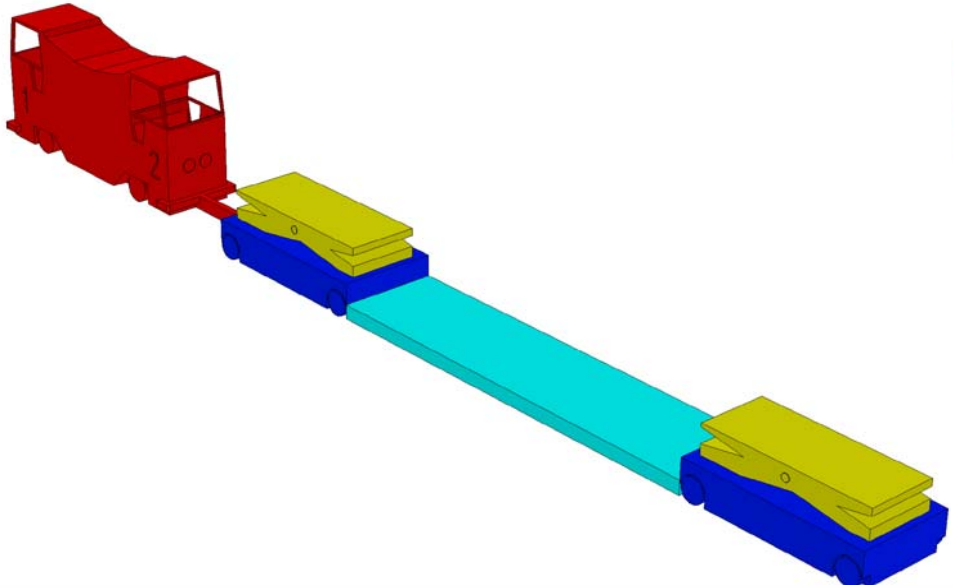
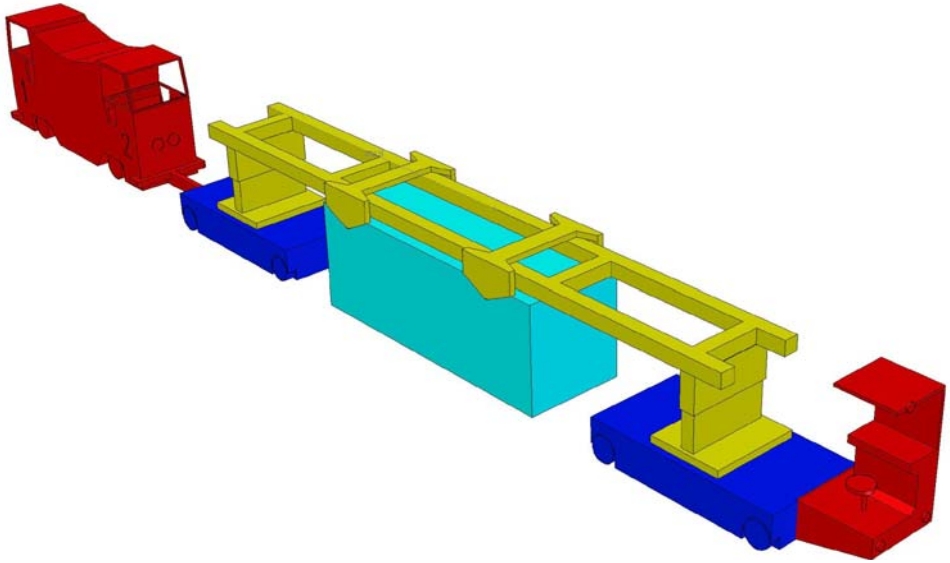
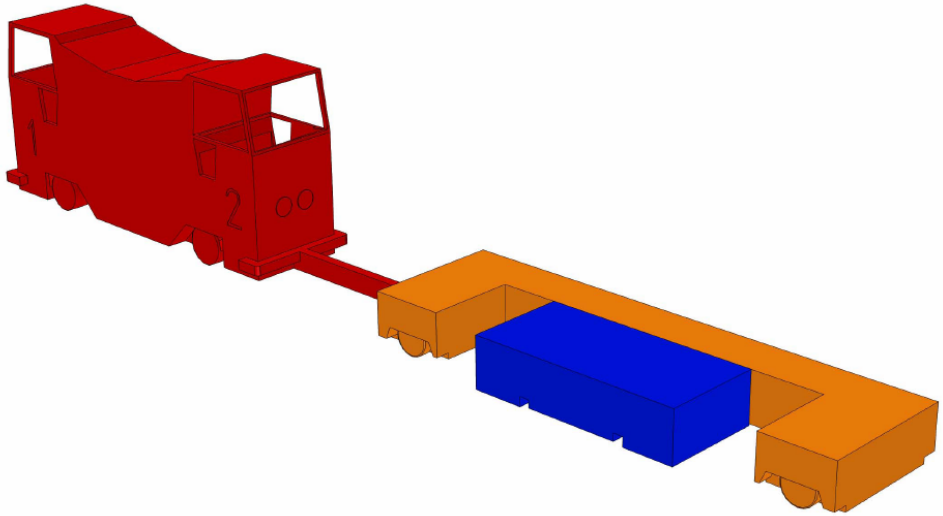
XFEL

