CLAIMS

1. A method of pipeline component design comprising:

identifying input parameters and output parameters for the component design;

using a design of experiments technique to construct analytic models representing the influences of the input parameters on the output parameters;

identifying value sets for the input parameters which meet one of one or more selection criteria for at least one of the output parameters, the selection criteria comprising minimising or maximising at least one of the output parameters;

conducting finite element analysis on the identified value sets, and identifying a pipeline component design choice from results of the finite element analysis;

.wherein no convergence criteria are used in the design of experiments technique or the finite element analysis.

2. A method as claimed in claim 1, wherein the pipeline component designed by the method is a tie-in component.

3. A method as claimed in claim 2, wherein the tie-in component is a jumper.

4. A method as claimed in claim 2, wherein the tie-in component is a spoolpiece.

5. A method as claimed in any preceding claim, wherein the input parameters comprise one or more misalignment tolerances.

6. A method as claimed in claim 5, wherein the input parameters comprise one or more translational tolerances and one or more rotational tolerances.

7. A method as claimed in any preceding claim, wherein the input parameters comprise one or more soil property parameters.

8. A method as claimed in any preceding claim, wherein the analytic model comprises at least one quadratic model.

9. A method as claimed in claim 8, wherein the analytic model comprises a quadratic model for each output parameter.

10. A method as claimed in claim 8 or claim 9, wherein the analytic model comprises only terms which are constant, first or second order terms and interaction terms.

11. A method as claimed in any preceding claim wherein the design of experiments technique comprises a Box-Behnken technique, an Optimal Latin Hypercube technique or an orthogonal array technique.

12. A method as claimed in any preceding claim, wherein identifying value sets for the input parameters which minimise or maximise at least one of the output parameters comprises iterating an optimization loop for each output parameter which minimises or maximises that output parameter.

13. A method as claimed in claim 12, wherein the optimization loop uses a differentiable optimization technique.

14. A pipeline component design system comprising a computing apparatus programmed to carry out the method of any of claims 1 to 13.

15. A method of manufacturing a pipeline component, comprising designing a pipeline component according to the method of any of claims 1 to 13 or with the pipeline component design system of claim 14, and manufacturing the pipeline component in accordance with the identified pipeline component design.

16. A pipeline component manufactured according to the method of claim 15.

17. A pipeline comprising one or more pipeline components as claimed in claim 16 as tie-in components.

CLAIMS

1. A method of manufacturing a pipeline component for an underwater pipeline system, the method comprising:

identifying a plurality of input parameters and output parameters for the component design;

using a design of experiments technique to construct analytic models representing the influences of the input parameters on the output parameters;

applying the analytical models to a plurality of sets of input parameters, each set of input parameters corresponding to a possible component design, to produce a plurality of output parameters;

selecting a limited number of the possible component designs for further analysis by identifying a plurality of selected value sets for the input parameters, each selected value set meeting one of one or more selection criteria for at least one of the output parameters, the selection criteria comprising minimising or maximising at least one of the output parameters;

conducting finite element analysis on each of the plurality of identified value sets, and identifying a pipeline component design choice from results of the finite element analysis; and

manufacturing the pipeline component according to the identified component design choice.

2. A method according to Claim 1, in which the pipeline component is a tie-in component.

3. A method according to Claim 2, in which the tie-in component is a jumper.

4. A method according to Claim 2, in which the tie-in component is a spoolpiece.

5. A method according to any preceding claim, in which the input parameters comprise one or more misalignment tolerances.

6. A method according to Claim 5, in which the input parameters comprise one or more translational tolerances and one or more rotational tolerances.

7. A method according to any preceding claim, in which the input parameters comprise one or more soil property parameters.

8. A method according to any preceding claim, in which the analytic model comprises at least one quadratic model.

9. A method according to Claim 8, in which the analytic model comprises a quadratic model for each output parameter.

10. A method according to Claim 8 or 9, in which the analytic model comprises only terms which are constant, first or second order terms and interaction terms.

11. A method according to any preceding claim in which the design of experiments technique comprises a Box-Behnken technique, an Optimal Latin Hypercube technique or an orthogonal array technique.

12. A method according to any preceding claim, in which identifying value sets for the input parameters which minimise or maximise at least one of the output parameters comprises iterating an optimization loop for each output parameter which minimises or maximises that output parameter.

13. A method according to Claim 12, in which the optimization loop uses a differentiable optimization technique.

14. A pipeline component manufactured according to a method according to any preceding claim.

15. A pipeline comprising one or more pipeline components according to Claim 14 as tie-in components.