

Bouygues Construction

Challenges in Design and Construction of Buildings & Infrastructures

Pierre BENNING

Civil Engineer & IT Manager of the
Technical Division (Bouygues Civil Works)

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BOUYGUES
TRAVAUX PUBLICS

Shaping a **Better Life**

Agenda

- Bouygues Construction
and Main current projects
- BIM for Buildings
(Philharmonie of Paris)
- BIM for Infrastructures
(L2 Ring around Marseilles)
- National Project MINnD and openINFRA initiative
- Conclusion - Questions

- **Bouygues Construction
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At the centre of a major group

BWEEG

Sales 2013
€33.3 billion



Energy – Transport
ALSTOM
(Ownership: 29.4%)

Telecoms

Television

Construction

Roads

Property



Specialist Civil Works division



Bouygues Construction:

Three business areas with high added value

With an extensive range of know-how, Bouygues Construction is involved through the entire value chain of building, infrastructure, energy and services projects: finance, design, construction, operation and maintenance.

Building

Housing, schools, hospitals, universities, hotels, office buildings, stadiums, airports, exhibition centres, leisure amenities, etc.

Civil works

Underground works, engineering structures, earthworks, roads, ports, public transport infrastructure, etc.

Energy and services

Integrated technical solutions in the areas of energy, industry, the service sector, transport, the environment and telecoms.



An efficient and innovative Group (Key figures 2013)

€**11.1** bn

sales
(including 46% international)

↗ +4%

46%



Active in
80
countries



52,200
employees

€**17,8** bn

order book

↗ +4%

€**277** m

net profit

↗ +4%

51%

of investment in R&D devoted to
sustainable construction



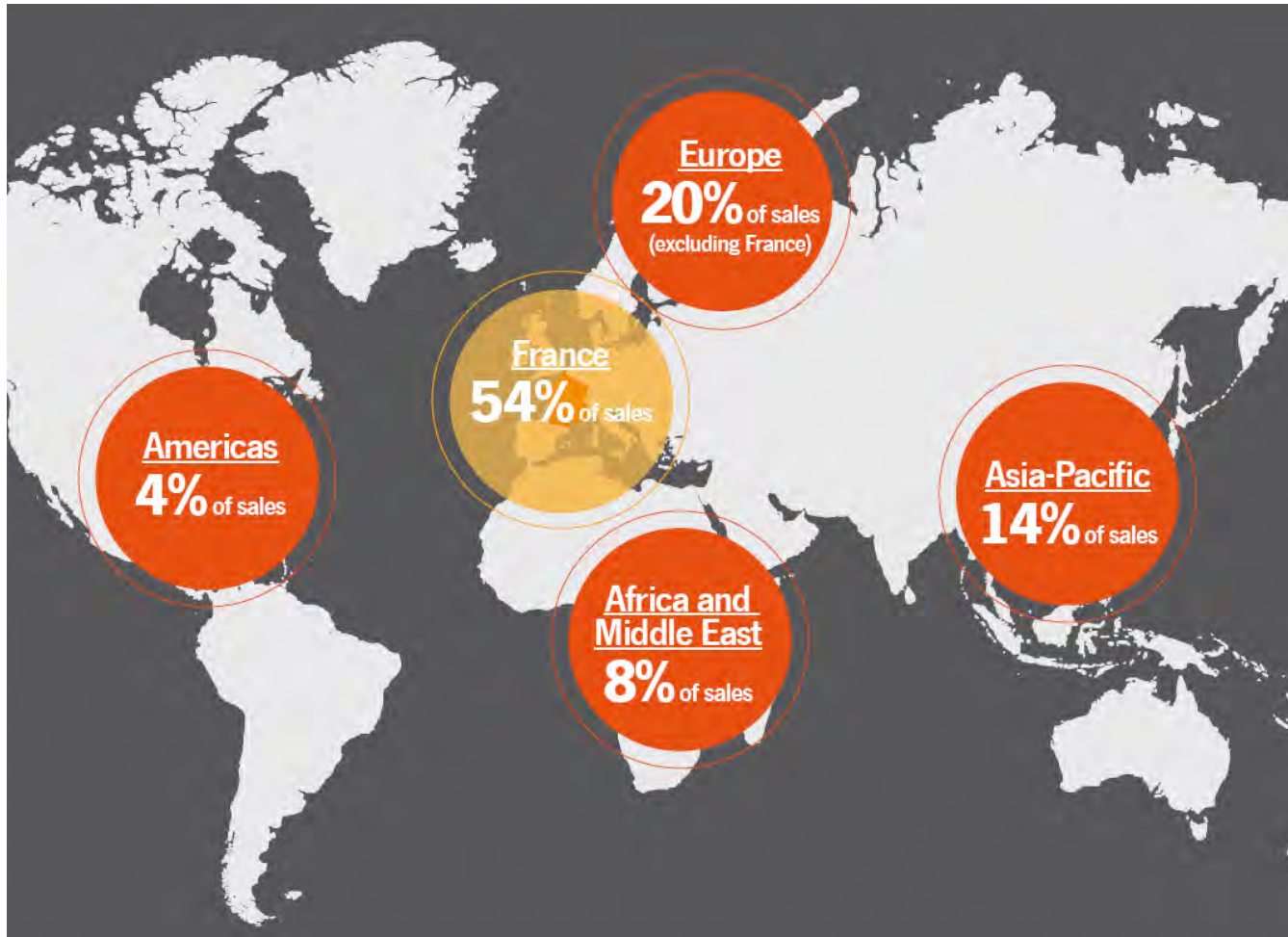
889

ENTRIES

in the Bouygues Construction
Innovation competition

Strong performance on international markets

In 2013, Bouygues Construction generated 46% of its business outside France.
This includes 20% in Europe (excluding France).



A continual development for years

2009

- Signature of the QP District project in Qatar, a vast 9-tower property complex

2010

- 3 major projects: Sports Hub (Singapore), Cruise terminal (Hong Kong), Stade Vélodrome (Marseille)

2011

- Signature of the contract for the future Ministry of Defence (Paris)
- Handover of the First Tower, the tallest building in France

2012

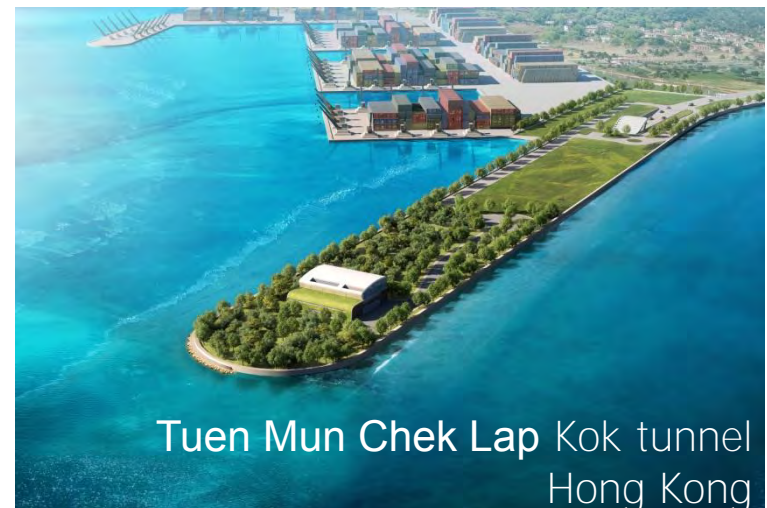
- 3 major contracts: Paris law courts complex, Nimes-Montpellier railway bypass and Hong Kong-Zhuhai-Macao bridge

2013

- Crédit Agricole Offices in Montrouge France, Tuen Mun Chek Lap Kok tunnel in Hong Kong, L2 Marseille Bypass

2014

- Signature of the contract for the Nouvelle Route du littoral coastal highway on Reunion Island
- First contract on Ghana for the « Ridge Hospital » extension of Accra



Bouygues Travaux Publics (Civil Works)

An expert in infrastructure projects

Bouygues Travaux Publics specialises in:

- > Underground works
- > Complex civil engineering projects
- > Engineering structures
- > Road, port and public transport infrastructure

With a strong international presence, it focuses its development on extremely technical operations with high added value.

