DynaWeld Feature and Capability

DynaWeld from 23.06.2018

DynaWeld is a pre-processor and simulation environment for finite element application on
- Welding
- Heat Treatment
- Forming

and allows an efficient setup of high sofisticated simulation models for single or multiple manufacturing steps with in the assembly of components.

Languages:
German
English

Supported solvers / FE-codes:
- LS-DYNA

Requested software aditionally to perform entire simulation:
- MS-Excel or Libre office
- Meshing software
- LS-PrePost

DynaWeld spreadsheet fomat:
EU-format with float separator comma and field separator semicolon
UK-format with float separator point and field separator coma
Both formats can be converted vice versa.

Simulation capabilities of DynaWeld:

Materials
Aluminium and aluminium alloys
Steel and steel alloys
Nickel and nickel alloys
Copper
other metals
Glass

Welding processes
Arc welding: GMAW, SAW, TIG
Laser welding
Electron beam welding
GMAW/Laser-Hybrid welding
Resistance Welding
Resistance Spot Welding
Brazing
tack welding, single pass welding, multi pass welding
single robot welding,

multiple robot welding

Heat Treatment processes
Pre heating
Quenching
Tempering
Press hardening

Forming / Tooling (Clamps)
forming processes
clamp closing
clamps with displacement driven kinetic
clamps with force driven kinetic
prestress
predeformation
Grinding or cutting

Load
Force
Displacement
Pressure
Dead load

Porcess chain / assembly simulation
Import of initial state (dynain format)
Dublicate and prepare model for next stage within initial state, add parts or tools
Export of final state (dynain format)

Supported analyses:
thermal only analysis (Solids, Shells, 2D shells)
thermal mechanical analysis with decoupled calculation (Solids, Shells, 2D shells)
thermal mechanical analysis with coupled simulation (Solids, Shells, 2D shells)
electro-magnetic thermal mechanical analysis (joule-heating) (Solids)

DynaWeld Modules

DynaWeld Material
DynaWeld Trajectory
DynaWeld Analyse Controler with DynaWeld process input
DynaWeld Tools

DynaWeld Material

Data input or import of material data
Material data adjustment
Data extensions for welding and heat treatment
Single phase material for thermal, mechanical, and electro-magnetic analysis.
Multi phase material model for mechanical analysis.

Supported data source
- user defined data inclusive user defined cct data
- Weldware
- SysWeld
- JMatPro

Data adjustment
- adjustment of flow curves by yield and tensile stress
- extrapolation of flow curves for discrete phases from basic data
- adjustment of minimum or maximum young modulus
- Automatic calibration of CCT data
- settings for not yet deposit material (filler) or molten material
- adjust data to fixed temperature and strain scale depending on material group (steel / aluminium)

Data extension
- Latent heat for melting
- Initial plastic strain
- Additional phases (base material, liquid material, tempered phases, heat affected phases)
- Hardness calculation
- Damage evaluation criteria

Single Phase Material
mechanical, thermal, electro-mechanical material
LS-DYNA Material *MAT_CWM (*MAT_270), *MAT_CWM_THERMAL, *EM_MAT_001
- latent heat for melting
- isotropic, kinematic or mixed isotropic kinematic hardening
- initial strain
- simplified approach for phase transformation strain (alpha - gamma transformation steel)
- electrical resistivity only
- evaluation of cooling rate
- temperature constant density

Multi Phase Material
mechanical material
LS-DYNA Material *MAT_GENERALIZED_PHASE_CHANGE (*MAT_254)
- isotropic hardening
- initial strain
- multi phase with phase transformation description by generalized JMAK law and Koistinen Marburger law
- phase transformation strain
- phase transformation latent heat
- hardness
- yield evolution, elastic and plastic stress utilisation level
- temperature constant density

Display generated material and its properties in spreadsheet with diagrams.

DynaWeld Trajectory

The trajectories define the weldpathes in the model
Evaluation of trajectory lenghts
Evaluation of number of elements on trajectory
Visualisation of trajectory with start point and reference

DynaWeld Analyse Controler with process input

Model features (process input)

Welding, Weld heat source

Equivalent heat source to cover all weld processes by equivalent heat input method:

Heat sources on shell and solid with or without forced heat input per unit time
Elipsoidal heat source (Loose, Rohbrecht, Goldak, SimWeld, Mokrov)
Konical heat source (Loose, Rohbrecht)
Zylindrical heat source

Heat source on shell 2D-shell and solid surface
Elipsoidal heat source (Loose)
Rectangular heat source (Rohbrecht)

Metatransient heat source
on shell 2D shell or solid part
on surface

Geometric heat source adjustment: rotation around trajectory, lateral offset, offset in reference direction

Trajectory definition with two node sets defining trajectory and reference
Trajectory definition with one node set defining trajectory, refererence automatically adjusted normal to surface

Calibration of heat input by global kalibration factor of each weld
Calibration of heat input by time function globally or for each weld separately

Up to 1000 heat sources in one simulation model (one stage)
Multiple weld roboter

Heat treatment
Heating, quenching, air cooling, tempering
Quenching medium, function for heat convection vs. temperature
Diving, define diving direction by vector or two nodes