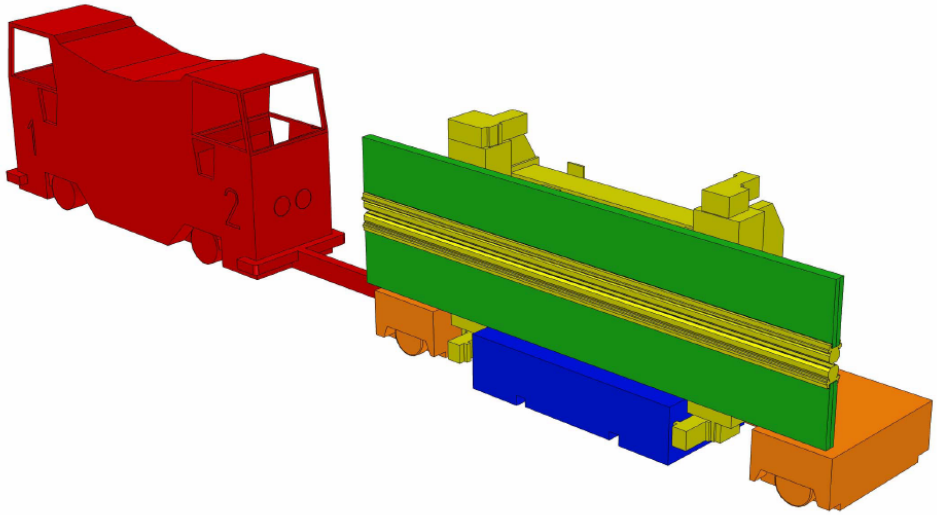
X-Ray Free-Electron Laser

Underground Transport









What do we have to transport/install?
In Linac tunnel (XTL) after the floor is installed:

- Floor plates
- Cable trays
- Water/Air/Helium pipes
- Cables
- Mounts for modules (240)
- Modules (4 + 116)
- Waveguide distribution (4 + 116)
- Mounts for string connection box (22)
- String connection box (11)
- Mounts for String end box (4)
- String end box (4)
- Mounts nc. Magnets
- Nc. Magnets
- Beam pipes

- Klystrons (29)
- Pulse Transformer (29)
- Matching network (29)
- Wave guide interface (29)
- Electronic racks (a lot)
- Rack shielding (a lot)

- Different small parts

- And the forgotten things!

What do we have to transport/install?

In the Undulator/Photon tunnels (XTDn):

- Cable trays
- Water/Air pipes
- Cables
- Undulators (119)
- Supports in-between Undulators (~119)
- Magnets/monitors etc. in-between Undulators
- Nc. Magnets
- Supports for Nc. Magnets
- Beam pipes
- Electronic racks
- Dumps
- Shielding
- Support for photon optics
- Photon optics
- Different small parts

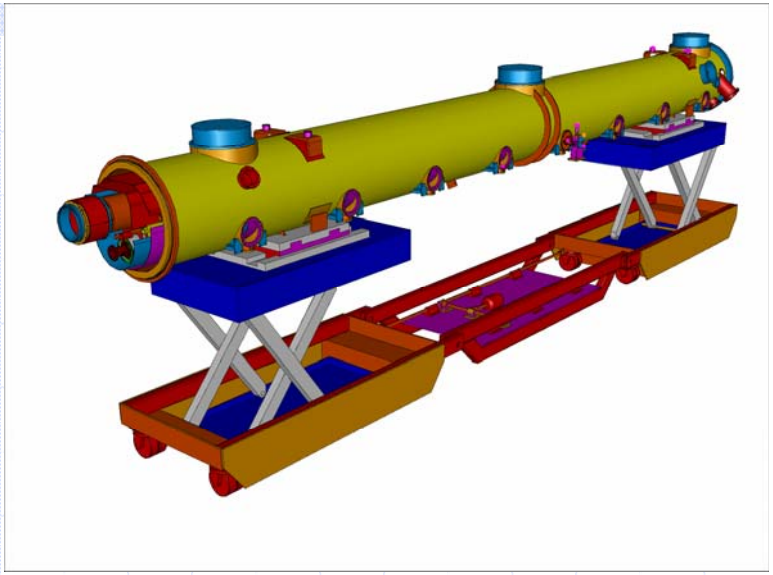
What is missing?

How to transport and install all this?

1. Standard Vehicles
   - Fork lift
   - Tractors with trailers or wheels attached to the components
   - BUT space is limited.
   - How to get the (heavy) load from the walk way to the final position in a controlled way?
   - Especially if this needs to be done very accurately and/or very often or "fast".
2. Special vehicles
   - A lot of possibilities!
   - Nearly everybody has ideas and feeling about it.

   - We developed a first concept, then we look at CERN, talked to possible vendors, revisited the concept and wrote a specification.

Module transport system



We started with then biggest component.

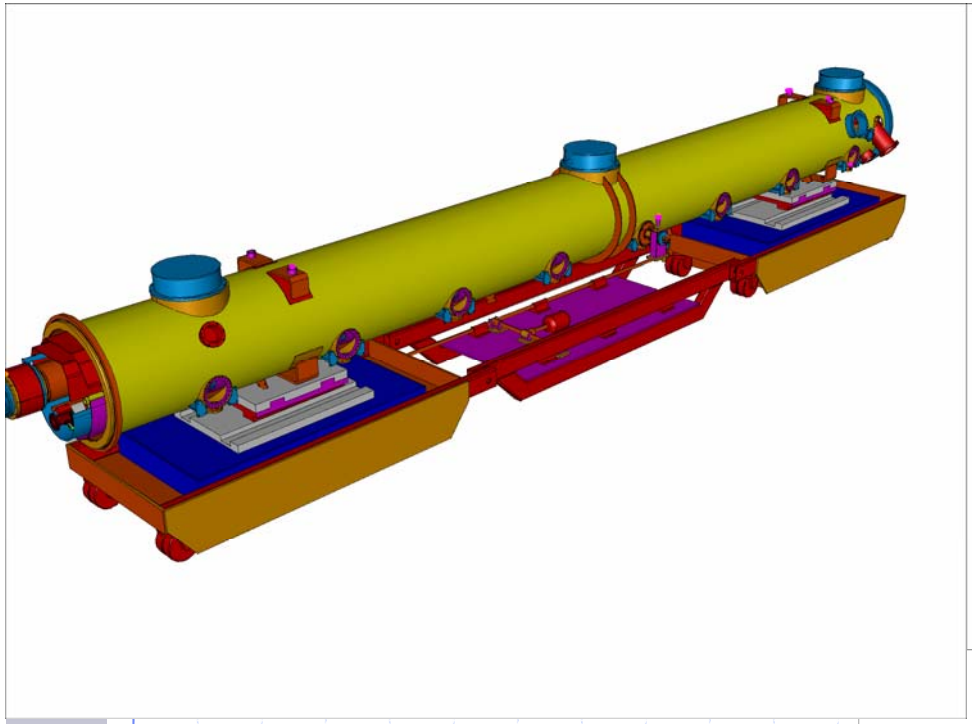
Suggestion/assumptions:

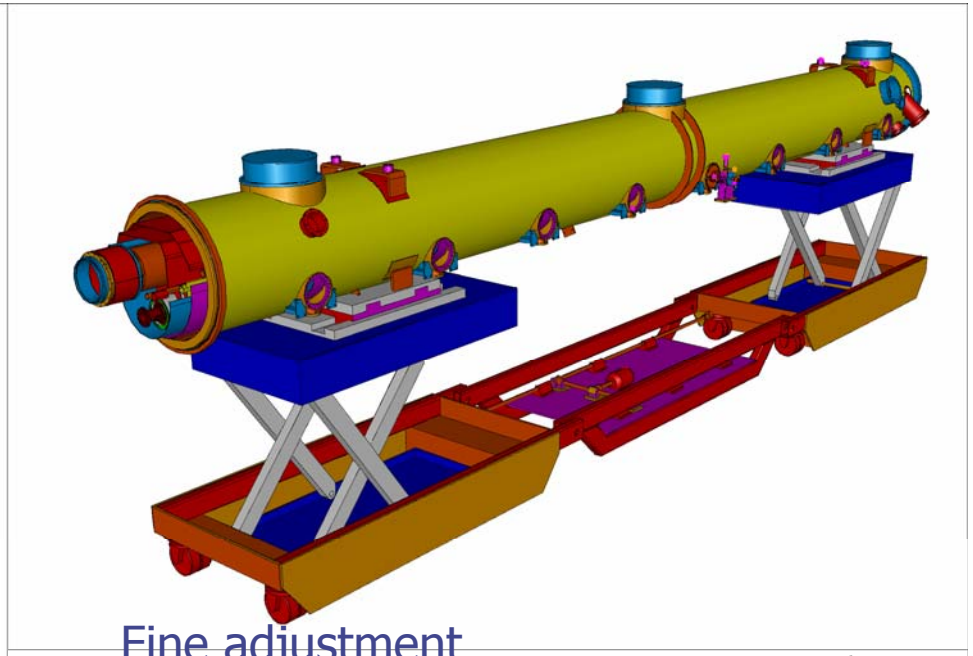
- Vehicle does transport and installation (like the HERA tram, the "dwarslöper" or the "boogies" at CERN)
- To lift 10t about 1m scissor lift tables are the only reasonable compact solution (≥2,5m x 1m x 41cm (h)).
  (Pure hydraulic cylinder can not take transverse forces!)
- There is no space to lift the module in the walk way position and 'roll' it over to the installation position!

➔ Vehicle transports the module to the installation place, turns its wheels by 90° and moves under the final position and lifts it up.

➔ Holes in the floor plates are not allowed at the wheel positions!

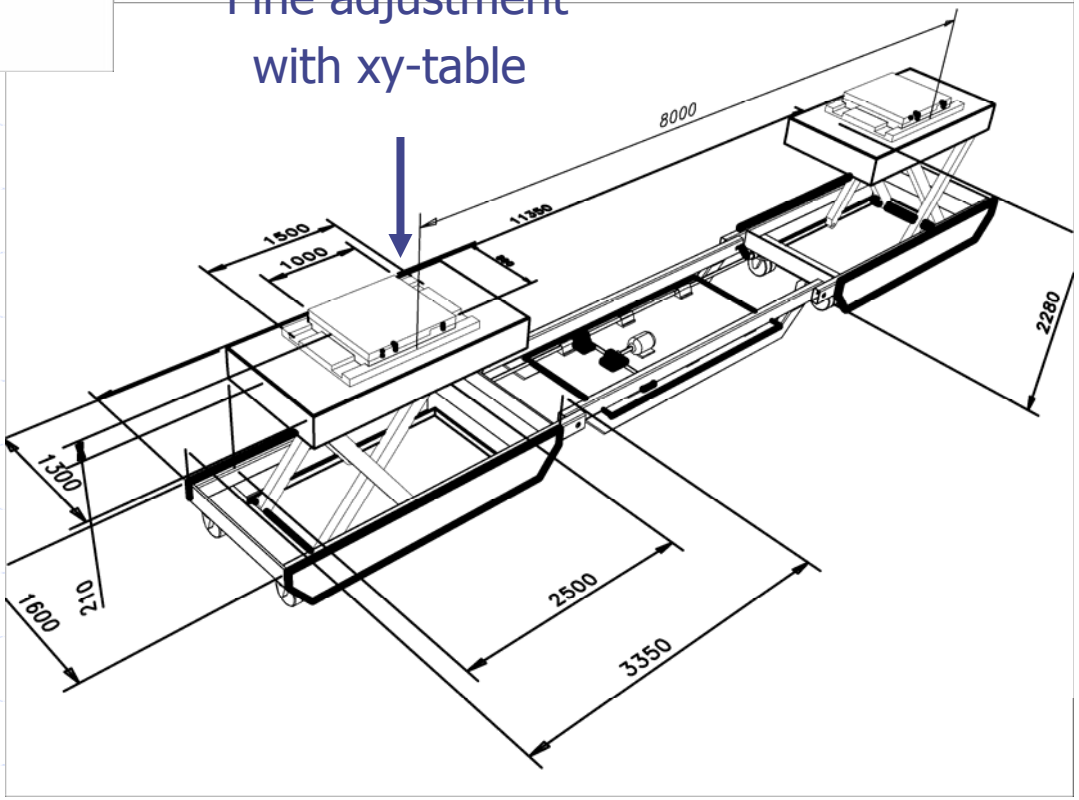
➔ To exchange a module later on the installation below has to be dismantle. In the worst case this will be a hole RF-station or other complicated stuff!