Sales 2013: 1,115 M€

Order Book 2013: 1,930 M€

5,500 employees (as at 31/12/13)



Tyne Tunnel, Newcastle, United Kingdom



EPR Flamanville, France

Bouygues Travaux Publics: recent key dates

2007

- The world's two widest tunnels bored in China
- Contract for the confinement shelter at Chernobyl

2008

- A41 motorway, Annecy-Geneva
- Nuclear power plant, Flamanville, France

2009

- Tangiers Med 1 port, Morocco

2010

- Stade Vélodrome, Marseille, France

2011

- Pusan container port, South Korea
- Tangiers Med 2 container port, Morocco

2012

- Nîmes-Montpellier railway bypass, France
- Hong Kong – Zhuhai – Macao bridge

2013

- L2 motorway, Marseille, France
- Tuen Mun Tunnels, Hong Kong

2014

- Miami Tunnel, United States
- Sydney rail tunnel, Australia



Confinement shelter, Chernobyl, Ukraine

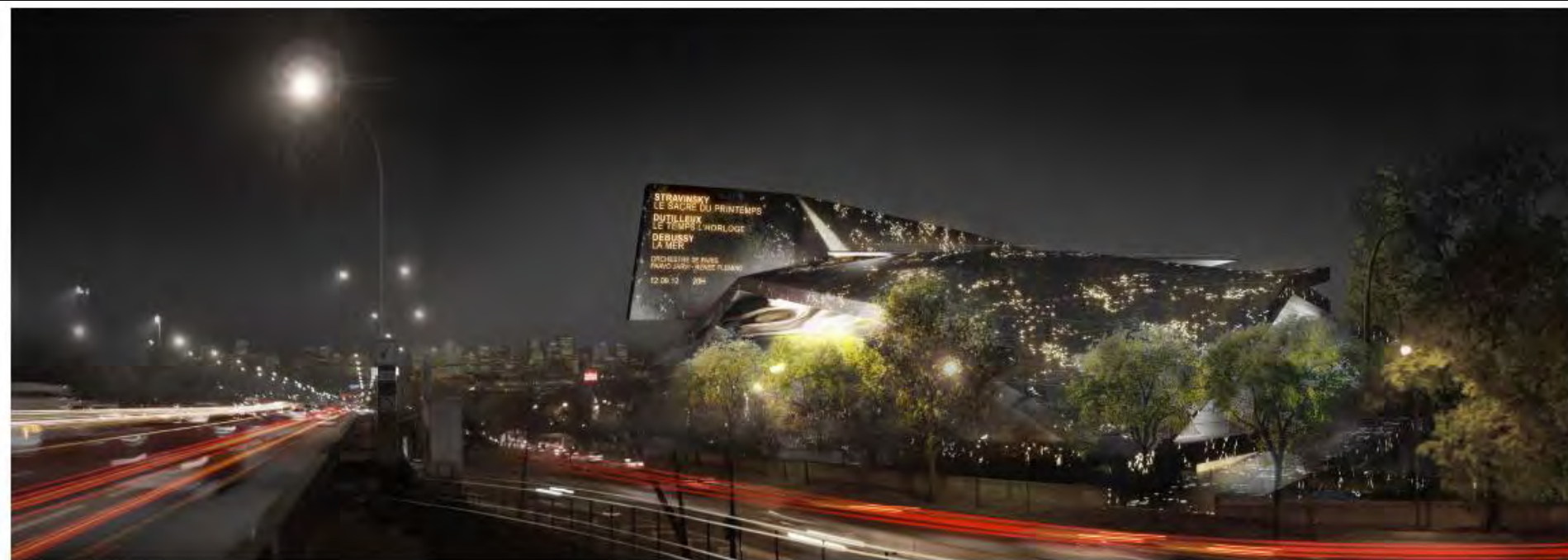


Port of Miami tunnel, United States

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La Philharmonie de Paris



La Philharmonie de Paris - History

- 2006: Initial Brief
- 2009 : Call for tender (Estimation 150M€)
- 2010 : Negotiations (based on a project alternative)
- January 2011 : Award to Bouygues Construction (Public Buildings division)
 - Design and Work duration : 38 month
 - Initial Cost : 220 M€ (Bouygues' part: 110M€)
- February 25. 2014 : Estimated date of building receipt
- October 2014 : Finishing
- January 14. 2015: First Concert
 - Final cost: 380M€
 - Operation: 18M€ per year



La Philharmonie de Paris – Project organization

Client

Association de la Philharmonie de Paris

Architect and Engineering

Atelier Jean Nouvel

EGIS (Civil Works, Structure and Technique)



Contractor

Leader: Bouygues Construction (Paris Buildings / Public Projects)

AMG-Fechoz, Axima Seitha, Belgometal N.V, Cunin SA, EGA, Gemo, INEO, Ingerop, Lindner AG, Otis, SAS Sodifra Agencement, Solétanche Bachy.

Operator (15 years)

COFELY

Qpark



La Philharmonie de Paris – The Project

Inside Paris (Parc de la Villette)

Close to the Boulevard Péripherique (Ring of Paris – North East)

Three Buildings, including:

- Car parks (600 places)
- Technical and logistics areas: 2 000 m²
- Total surface: 94 000 m² (Usefull surface: 20 000 m²)



La Philharmonie de Paris – The Project



Buildings C/D

- Administrative area (1660 m²)
- Classrooms

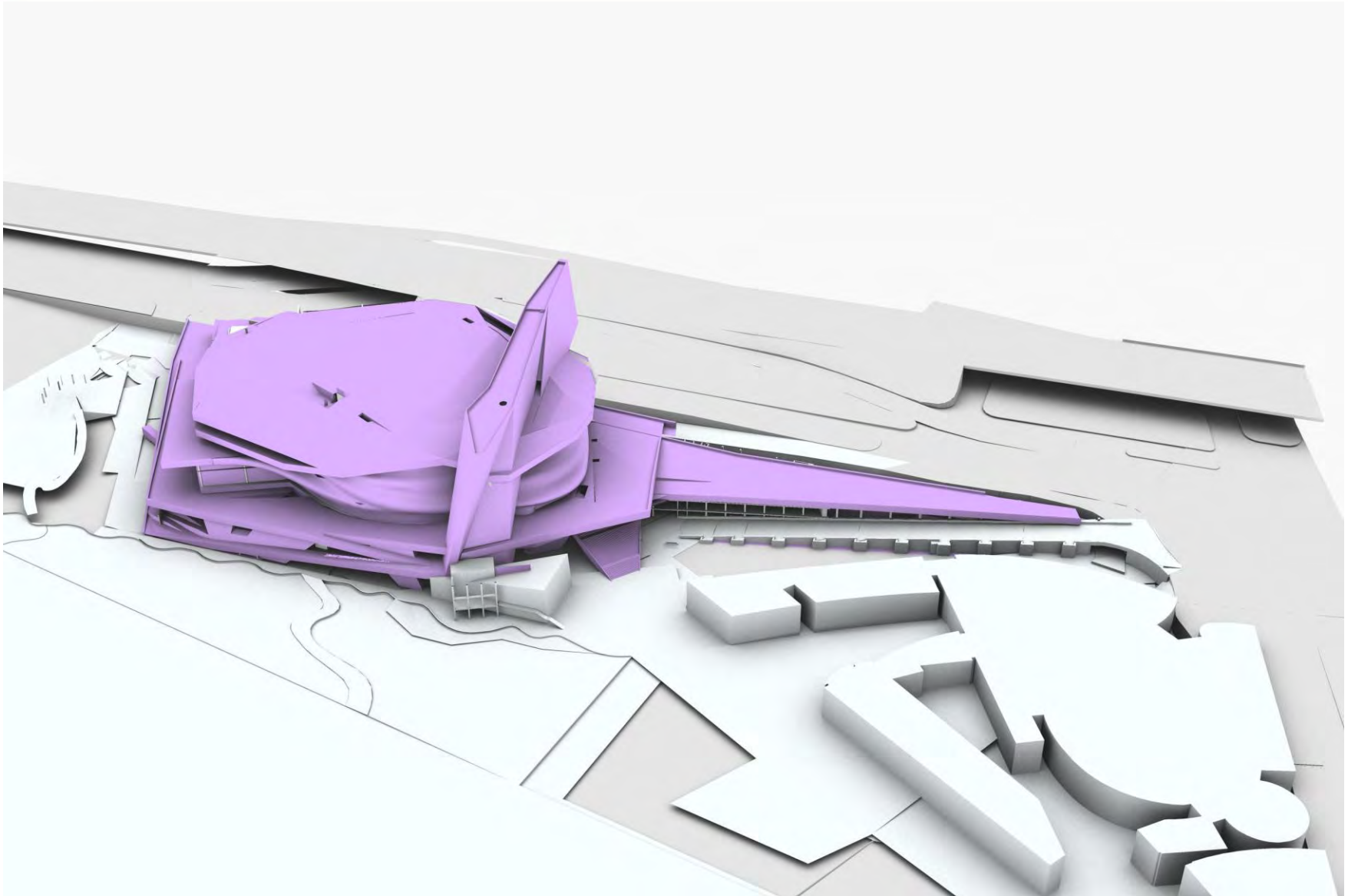
Building B

- 1 Philharmonic theater (2400 seats)
- 1 exhibition area (800 m²)