Heating in oven and tempering simulated by heat exchange on surface or by applied foreced temperature-time curve
Autodetect of surface of entire model or user defined quenching surface

Case hardening (carburisation) and inductive hardening (inductive heating) is not included

Time stepping

implicit, explicit or mixed implicit-explicit mechanical analysis
Timestep fine adjustment for thermal-, mechanical- and EM-solver
Automatic calculation of minimum requested time step vs. time for all solvers
Automatic or user defined time stepping for heat treatment process

Boundary conditions, loads, movements, temperatures, electrical bcs

Thermal and mechanical boundary conditions can be applied with birth and death functions. This means
bcs can be switched on at time a and switched off at time b.

thermal
Initial temperature on all nodes
Initial temperature on node sets / part of the model
Imposed temperature (trapezoidal function or user defined tabulated data)
Heat transfer to environment, convection
Heat radiation to environment

mechanical
Singel point contraints (SPC)
Displacement on nodes and rigid parts (constant, trapezoidal function or user defined tabulated data)
Force on nodes and rigid parts (constant, trapezoidal function or user defined tabulated data)
Pressure on surface (constant, trapezoidal function or user defined tabulated data)
Elastic spring (no birth death option)
Dead load (gravity)

Force, Displacement and SPC consider global or local coordinate systems
The kinematic of clamps and the kinematic for tools for forming are defined by these mechanical boundary features.

electro-mechanical
Potential (voltage) (constant, trapezoidal function or user defined tabulated data)
Isopotential
Current (ampere) (constant, trapezoidal function or user defined tabulated data)

Parts

Shells, thermal thick shell
Solids (penta, hexa, tetraeder)
2D-shell axissymmetric
2D-shell plane strain
Beams
Define of node sets, segment sets, element sets (shell, solid, beam), part sets by parts

Contact
mechanical contacts:
Friction contact (2D, 3D)
Tied contact (2D, 3D)
Welding contact (3D)
Shell edge to solid tied contact (3D)
Friction contact for all parts against all parts of one part set automatic

thermal contacts:
heat conduction contact (2D, 3D)
quasi tied contact (quasi perfect heat conduction) (2D, 3D)
Welding contact (3D)
Shell edge to solid quasi tied contact (3D)
heat conduction contact for all parts against all parts of one part set automatic
The heat conduction contact can be applied with constant heat conduction or with pressure and or temperature dependend heat conduction

Electrical contats:
Thermal and pressure dependent electric resistance contact using Jonny Kaars law.)

Simulation settings

Erase of element at discrete time (Grinding, cutting)
Static analysis
Dynamic analysis (takes mass into account)
General or selective mass scaling (explicit analysis)
General time scaling (explicit analysis)
Result export for input in next simulation step full model or part of model including temperature, deformed geometry, residual stress, phase proportion and contact status
Springback stabilisation
Output settings

Analyse controler

Clean functions:
- delete input,
- delete result
- delete stored postprocessing prints

Genereate solver input in structured folders

Generate solver input in one file
View log files for solver input generation

Electro-thermal-mechanical coupled analysis
thermal-mechanical coupled analysis
thermal-mechanical decoupled analysis (run first whole thermal then whole mechanical analysis)
thermal only analysis
mechanical only analysis (on prior calcualted thermal results)

Run simulation
view analysis log file

DynaWeld Tools

Model preparation
Dublicate model
- dublicate and prepare for next stage simulation
- dublicate for variant simulation
- dublicate for mechanical variant simulation, dublicate thermal results
Clean mesh file by delete of empty lines
Import mesh in abaqus format
Source existing LS-DYNA keyword file and prepare for DynaWeld analysis. Existing keywords which do not conflict with DynaWeld are kept in DynaWeld
Clean and merge initial mesh and keyword files

Postprocessing
Launch LSPrePost with predefined scala and DynaWeld colors
- thermal results steel scala temperature
- thermal results aluminium scala temperature
- mechanical results steel scala temperature
- mechanical results aluminium scala temperature
- mechanical results stress scala Neg-Pos
- mechanical results Phase proportion scala Pos
Launch LSPrePost with interface results (contact status)
Launch LSPRepost with user defined command file executed
Automated postprocessing of results on pathes by predefined node sets (result over path-length)
Automated postprocessing of results on nodes by predifined node sets (result over time)

Model evaluation
Evaluate heat input
Evaluate heat input averaged for each weld in case of sequence welding, not simultaneous
Grafical display of heat input
Caclulate calibration function for heat input
Evaluate results on electro-magnetic analysis

Perfomance analysis thermal and mechanical solver (iterations, steps and calculation time versus time in simulation model)

Converter
Convert all result files (*.dat) generated from LSPrePost from UK format to EU format (float separator point to coma)
Convert all csv files from UK format to EU format
Convert all csv files from EU format to UK format

Other tools
Show DynaWeld Environment variables
Switch language
Check license

System requirements

Windows compatible PC
Linux 32 bit or 64 bit
Monitor minimum resolution 1920 x 1080

Installation and Licensing

DynaWeld can be installed in single user mode (administrative rights are not required).
The software is licensed via a dongle, which is connected to a USB port.