Fine adjustment
with xy-table

Module transport system (0.Version)



Norbert Meyners, MEA/XFEL WP33

At CERN

"Mafis" (LHC cryo magnet vehicles)

Operator unit
+ Short trailer
+ Operator unit

Long trailer

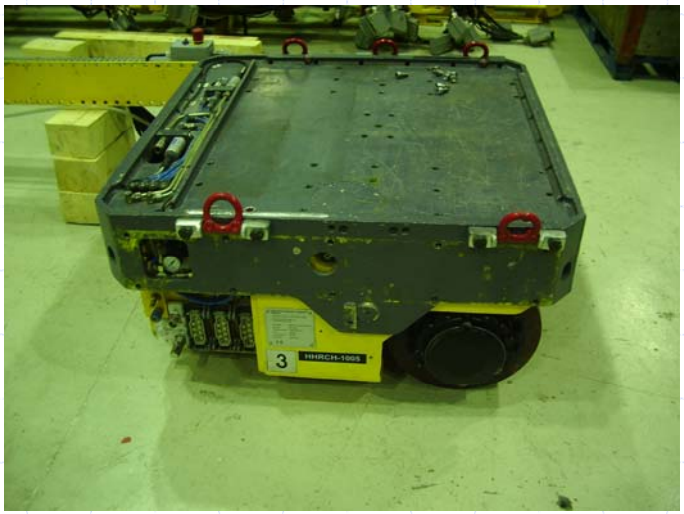
Long sc. Magnets
L: 16.3m; weight: 34t

At CERN

"Mafis" (LHC cryo magnet vehicles)

- "Only" transport
  - Unloading with "unloading equipment"
  - Installation with "transfer equipment set"
- Small cross section
  (h: 50cm; w: 1m; long)
- Hydraulic motors
- Overhead power rail/
  No batteries
- Optical guidance (white line)
  (SLOW; Main trouble maker;
  but very flexible)
- Hydraulic suspension
- Trailer is less rigid
  then the magnet

At CERN "Boogies"
(transfer line vehicles)



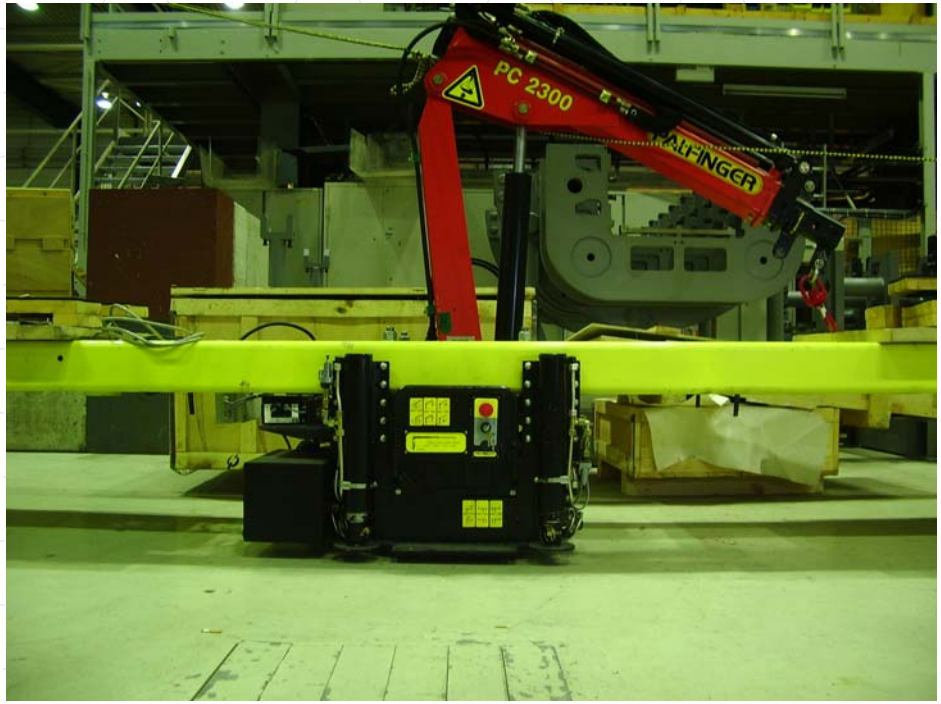
- Transport and installation
  (Small lifting capacity with added compressed air cushions)
- Compact (h: 55cm; w/l: 1m)
- 9t load capacity each
- Up to four boogies can be coupled together
- Overhead power rail + Backup battery (~4h)
- Optical guidance
- NO suspension!

