
10AM - 10:30AM	Morning Break	2nd Floor Vestibule
10AM - 4PM	Exhibitor Set-up	Renaissance I & II
12PM - 1PM	Lunch	Instructor Choice
3PM - 3:30PM	Afternoon Break	2nd Floor Vestibule
6PM - 9PM	Welcome Reception	2nd Floor Foyer
9PM - 11:30PM	Hospitality Suite	Roselli (3rd Floor)

General Schedule		
Monday, May 19, 2014		
7AM - 5PM	Registration Desk	2nd Floor Vestibule
7AM - 9AM	Coffee Service	Renaissance V
8AM - 9AM	Opening Session Guest Speaker-Roberto Ramirez	Renaissance V
8AM - 12PM	Aircraft Weight & Balance (Day 2) - Tom Oole	Offsite
9AM - 5PM	Exhibitor Displays	Renaissance I & II
9AM - 9:50AM	Morning Break	Renaissance I & II
9:15AM - 5PM	SHIPWEIGHT User Group	Sicilian A
9:30AM - 3:30PM	Wayfarer's Chapel and Ports 'O Call Village	Hotel Lobby
9:50AM - 12PM	Plenary Session I	Renaissance V
12PM - 1:30PM	Corporate Partner Meeting	Sicilian B
12PM - 1:30PM	Lunch Break	
1:30PM - 5:10PM	Plenary Session II	Renaissance V
1:30PM - 5PM	Flight Technology - Unmanned & Space	Renaissance III
2:50PM - 3:20PM	Afternoon Break	Renaissance I & II
4PM - 5PM	Officers One-on-One Meeting	Roselli (3rd Floor)
5:15PM - 10:00PM	Medieval Times	Hotel Lobby
Closed	Hospitality Suite	Roselli (3rd Floor)
Tuesday, May 20, 2014		
7AM - 5PM	Registration Desk	2nd Floor Vestibule
7AM - 9AM	Coffee Service	Renaissance I & II
8AM - 5PM	Exhibitor Displays	Renaissance I & II
8AM - 5PM	AWBS Training - Harold Smoot	Sicilian B
8AM - 5PM	Ship Inclining - William Fox	Sicilian A
8AM - 10AM	Technical Forum: The Role of Mass Properties Engineering	Renaissance V
9:30AM - 3:30PM	CSULE Japanese Gardens and Gondola Cruise	Hotel Lobby
10AM - 10:40AM	Morning Break	Renaissance I & II
10:40AM - 12PM	Plenary Session I	Renaissance V
12PM - 1:30PM	Lunch	
1:30PM - 5:30PM	Plenary Session II	Renaissance IV
1:30PM - 5:10PM	Marine Systems Design and Offshore Track	Renaissance III
1:30PM - 5PM	Exhibitor Teardown	Renaissance I & II
2:50PM - 3:30PM	Afternoon Break	Renaissance I & II
3:30PM - 5PM	Lessons Learned Meeting	Corsican
6PM - 7PM	Social Hour and Silent Auction	2nd Floor Foyer
7PM - 10PM	Awards Banquet	Renaissance V
10PM - 12AM	Hospitality Suite	Roselli (3rd Floor)
12PM - 1:30PM	SPC Luncheon Guest Speaker: David Davis	2nd Floor Foyer

General Schedule		
Tuesday, May 20, 2014		
1:30AM - 4PM	SPC - Breakout Workshops	
	Marine Systems	Corsican
	Airline Affairs	Renaissance III
	Missiles & Space Systems	Sicilian B
	Offshore Industry	Capri
	Military Aircraft	Renaissance IV
	Aviation Wt Report Template	Sicilian A
4PM - 4:30PM	Afternoon Break	Renaissance I & II
4:30PM - 5PM	SPC Joint Session	Renaissance V
6PM - 11:30PM	Hospitality Suite	Roselli (3rd Floor)
Wednesday, May 21, 2014		
7AM - 5PM	Registration Desk	2nd Floor Vestibule
7AM - 9AM	Coffee Service	Renaissance I & II
8AM - 5PM	Exhibitor Displays	Renaissance I & II
8AM - 5PM	AWBS Training - Harold Smoot	Sicilian B
8AM - 5PM	Ship Inclining - William Fox	Sicilian A
8AM - 10AM	Technical Forum: The Role of Mass Properties Engineering	Renaissance V
9:30AM - 3:30PM	CSULE Japanese Gardens and Gondola Cruise	Hotel Lobby
10AM - 10:40AM	Morning Break	Renaissance I & II
10:40AM - 12PM	Plenary Session I	Renaissance V
12PM - 1:30PM	Lunch	
1:30PM - 5:30PM	Plenary Session II	Renaissance IV
1:30PM - 5:10PM	Marine Systems Design and Offshore Track	Renaissance III
1:30PM - 5PM	Exhibitor Teardown	Renaissance I & II
2:50PM - 3:30PM	Afternoon Break	Renaissance I & II
3:30PM - 5PM	Lessons Learned Meeting	Corsican
6PM - 7PM	Social Hour and Silent Auction	2nd Floor Foyer
7PM - 10PM	Awards Banquet	Renaissance V
10PM - 12AM	Hospitality Suite	Roselli (3rd Floor)
Thursday, May 22, 2014		
9:30AM - 1PM	Battleship Iowa	Hotel Lobby

sawe.org → Conferences → Previous Conferences





Q&A