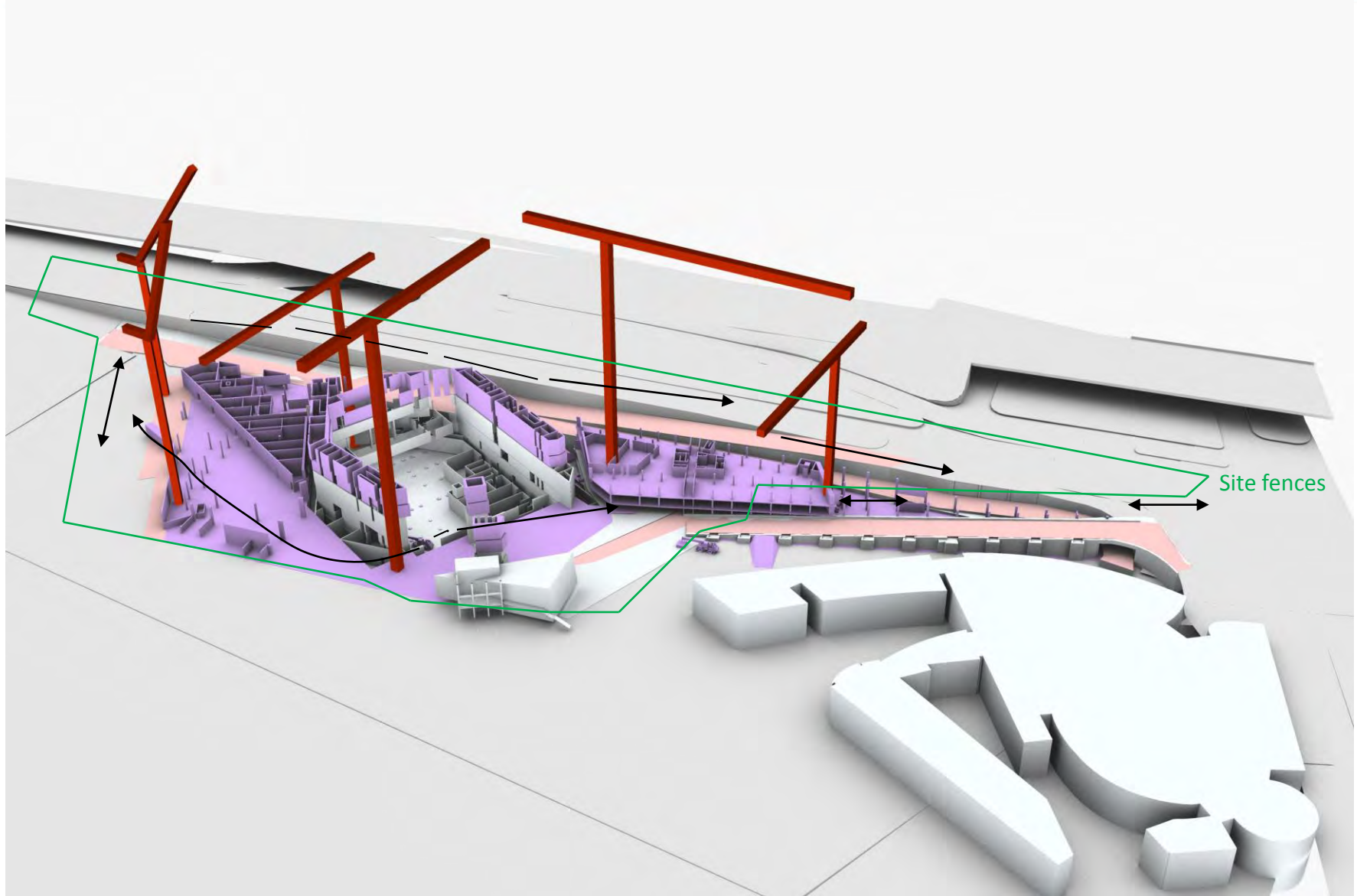
Building A

- 7 rehearsal rooms (1350 m²)
- 1 educative area (2000 m²)
- 1 restaurant (670 m²)

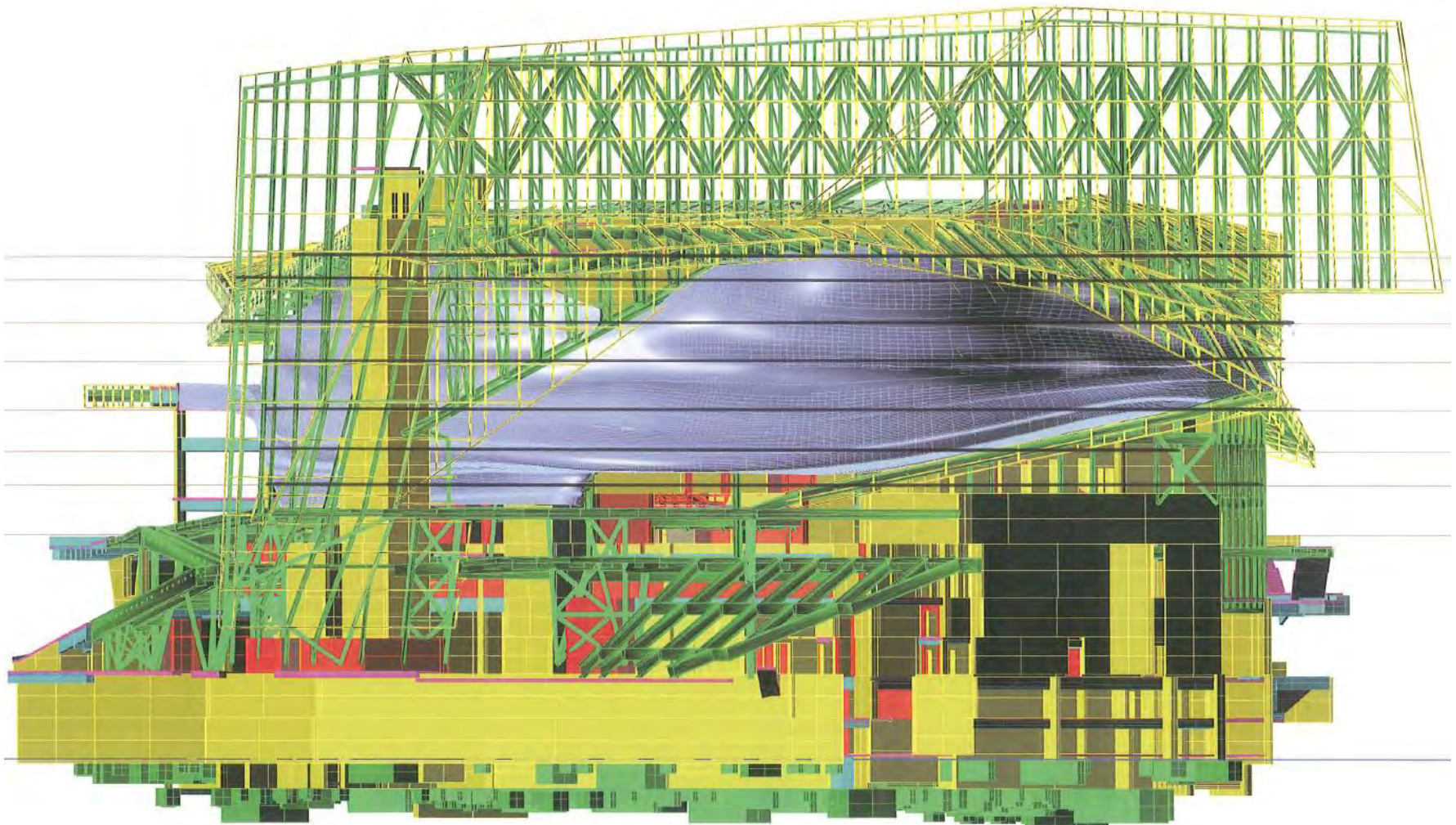
La Philharmonie de Paris – Conceptual model