Boogie concept

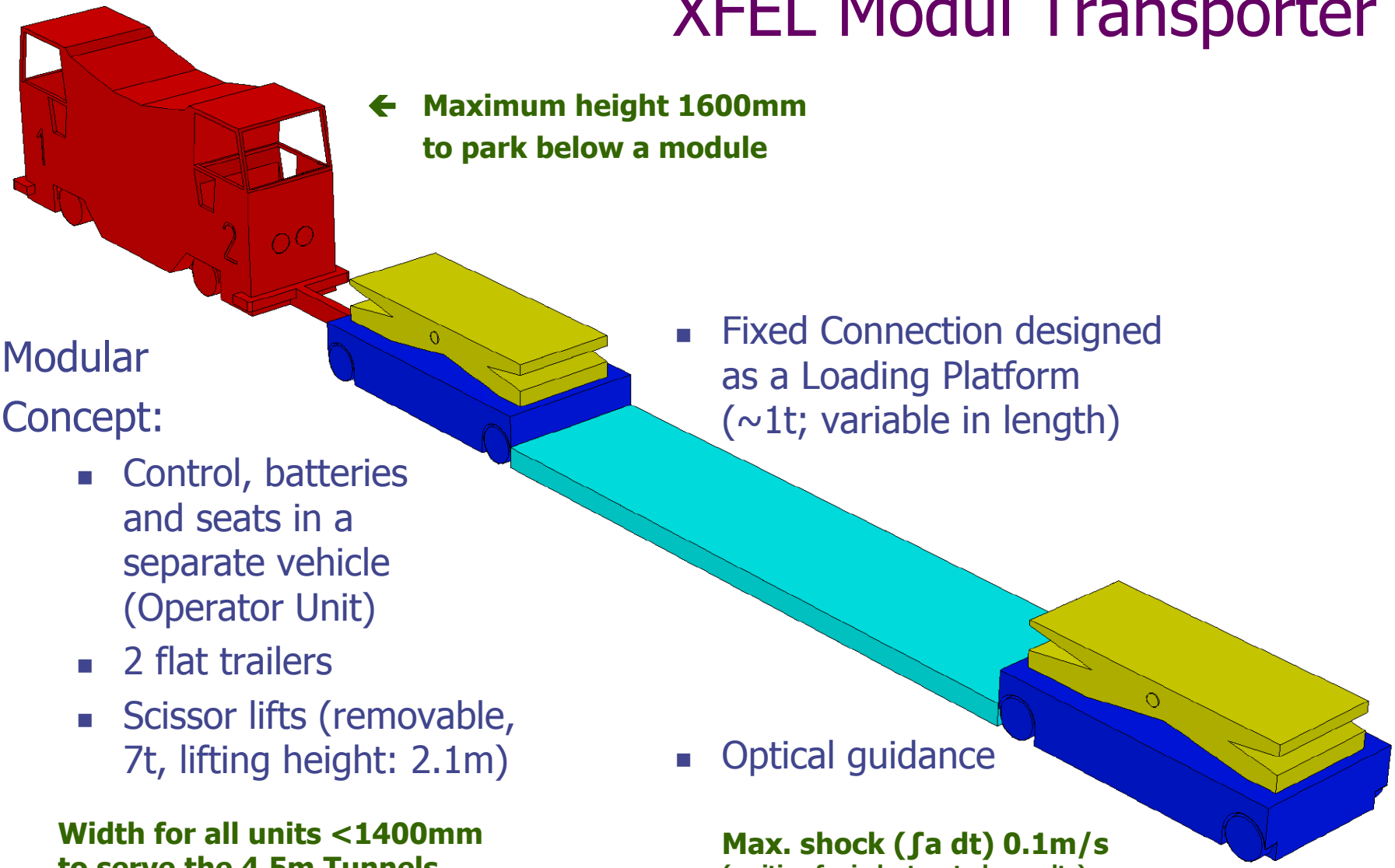
- Electric motors
  "It is hard to maintain hydraulic system over 20 year"
- Three wheels
  - Two driven and steered (3,5t)
  - One castor (2t)
  - Can move sideways

Boogie concept

- Operator unit with batteries and control system
  (l: 4,5m; w: 0.95m)
- Crane can be added



XFEL Modul Transporter



Maximum height 1600mm to park below a module

Modular Concept:

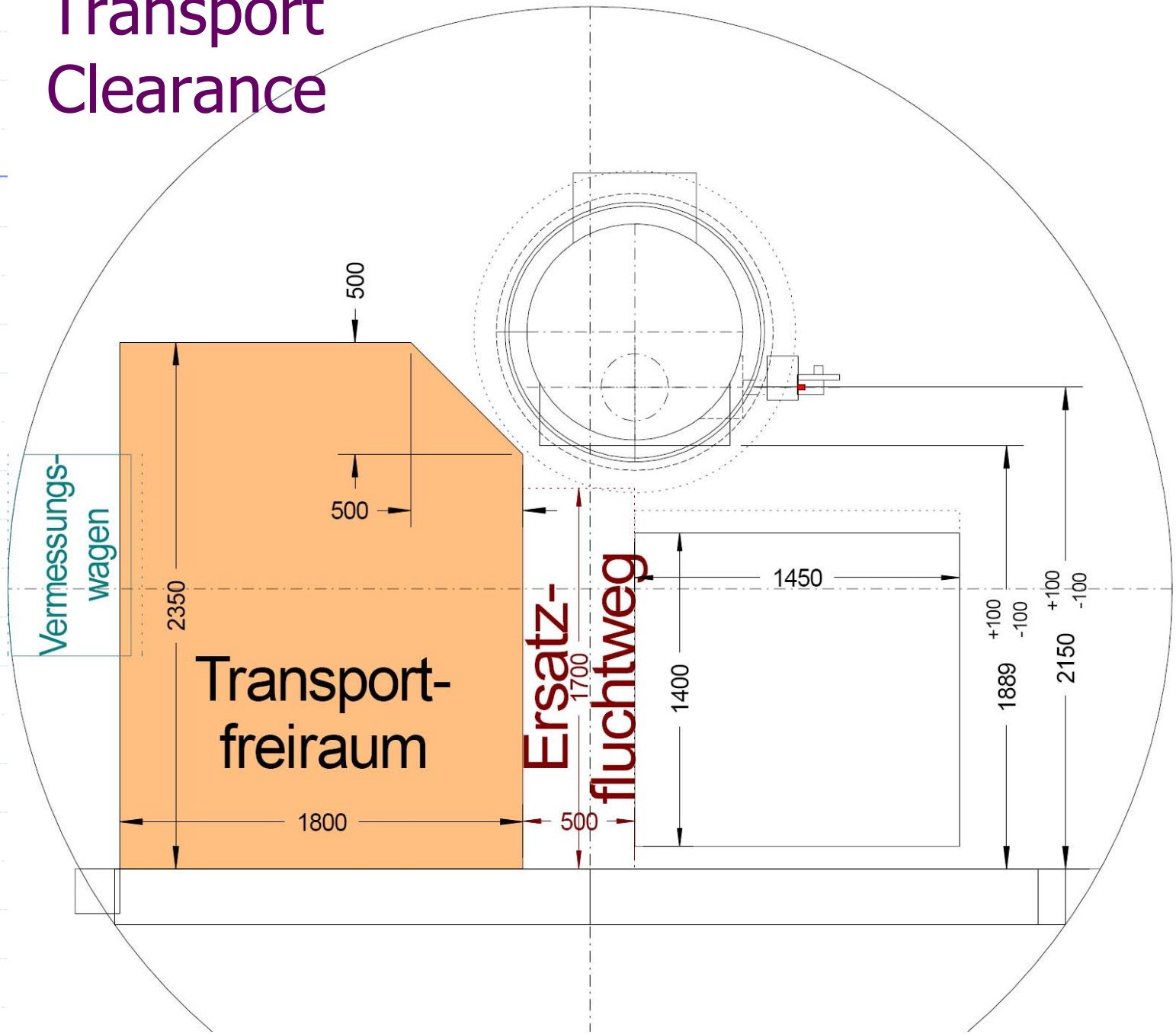
- Control, batteries and seats in a separate vehicle (Operator Unit)
- 2 flat trailers
- Scissor lifts (removable, 7t, lifting height: 2.1m)

