AN INTRODUCTION TO ORCAFLEX

Training Course Syllabus

OrcaFlex Introductory Training Course

The course assumes no prior experience with the software and is organised as a series of lectures and practical sessions each lasting typically 1½ hours to 2 hours.

1. Day 1

Introductions and welcome to course. Explain that course is intended to be 'hands on' and encourage trainees to follow the trainers actions throughout.

1.1. Session 1: Introduction To OrcaFlex

a) Establish backgrounds and areas of interest. *Group discussion*

b) Reasons for doing dynamic analysis. *Group discussion*
The difference between static and dynamic analysis.

c) Show some OrcaFlex examples. *Tutor*
A02 (LWR), A08 (Pliant S), B01 (HRT),
B02 (Releasable Turret), D04 (TLP),
E01 (TCMS),
F02 (Chinese Lantern), K02 (Zip wire).

d) Do OrcaFlex tutorial. *Group work*

- Show how to find tutorial.
  (general description of first figure / menu, toolbar and shortcut keys)
- Setting up a simple model (catenary line + vessel)
- Statics (Tables, Range Graphs))
- Dynamics (replay: control & view parameters)
- Dynamic results (Time Histories, Range Graphs, X-Y Graphs, Linked Statistics)
- Using live results and interrupting simulations
- Axis systems (global & local)
- Copy / paste & exporting to file (views, graphs & tables)

e) Model browser, data forms, right click, default data and Help (F1). *Tutor*

***** BREAK *****

1.2. Session 2: Lines and Line Properties Wizard

a) Line theory (nodes and segments)	*Tutor*
b) Connections, end conditions and end angles	*Tutor + Group work*
c) Sections, segmentation, line properties (line type wizard & right click).	*Tutor*
d) Lazy wave using smeared buoyancy & setting line contents	*Worked example (Tutor & Group work)*
e) Lazy wave with discrete buoyancy using line attachments	*Worked example (Tutor & Group work)*
f) Torsion (where appropriate, run-time & data implications)	*Tutor*
g) Clashing: contact properties, enabling, hammer & anvil example, effect of contact stiffness, use of clash energy.	*Worked example (Tutor & Group work)*

***** LUNCH *****

1.3. Session 3: Links, Winches and Shapes

a) Links: *Tutor*

- Connection data (to lines and other objects)
- Linear spring (no compression)
- Non-linear spring-damper (supports compression)
- Link connecting lines & Link results — *Worked example (Tutor + Group work))*

b) Winches: *)*

- Connection data (to lines and other objects) — *Tutor*
- Winch control (length or tension) — *Tutor*
- Pull-in to a specific point & Winch results — *Worked example (Tutor + Group work))*

c) Shapes

- Elastic solids / trapped water - applications — *Tutor*
- Options, connections, geometry, contact stiffness — *Tutor*
- Line interacting with elastic solid (catenary over cylinder). Nodal interaction and 'locking' — *Worked example (Tutor + Group work)*

***** BREAK *****

1.4. Session 4: The Environment

a) Sea properties — Tutor

- Reynolds number (viscosity, temp & formulations)
- Density (constant & spatially varying)

b) Seabed: — Tutor

- Types of seabed (flat, profile, 3D), origins & directions
- Contact stiffness and damping
- 2D / 3D interpolation methods

c) Current: — Tutor

- Interpolated data: profile and ref speed & direction
- Use of variable data
- Power Law data
- Multiple current data sets
- Exclude from statics
- Vary horizontally

d) Wind: — Tutor

- Wind type options (constants, spectral & time history)
- Which objects affected

e) Waves: — Tutor

- Regular and random (different wave types)
- Wave height, period and direction
- Wave preview (for random waves)
- Multiple wave trains
- Wave example: — Worked example (Tutor and Group)

1.5. Session 5: Worked Example (8 point mooring system)and Q&A

a) Vessel + 8 pt mooring example — Worked example (Tutor and Group)

- Line setup wizard
- Duplicate line
- All-objects data form (polar / cartesian coords)
- Lay azimuth (as laid direction)
- Grouping objects (create, duplicate, move & locate)
- Library facilities
- Save model for start of next session

b) Questions & Answers: (covering today's topics) — Group discussion

2. Day 2

Brief review of yesterday's work and introduction to Day 2.

2.1. Session 6: Vessels and Buoys

a) Overview: *Tutor*

- Vessels and vessel types
- 3 frequency regimes (zero, wave, low)
- Imposed and calculated options.

b) Vessels: *Tutor*

- Position, heading etc.
- Statics, primary & secondary motion
- Imposed motions (prescribed, harmonic, time history, displacement RAOs)
- Calculated motions (3DoF, 6DoF, included load effects)
- 8 pt mooring model example *Worked example (Tutor and Group)*

c) Vessel types: *Tutor*

- Structure and conventions
- Hydro & wind drag
- RAOs (disp. & load), hydrostatic stiffness, added mass and damping
- Wave drift (low freq. – QTFs)
- Hydro data import
- RAOs: conventions and checks *Tutor and Group*
- Drawing (wire frame / shaded / origin for draught)

d) 3D Buoys: *Tutor and Group*

- Draw parallel with data for clump attachments

- Irrotational example

e) 6D Buoys: *Tutor and Group*

- Degrees of freedom included
- Type (Lumped / Spar / Towed Fish)
- Lumped properties (ie no geometric description entered)
- Distributed properties (ie, geometry described)
- Indeterminate case example (infinite rotational solutions)

f) Wings, applied loads, buoys as attachments (torsion) *Tutor*

2.2. Session 7: Statics, the General data Form and Dynamics

a) Statics overview: (i) lines only and (ii) lines connected to other free objects. *Tutor*

b) Statics of Lines only: Tutor and Group

- Step 1 (Quick, Catenary, Prescribed, Spline, User Defined): Starting point for Step 2
- Step 2 Full statics adds all relevant loads

c) Statics of lines connected to other free objects: Tutor and Group

- Two options: Separate Buoy and Line and Whole System Statics.
- Degrees of freedom included (Buoy and Vessels)
- Use Calculated Positions
- Convergence parameters (Tolerance / Minimum Damping)
- Worked example: Two lines & 6D Buoy Worked Example (Tutor and Group)
- Starting velocity Tutor

d) The General Data Form

- Comment field
- Units

- Stages, ramping, log intervals, peak logging, extending simulation

e) Selecting integration method - overview

- Iterative vs. non-iterative
- Conditional and un-conditional stability
- Accuracy & time step sensitivity studies

f) Implicit

- General applications
- Setting timesteps
- Constant and variable step options
- HF dissipation

g) Explicit

- Inner and outer timesteps
- OrcaFlex recommended values for timestep (shortest natural nodal period)

***** BREAK *****

2.3. Session 8: How To Use OrcaFlex Efficiently

a) QA checks of models — Tutor and Group

- Mesh sensitivity
- Time history (steady dynamics)
- Movement at anchor (terminated model to soon)
- Compression (Euler buckling)
- File Compare

b) Automation (OrcaFlex Spreadsheet) — Tutor and Group

- Script Table (batch scripts and auto-script generation)
- Instructions sheet .
- Duplicate Instructions
- Worked example

***** LUNCH *****

2.4. Session 9: Other Uses of OrcaFlex

a) Modal analysis (resonance problems) — Tutor
b) Fatigue analysis (and wave scatter conversion) — Tutor
c) External functions and the dll — Tutor
d) VIV analysis — Tutor

***** BREAK *****

2.5. Session 10: Review, Questions and Worked Example

a) Review of What You Should Know.

b) Worked examples, or trainees own project models, and general discussion time.