La Philharmonie de Paris – General arrangement

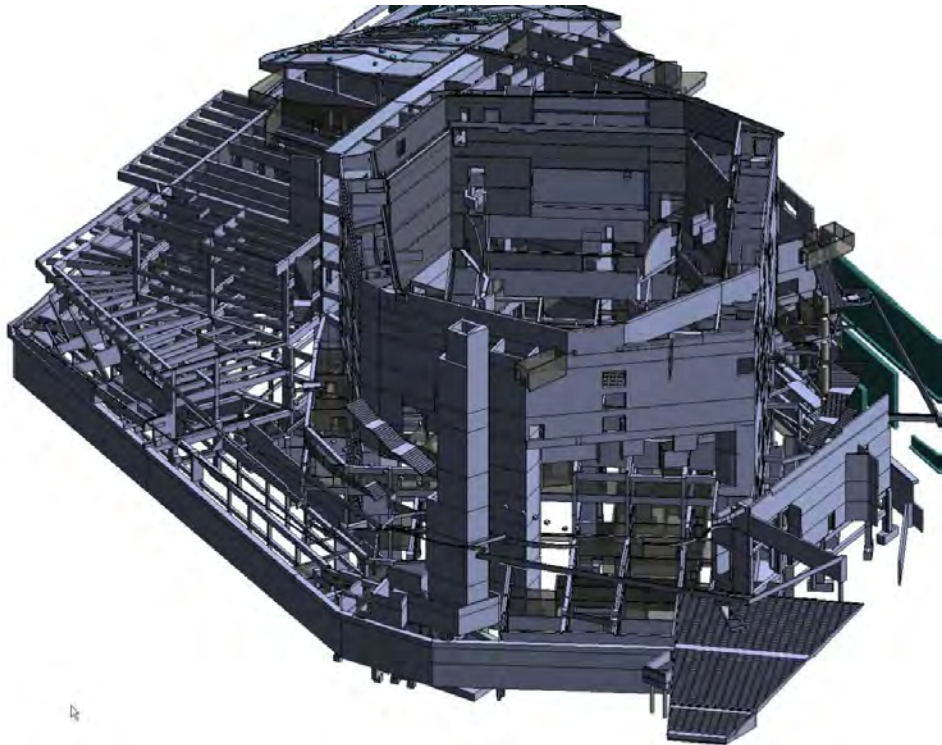


La Philharmonie de Paris – 3D Model and Coordination

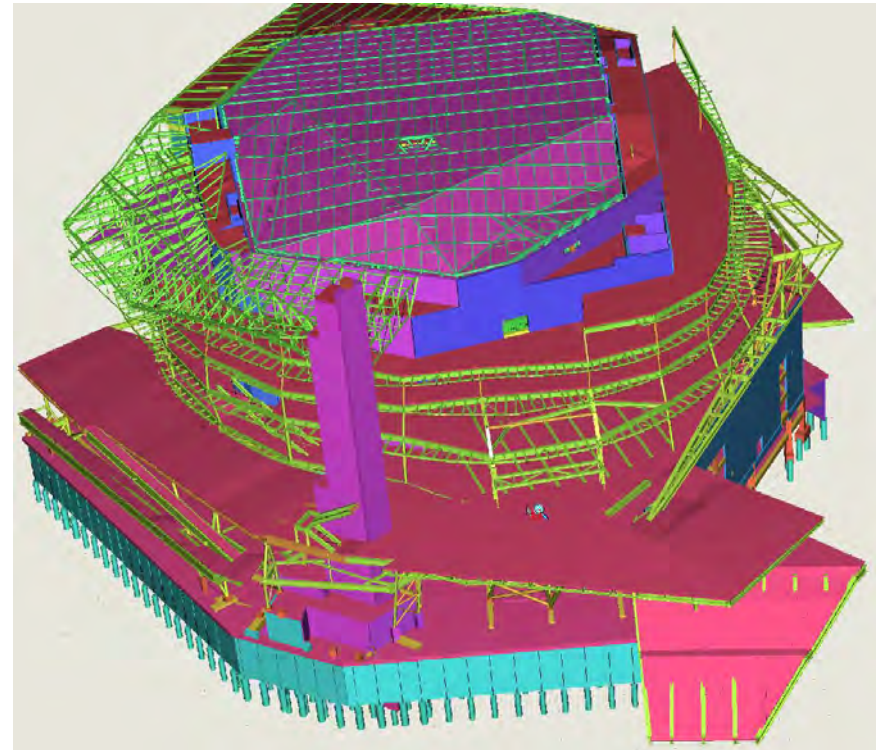


La Philharmonie de Paris – Combination of 3D Models

Geometry: Project understanding



Analysise: Finite Element modeling



La Philharmonie de Paris – 4D modelling

Goals:

- Logistics, Access and Traffic
- Site works Safety and Interfaces

OPB - PHILHARMONIE - Toiture ZA - Phasage
Michel Aroichane - Jean-François Rouanet
DTIF

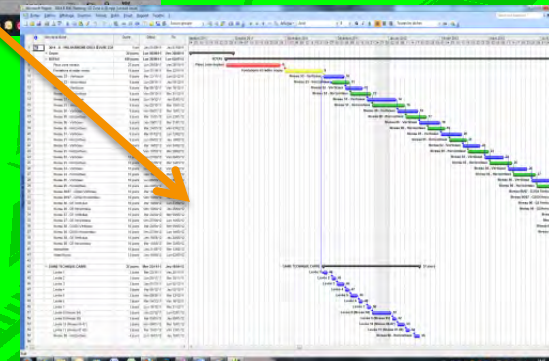
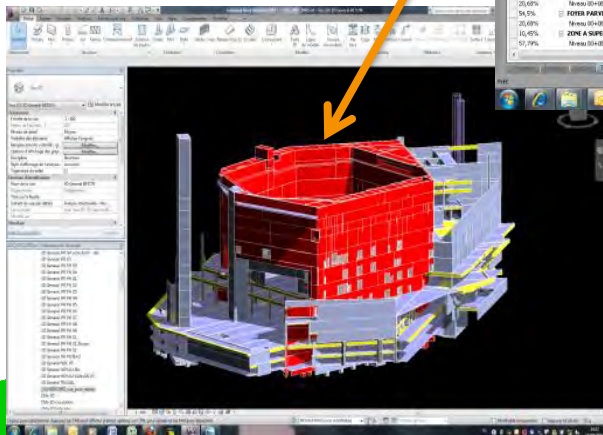
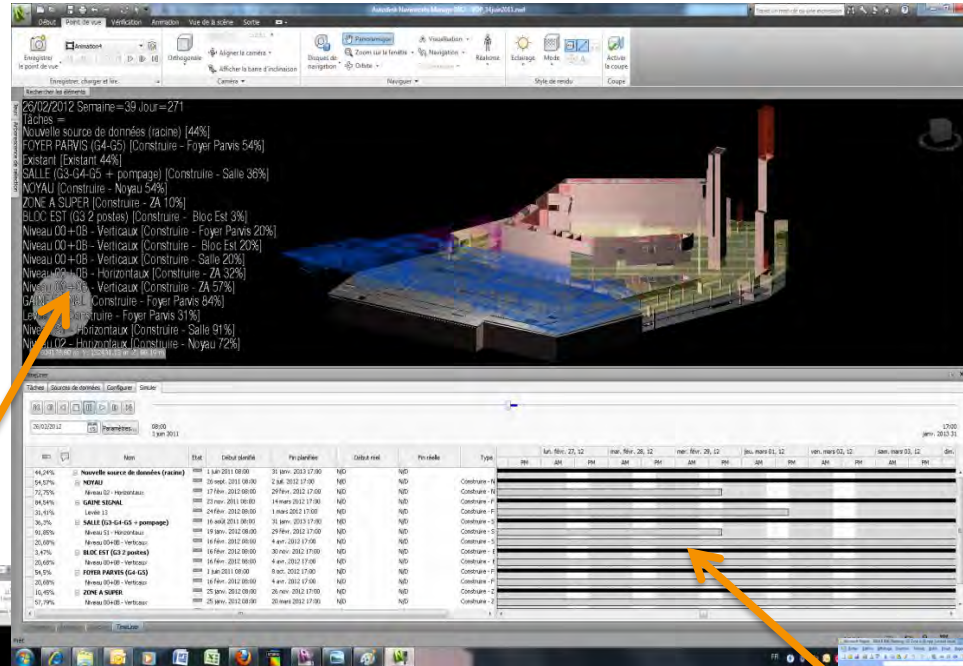
ven. 01/03/2013 Day=1 Week=1

Philharmonie - Toiture ZA - Phasage (racine) [04]

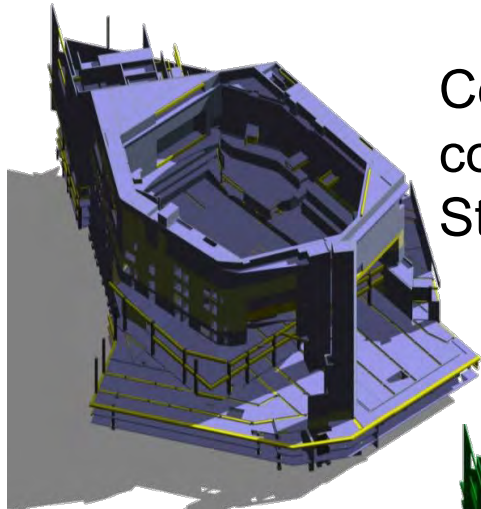
Existant [Construire 04]

ZONE A - TOITURE - MATERIEL [04]

MATERIEL 31.A1 Prefa [Construire_materiel 04]

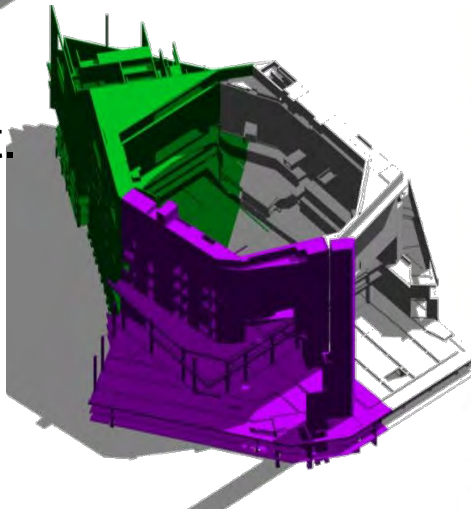


La Philharmonie de Paris – Structure Breakdowns

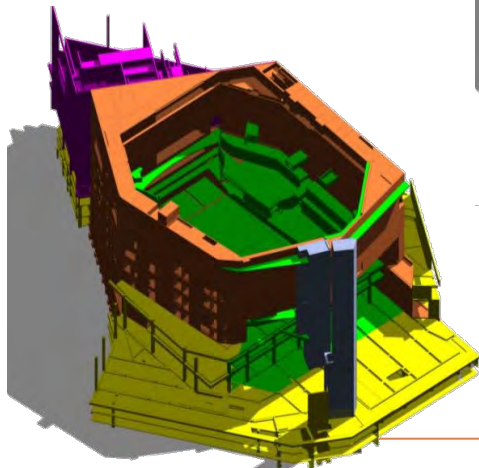


Complete
concrete
Structure

Concrete Struct.
“Crane”
Breakdown



Concrete Struct.
“Zone”
Breakdown



Poutre Evidée	Orange
Poutre Préfa2	Green
Poutre Précontrainte	Yellow
Poutre Tradi2	Red