Width for all units <1400mm to serve the 4.5m Tunnels

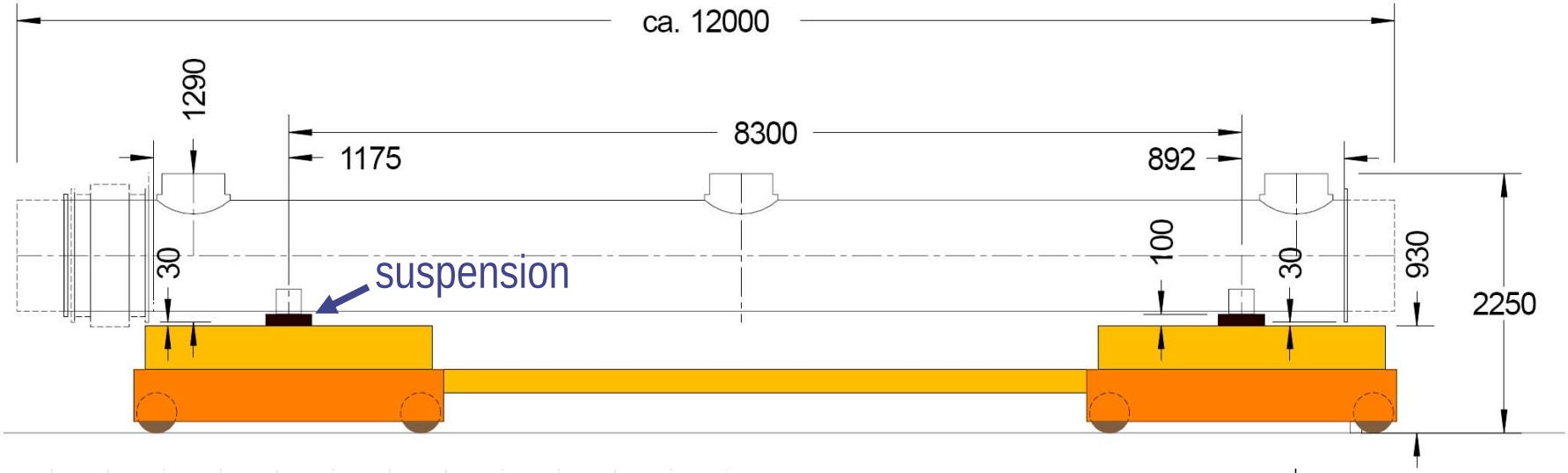
- Fixed Connection designed as a Loading Platform (~1t; variable in length)
- Optical guidance

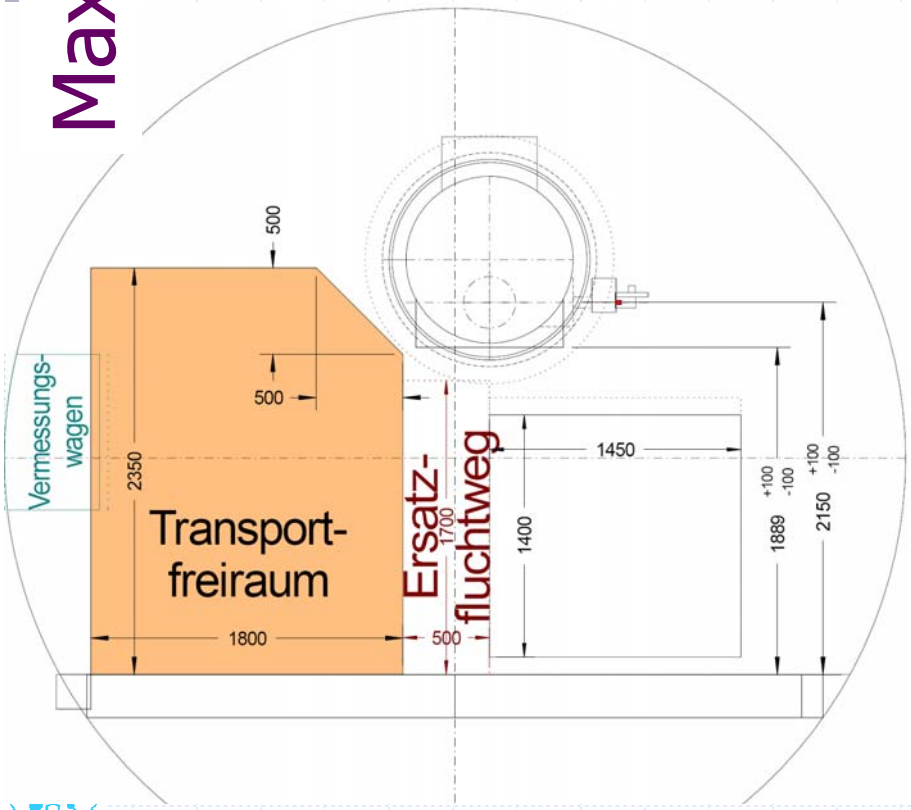
Max. shock (∫a dt) 0.1m/s
(waiting for industry study results)

