PRACTICAL GUIDELINES FOR LIFE CYCLE ASSESSMENT APPLIED TO RAILWAYS PROJECT

CONTEXT

The current transport system is not sustainable
CONTEXT

Sperling and Gordon (2009)
Wake up!!!

We are here

Peak Oil
Wake up!!!

We are here

Peak Oil

CONTEXT
CONTEXT

Grenelle (2007)
CONTEXT

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National Transport Policy
CONTEXT

Grenelle (2007)

National Transport Policy

4 000 km of High Speed Railways

Partnership RFF & IFSTTAR energy efficiency of railways investment
CONTEXT

Grenelle (2007)

National Transport Policy

4 000 km of High Speed Railways

Partnership RFF & IFSTTAR
energy efficiency of railways investment
An example
An example
An example

- Centrifugal forces
- Construction phase
  - Important cant (surperelevation, camber, cross slope)
An example

- Centrifugal forces
- Maintenance phase
  - Maintenance operation is more frequent cornering
An example

- Centrifugal forces
- Operation phase:
  - Consumption is higher cornering
  - Dedicated train: Tilting train
  - Decrease the speed: modal shift?
- Fragmentation of the habitats of animals
An example
An example

- Operation phase
- Due to overpression in tunnel
  - Decrease the speed
  - Dedicated train (long nose)
An example

- Construction phase
  - Expensive
  - GHG
An example
Practical example
CONTEXT

Partnership RFF & IFSTTAR
energy efficiency of railways investment

Construction
CONTEXT

Partnership RFF & IFSTTAR
energy efficiency of railways investment

Construction

Maintenance, Operation

Recycling
Know How (road) : Ecorce
a double track high speed railway of 400 km with travel time of 1 h 50 mn and with 40 trains per day for each track during 50 years
- Fu 1 = about 400 earthwork units composed of cut and fill; an earthwork unit is a 1 km area worked to obtain either cut or fill (subgrade soil, capping layer);
- Fu 2 = about 488 civil engineering structures including one tunnel;
- Fu 3 = about 400 km of sewer drainage system;
- Fu 4 = about 300 km of road rehabilitation;
- Fu 5 = about 400 km of railway foundation (sublayer);
- Fu 6 = about 400 km of railway equipment (ballast, sleepers, signing equipment, catenaries, substations);
- Fu 7 = about 400 km of traffic and maintenance railway.
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FU1

A double track high speed railway of 400 km with travel time of 1 h 50 min and with 40 trains per day for each track during 50 years.

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Fu 1: Earthwork

- Earth movement
- Railroad track design 1
- Railroad track design 2
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Fu 5: Railway structure

- Maintenance scenario
- Traffic
- Scenario type 1: Rails, Sleepers, Ballast, Untreated graded aggregate: 20 cm, Sublayer, Thickness: 35 cm, Capping layer, Thickness: 10 cm
- Scenario type 2: Rails, Sleepers, Ballast, Bitumen-bound graded aggregate: 14 cm

Fixed parameters

Earthwork movement changed
FUNCTIONAL UNIT

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FU 7 : methodology

Consumption model based on a mechanical model

\[-kM \cdot \gamma = F_j - R - M \cdot g \cdot \sin(\alpha)\]

\[R = A + B \cdot V + C \cdot V^2\]
FU 7 : Model Validation
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Graph showing estimated and measured power over distance.
Conclusion

Economical and environmental constraints on the current transport system
=> railways investments which have to be evaluated from a LCA Point of View

Construction phase:
Earthwork: energy spent due to earthmoving
Structure: classical vs bitumen bound aggregates

Operation phase:
Electrical consumption due to the traffic

Final goal: global comparison of different projects including different techniques of construction and different geometries for different criteria
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