PLAN DE		PLAN DE COUPE EN ZONE DE CRUE		PLAN DE COUPE EN ZONE	
<p>PHILHARMONIE MÉTROPOLITAIN DE PARIS ANALYSE DE LA STRUCTURE Plan de PEP A</p>		<p>PHILHARMONIE MÉTROPOLITAIN DE PARIS ANALYSE DE LA STRUCTURE Plan de PEP A</p>		<p>PHILHARMONIE MÉTROPOLITAIN DE PARIS ANALYSE DE LA STRUCTURE Plan de PEP A</p>	
<p>Oct 2014</p>		<p>Oct 2014</p>		<p>Oct 2014</p>	

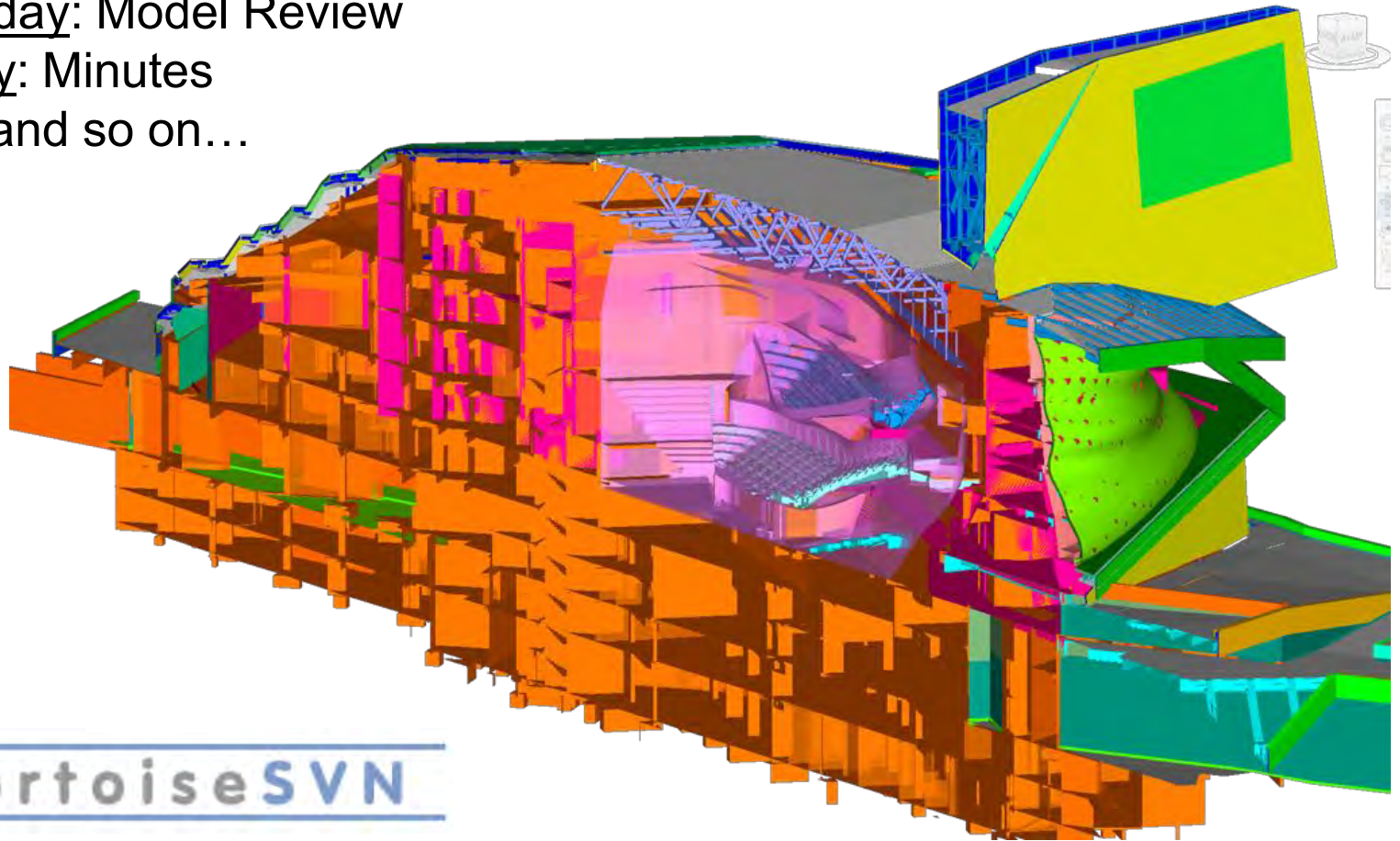
La Philharmonie de Paris – Structure Model Review

Friday: Call for contributions

Tuesday: Report of clashes

Wednesday: Model Review

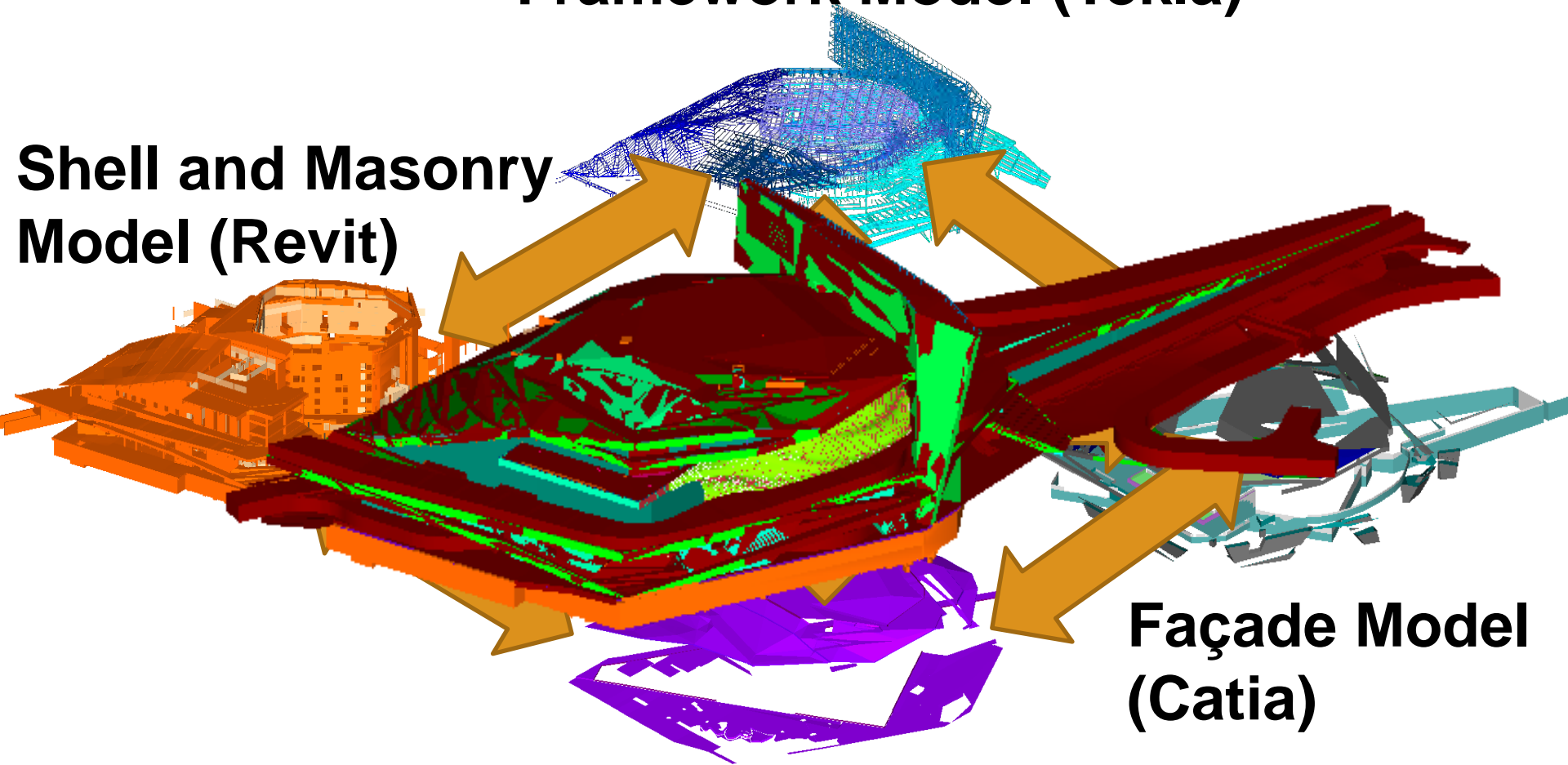
Thursday: Minutes
and so on...