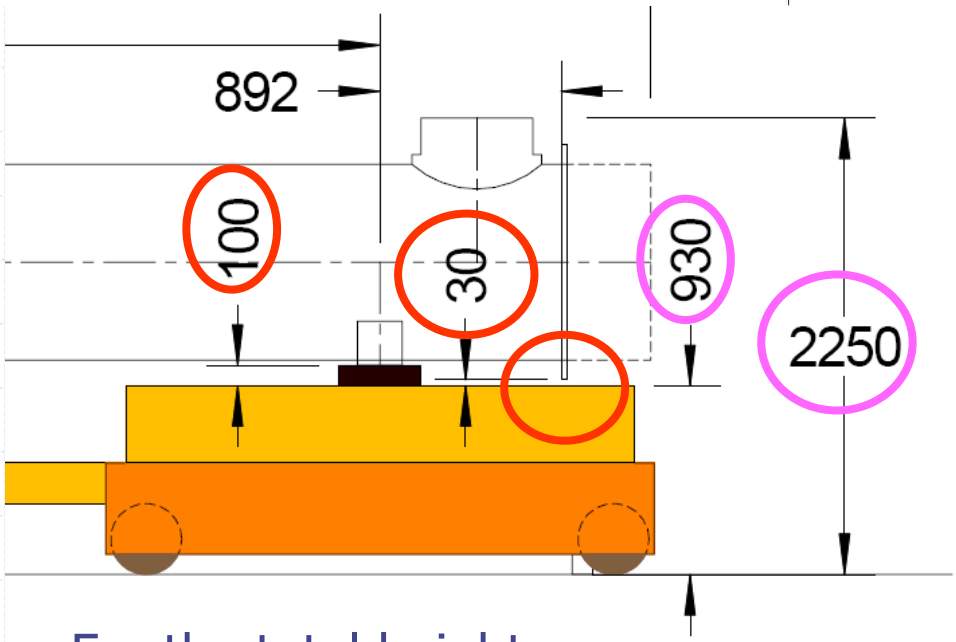
Transport Clearance



Maximum Height

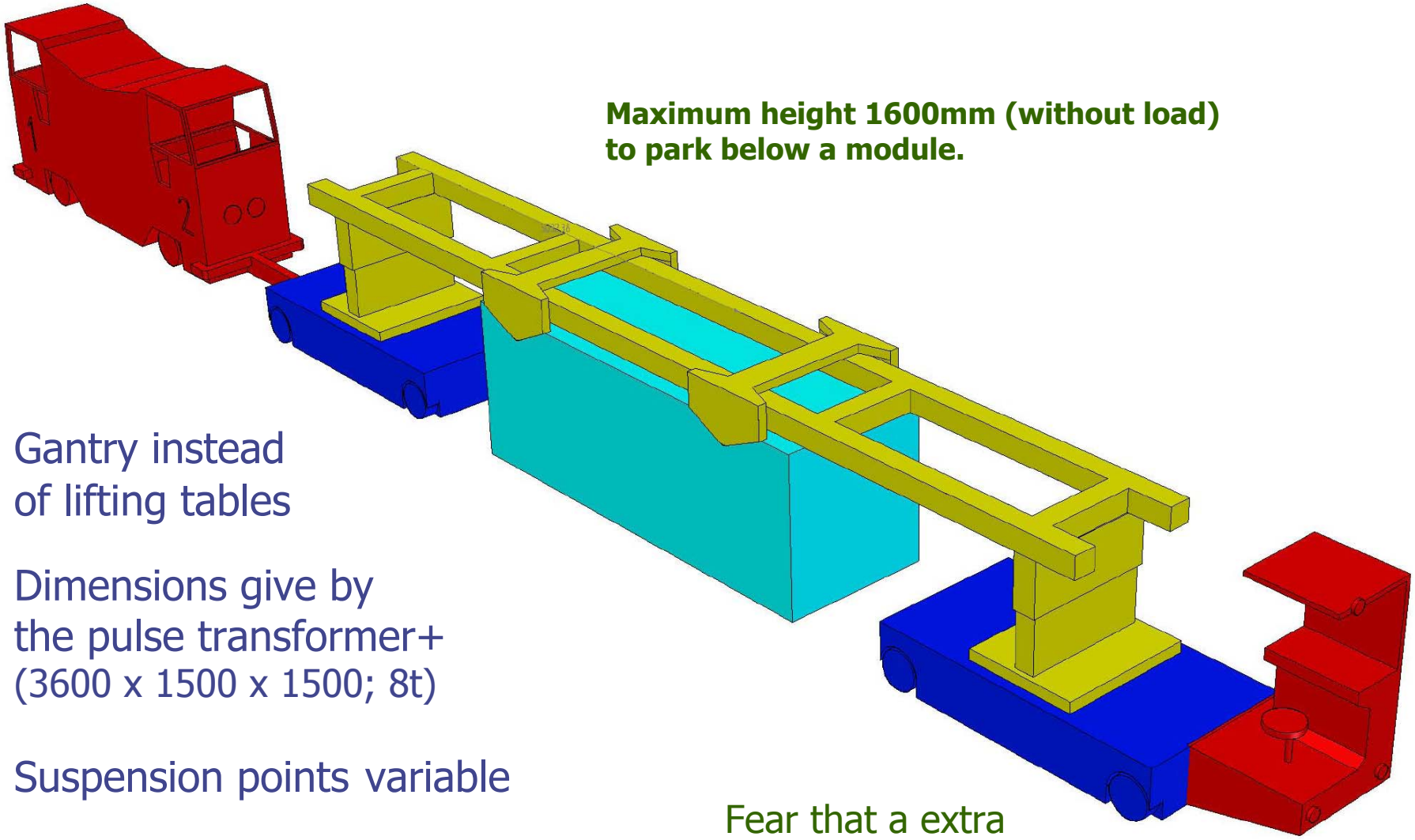






For the total height
+50mm allowed!

