FCC Underground Civil Engineering Update

FCC Feasibility Study

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FCC Civil Engineering Studies

Feasibility study of FCC construction at CERN

Mid-term review 2023

Geological site investigations 2024

Feasibility study delivery 2025
PA31-3.2 Alignment

90.7 km circumference
Swiss molasse basin
Lake crossing
River (moraine) crossings
Mountain topography
Geneva metropolitan area
Civil Engineering Sub Surface

- 8 surface sites
- 13 shafts
- 4 experiment caverns
- 8 service caverns
- Beam dump
- RF klystron galleries
- SPS injection lines
Main Beam Tunnel

- Smoke extraction duct
- In-situ concrete floor
- Tunnel invert drainage
- Tunnel monitoring / maintenance robot
- Precast concrete tunnel segments
- Ventilation duct

Credit: Fani Valchkova-Georgieva
Shafts

Shaft depths, 180m to 400m

2 x 18.4m elliptical

4 x 18m circular

7 x 12m circular

Credit: Angel Navascues Cornago
Caverns

FCC

ATLAS (LHC)

CMS (LHC)

Credit: Angel Navascues Cornago
Experimental Area

Credit: Angel Navascues Cornago
Tunnel Widening
FCC-ee Beam Dump – Point B

- 660m length cavern
- $e^+$ and $e^-$ beam dumps
- 10mrad septum angle
- 5.5m separation of dump and beam
- 700m length extraction line

Credit: Angel Navascues Cornago
Alcoves and Passing Bays

7 Alcoves per sector

Every 1.6km

Passing bays included

Larger alcoves near FCC points for additional EL
Klystron Galleries

PH 2000m
PL 1200m

Service tunnels to both Klystron gallery and machine tunnel

Klystron gallery

Machine tunnel

Service cavern

Credit: Fani Valchkova-Georgieva

Credit: Angel Navascues Cornago
SPS Injection Lines

CERN Prevessin LINAC to SPS Point 4

SPS Point 4 to FCC

Reuse of SPS machine

Credit: Angel Navascues Comago
Excavation

Estimate of the quantity of excavated material

Baseline TBM layout and direction of drives

Balance of material between France and Switzerland

Bulk total: 8,100,000 m³

160,000 to 1,400,000 m³ per site

96% molasse

3% limestone

1% moraine
Lifecycle Assessment
Future Tunnels

Embodied carbon of the whole project lifecycle

Concrete and steel are very carbon intensive materials

Opportunities to implement greener material choices

Early implementation in the design process provides greatest opportunity for the most significant improvements

6,500 tCO2e/km
FCC UNDERGROUND CIVIL ENGINEERING

2023 – FCC Cost and Schedule study by ILF Consulting Engineers

2018
- 12 Points FCC
- Cost and schedule study by ILF

2023
- 8 Points FCC
- New cost and schedule study by ILF
ILF GROUP

6,000+ PROJECTS SUCCESSFULLY EXECUTED

150+ COUNTRIES IN WHICH ILF HAS BEEN SUCCESSFUL

40+ OFFICE LOCATIONS ACROSS FIVE CONTINENTS

2,400+ EMPLOYEES WORLDWIDE

224 MILLION € REVENUE

50+ YEARS OF EXPERIENCE
ILF SWITZERLAND AT A GLANCE

30 YEARS OF EXPERIENCE
140+ PROJECTS SUCCESSFULLY EXECUTED
2 OFFICE LOCATIONS ZÜRICH + BAAR (ZG)

1993 BRANCH OPENING IN ZÜRICH
10+ COUNTRIES IN WHICH ILF HAS BEEN SUCCESSFUL
50+ EMPLOYEES
ROAD TUNNEL

RAILWAY INFRASTRUCTURE

SPECIAL PROJECT

DIGITAL DESIGN & CONSTRUCTION

TUNNEL VENTILATION SYSTEM

PROJECT MANAGEMENT

CONSULTANT BUILDINGS
Construction Schedule Study

Tilos is a linear infrastructure tool
- simplified, visual look at the construction project through a powerful linear scheduling view
- Time Chainage & Scenario optimization
- Optimal mass handling
- Cost overview with time

Credit: ILF
Longitudinal view with specification to: Country, section, Alcoves, Tunnel Widening, Machine Tunnel, Klystron Stairwell
Construction Schedule Study

Start excavation: January 2033

Sector completion:
  • End first sector (A & A-B) :
    About 6.5 years
  • End last sector (F & F-G) :
    About 8.5 years

Credit: ILF
Sequence of the construction schedule

- Site installation
- Shaft
- Conventional excavations
- Caverns
- Main Beam tunnel excavation with TBM
- Cavern steel construction

Installation around 2 shafts (LHC construction)
Sequence of the construction schedule

Shaft & conventional excavation

- Service shaft with diameter = 12m
- Experiment shaft with diameter = 18m  
  → excavation takes longer
- Bypass tunnel with conventional excavation

Roadheader
Shotcrete for breakout protection

Schedule at Point G
Sequence of the construction schedule

Machine tunnel excavation with TBM

Excavated diameter ca. 7 m
Tunnel Boring Machine (TBM)
Sequence of the construction schedule

Cavern steel construction

CMS cavern

3 months for the steel structures in the experiment cavern
Sequence of the construction schedule

Cavern steel construction

CMS cavern → experiment cavern

CMS cavern
Thank you for your attention.

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