TortoiseSVN

Framework Model (Tekla)

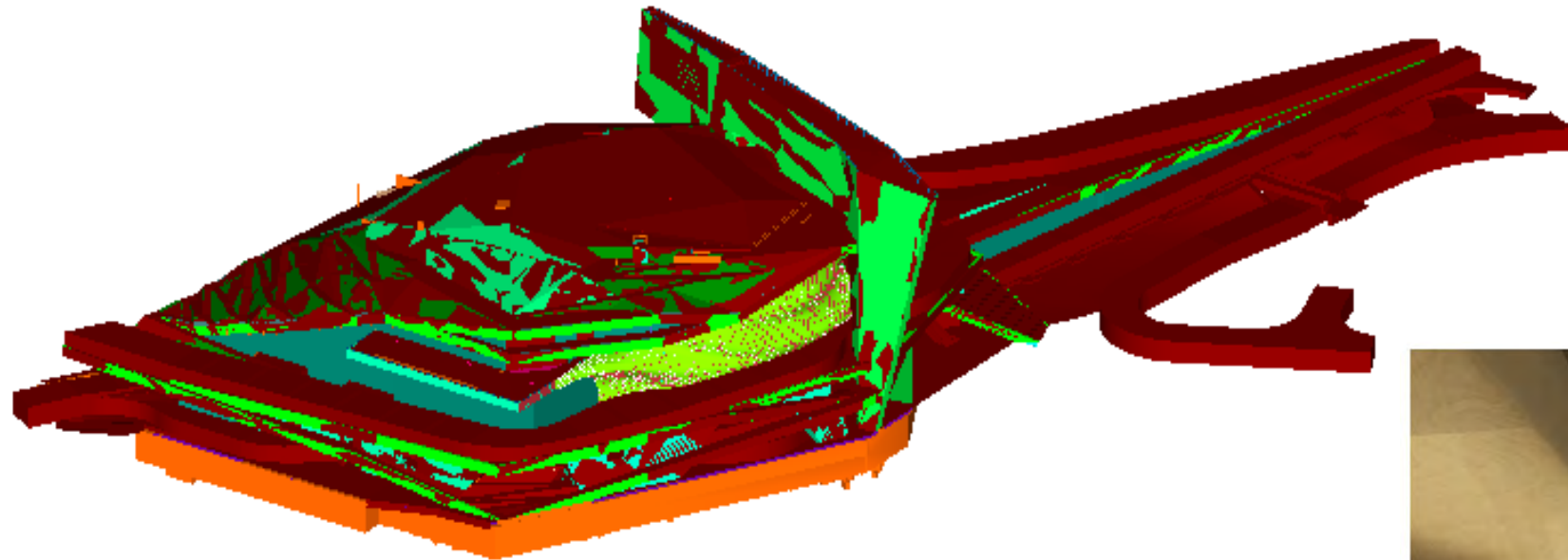
Shell and Masonry Model (Revit)



Façade Model (Catia)

Water tightness Model (Autocad 3D)

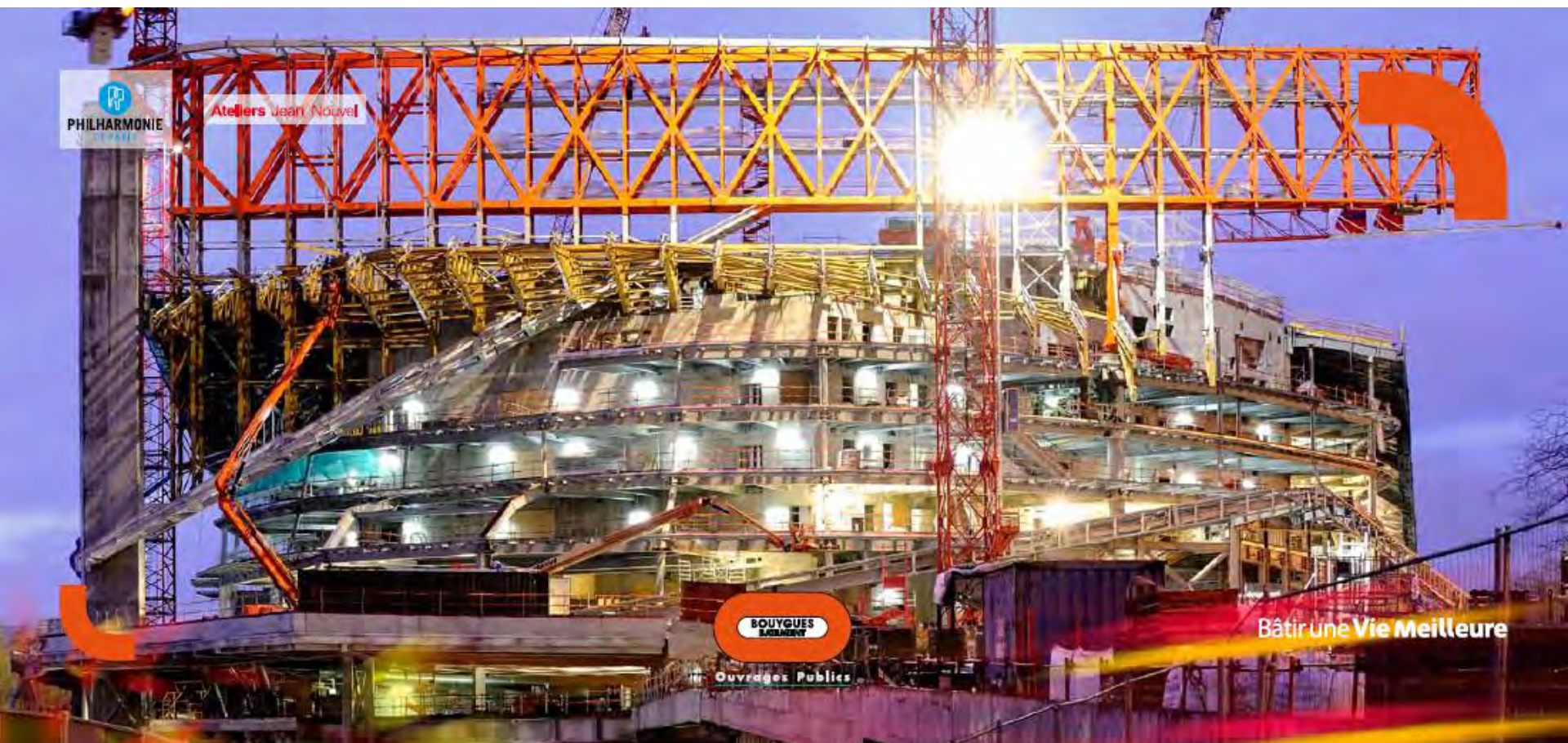
Envelope (Rhino)



All Construction Works (Rhino)



La Philharmonie de Paris – The delivery



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Marcory-Riviera Bridge in Abidjan (Ivory Coast)



Marcory-Riviera Bridge in Abidjan (Ivory Coast)

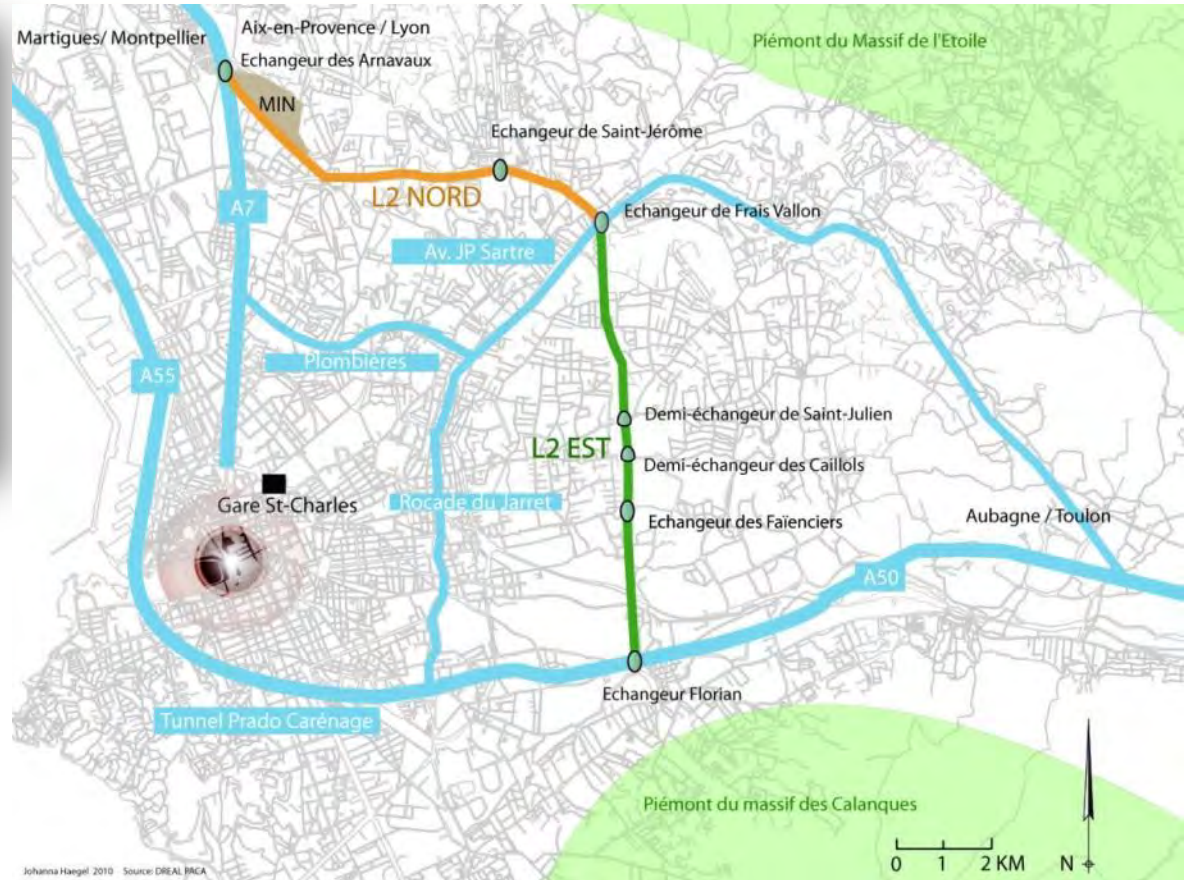
Collaborative and coordination Processes on a linear project