Container Transporter



**Maximum height 1600mm (without load)
to park below a module.**

Gantry instead
of lifting tables

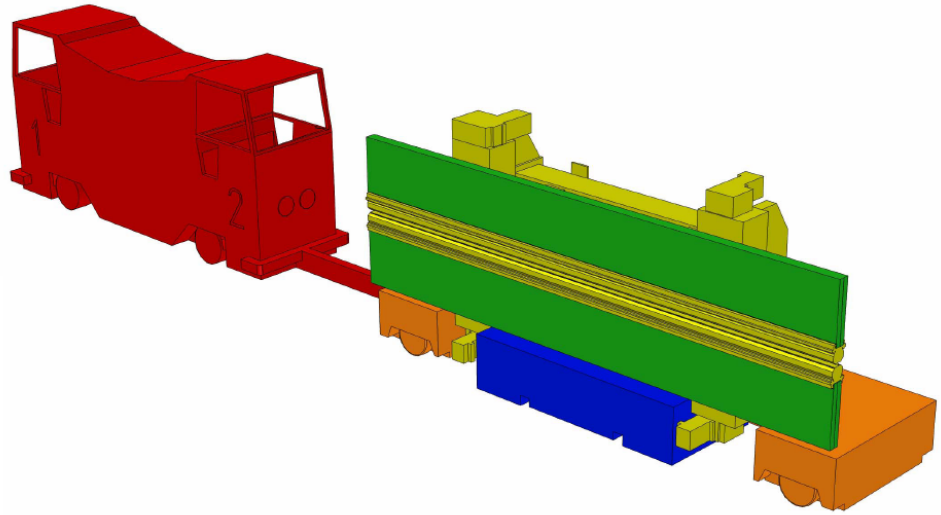
Dimensions give by
the pulse transformer+
(3600 x 1500 x 1500; 8t)

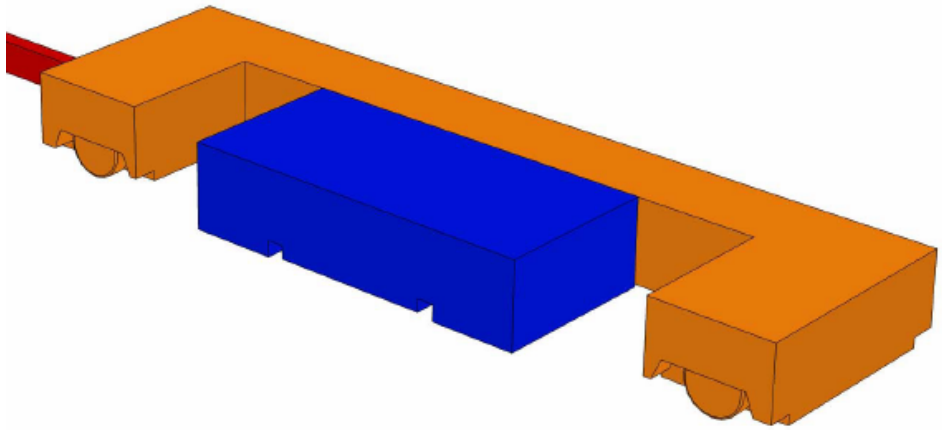
Suspension points variable

Fear that a extra
rear seat is needed!

Undulator Trailer

- Supplied and controlled by the operator unit
- Wheels for transport
- Air cushions in unloading device (in blue)
- Design included
- Construction optional





Summary

- Need 1. vehicle for the mock-up tunnel
- Concept has been revised and is ready
- Call for tender has been published yesterday
  - Order can be place in spring 2007
  - Last changes can be feed in before design
  - Delivery Fall 2007

Order with Options

2 Lieferumfang

2.1 Erstbestellung

Die Erstbestellung umfasst:

- 1 Steuer/Energiefahrzeug
- 2 Plattformwagen mit Hubtischen
- 1 längenveränderliche Verbindungsplattform
- 1 kurzer Verbindungsträger
- 1 15m Verlängerungskabel für die Verbindung vom Steuer/Energiefahrzeug zum Plattformwagen
- 1 Lastbrücke
- Konstruktion eines Undulatortransportwagen mit Abladeeinrichtung inklusive der Vorbereitung der Steuerung und falls nötig des Steuer-/Energiefahrzeugs
- Wartung der Fahrzeuge
- Optional: 1 Rückwärtiger Fahrerplatz
- Optional: Herstellung eines Undulatortransportwagen mit Abladeeinrichtung
- Optional: Ausführung der Fahrzeugsteuerung mit Siemens SPS-S7-300 oder mit einer SPS gleichwertiger Art
- Optional: Induktive statt optischer Spurführung

Der Preis soll in die verschiedenen Einheiten des Fahrzeuges aufgegliedert werden. Auch die Wartung soll als separate Position aufgeführt werden.

2.2 Nachbestellungsoption

Die Nachbestellung einzelner Einheiten oder eines kompletten Fahrzeugs soll möglich sein. Dabei sollen mögliche Änderungswünsche aus den Erfahrungen durch die Erprobung des Fahrzeugs im Testtunnel berücksichtigt werden.

Technische - Spezifikation

Projekt: **XFEL**

Komponente: **Tunnelfahrzeug**

Datum: 28.9.2006

Inhaltsverzeichnis

Outline (cont.)

Outline (cont.)

Outline (cont.)

Very detailed to allow „Nebenangebote“