Complete 3D Model

- Data structure (space and systems)
- Data consistency
- Collision detection and management
- **Simulations / Construction sequences**
- Link with EDMS
- Alternative impacts
- Decision support



“L2 Ring” Project around Marseilles



Motorway A507
(linking A7 to A50)

- Length: 11km
- PPP Contract (30 years)
- Commissioning L2 East: Summer 2016
- Commissioning L2 North: Late 2017

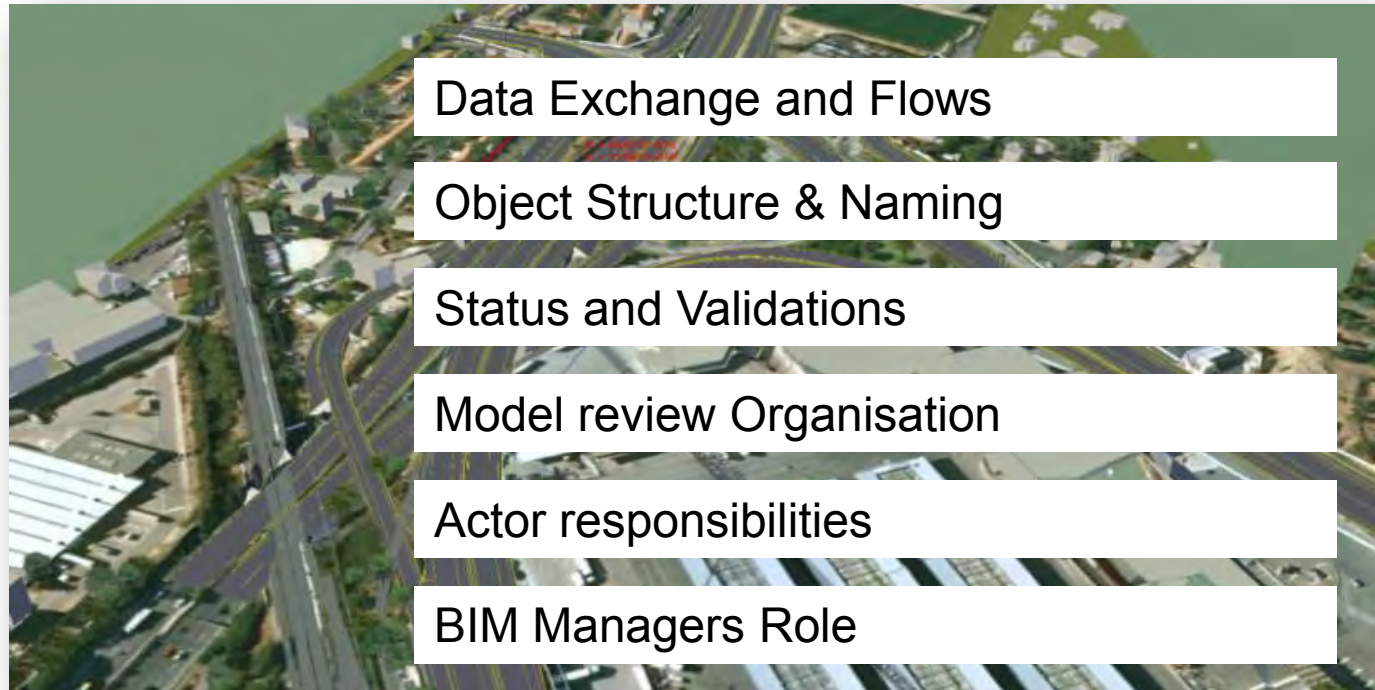
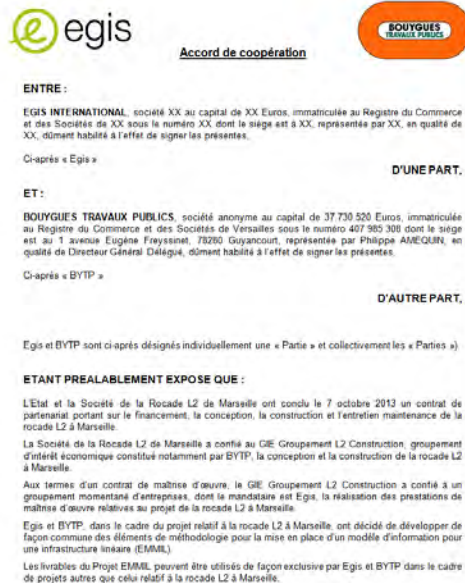


SOCIÉTÉ DE LA ROCADÉ
L2 DE MARSEILLE

L2 Ring : BIM Cooperation agreement



Methodology for an Information Model Development dedicated to a Linear Infrastructure



L2 Ring : BIM Goals



Main goals

- Data consistency control
- Discipline Coordination
- Construction sequences
- Support for communication and consultation

L2 Ring : Information Breakdown

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Section	Famille	Zone Géographique	Ouvrage	Catégorie	Type de donnée	Nom du calque	Nom de la source	Etat	Ph	Date d'intégration théorique	Date d'intégration réel					
679	Aréaliser	L2 Est	Projet routier	Saint Julien	Bretelle B2	Signalisation V	Bloc										
680	Aréaliser	L2 Est	Projet routier	Saint Julien	Bretelle B2	Équipements	Bloc										
681	Aréaliser	L2 Est	Projet routier	Saint Julien	Bretelle B2	Assainissement	Réseau de surface	Polygone 3D				30/04/2014					
682	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Ave	Polygone					30/04/2013					
683	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Corps de chaussée	Face 3D	XREF_ELAPA_IMAGE_PROJET	Bretelle A4	Ei	APA	30/04/2013					
684	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Terrassement	plate-forme	Face 3D	FRS_VALLON_A4	Ei	APA	30/03/2014					
685	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Terrassement	Talus	Face 3D									
686	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Équipements	Dispositif de sécurité	Bloc	00-EQTS-ECL-1x250			07/03/2014					
687	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Équipements	Éclairage	Bloc	00-EQTS-ECL-1x250			07/03/2014					
688	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Équipements	Signalisation H	Polygone									
689	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Équipements	Signalisation V	Bloc	VUE_EN_PLAN_L2_EST_VS_SH	Intégré		03/03/2014					
690	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Équipements	Exploitation	Bloc									
691	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A4	Assainissement	Réseau de surface	Polygone 3D									
692	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Ave	Polygone					30/04/2014					
693	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Chaussée	Corps de chaussée	Face 3D	XREF_ELAPA_IMAGE_PROJET	Bretelle A5	Ei	30/04/2013					
694	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Terrassement	plate-forme	Face 3D	FRS_VALLON_A5	Ei	APA	30/04/2013					
695	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Terrassement	Talus	Face 3D			APA	30/03/2014					
696	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Équipements	Dispositif de sécurité	Bloc	00-EQTS-ECL-1x250			07/03/2014					
697	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Équipements	Éclairage	Bloc	00-EQTS-ECL-1x250			07/03/2014					
698	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Équipements	Signalisation H	Polygone									
699	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Équipements	Signalisation V	Bloc	VUE_EN_PLAN_L2_EST_VS_SH	Intégré		03/03/2014					
700	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Équipements	Exploitation	Bloc									
701	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A5	Assainissement	Réseau de surface	Polygone 3D				30/04/2014					
702	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Ave	Polygone					30/04/2013					
703	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Chaussée	Corps de chaussée	Face 3D	XREF_ELAPA_IMAGE_PROJET	Bretelle A6	Ei	30/04/2013					
704	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Terrassement	plate-forme	Face 3D	FRS_VALLON_A6	Ei	APA	30/04/2013					
705	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Terrassement	Talus	Face 3D			APA	30/03/2014					
706	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Équipements	Dispositif de sécurité	Bloc	00-EQTS-ECL-1x250			07/03/2014					
707	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Équipements	Éclairage	Bloc	00-EQTS-ECL-1x250			07/03/2014					
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709	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Équipements	Signalisation V	Bloc	VUE_EN_PLAN_L2_EST_VS_SH	Intégré		07/03/2014					
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711	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A6	Assainissement	Réseau de surface	Polygone 3D									
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713	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Chaussée	Corps de chaussée	Face 3D	XREF_ELAPA_IMAGE_PROJET	Bretelle A7	Ei	30/04/2013					
714	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Terrassement	plate-forme	Face 3D	FRS_VALLON_A7	Ei	APA	30/04/2013					
715	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Terrassement	Talus	Face 3D			APA	30/03/2014					
716	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Équipements	Dispositif de sécurité	Bloc	00-EQTS-ECL-1x250			07/03/2014					
717	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Équipements	Éclairage	Bloc	00-EQTS-ECL-1x250			07/03/2014					
718	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Équipements	Signalisation H	Polygone									
719	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Équipements	Signalisation V	Bloc	VUE_EN_PLAN_L2_EST_VS_SH	Intégré		07/03/2014					
720	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Équipements	Exploitation	Bloc				03/03/2014					
721	Aréaliser	L2 Est	Projet routier	Frais Vallon	Bretelle A7	Assainissement	Réseau de surface	Polygone 3D									
722	Aréaliser	L2 Est	Basins autoroutiers	Florian	Basins autoroutiers	Assainissement	Bassin	Face 3D				30/04/2014					

Information

- Spatial breakdown
- System breakdown
- Object families
- LOD (Levels of Detail, Definition, Development, Decision ???)
- **Partners' responsibility definition**
- Milestones for 3D data delivery

L2 Ring : Model Generation

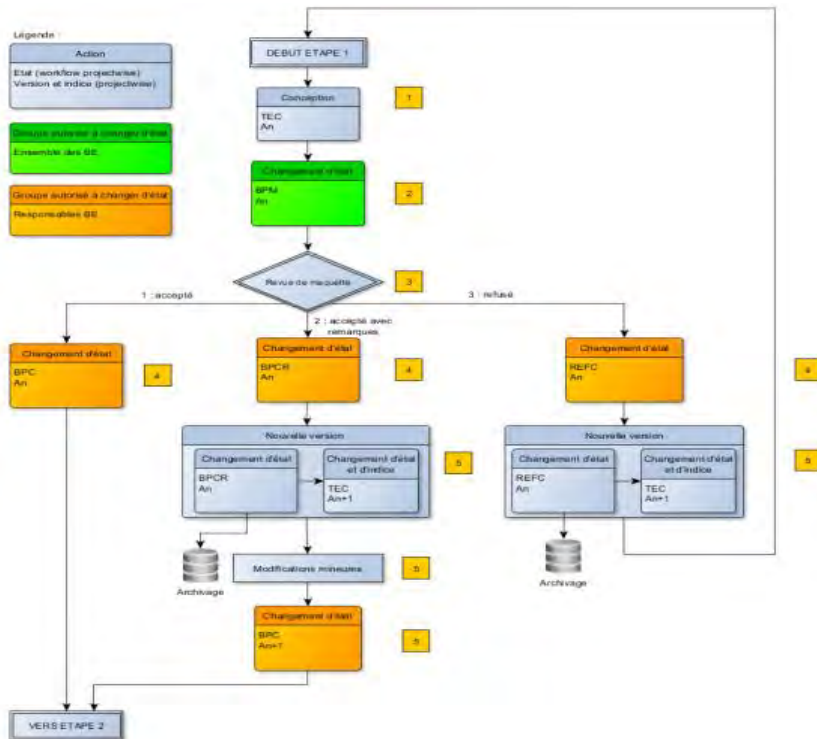
- GIS Data
- LIDAR Data (Light Detection And Ranging)
- Existing buildings and project environment
- New design Data



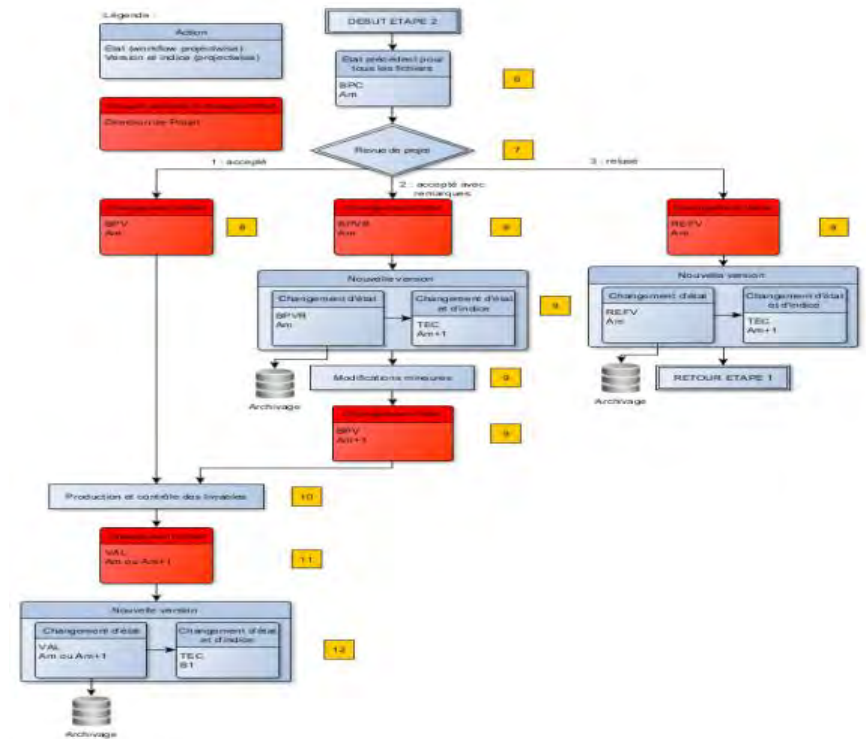
L2 Ring : Necessary processes

- Exchange platform
- Graphic charts and Naming convention
- Data status
- Coordination and Synthesis
- Deliverables

Model review

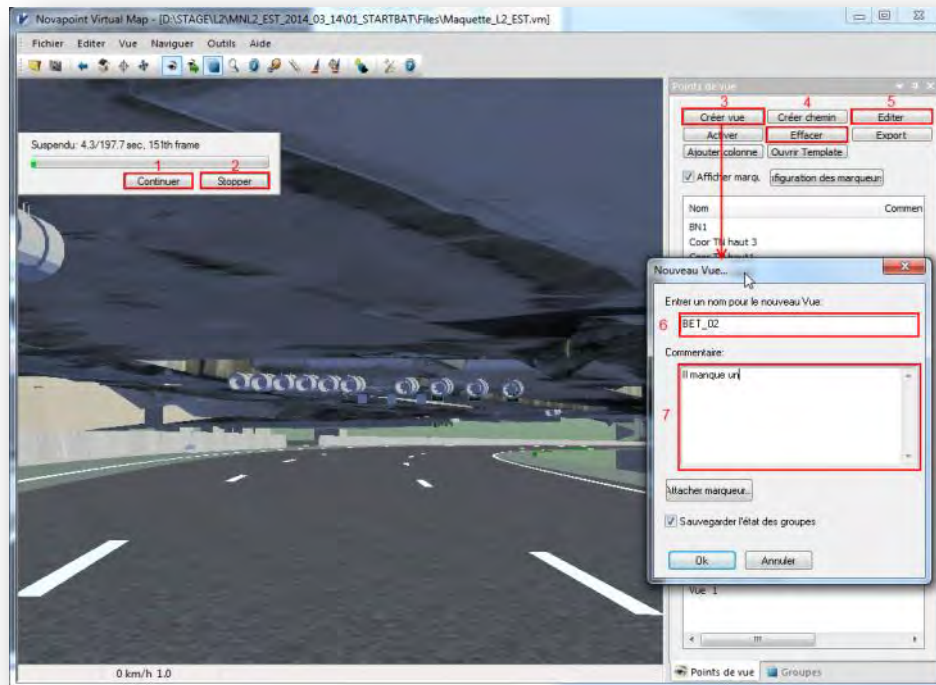


Project review

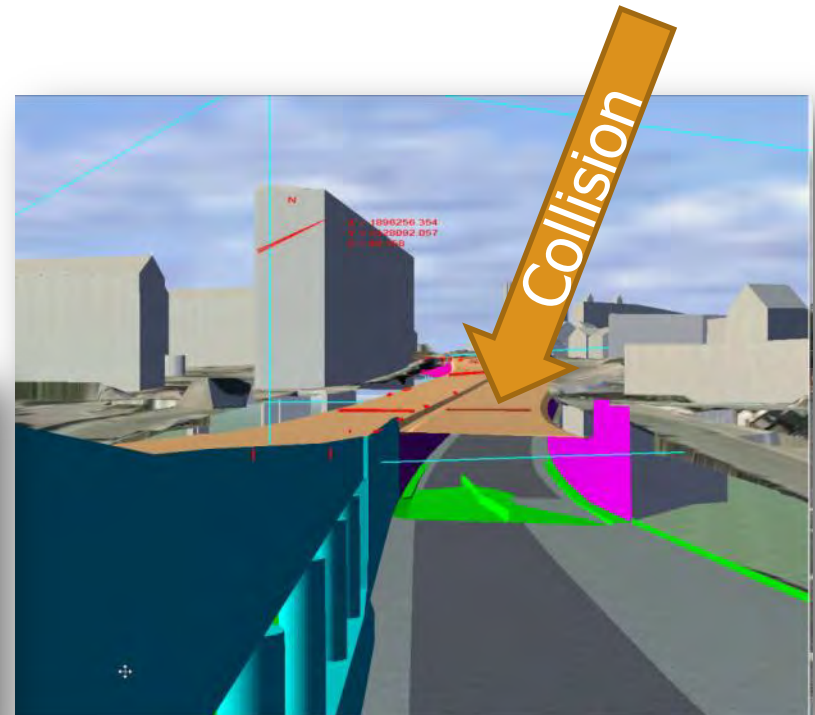


L2 Ring : First results

- Inconsistency
- Road gauges
- Visibility Checks
- Safety Checks



Path analysis

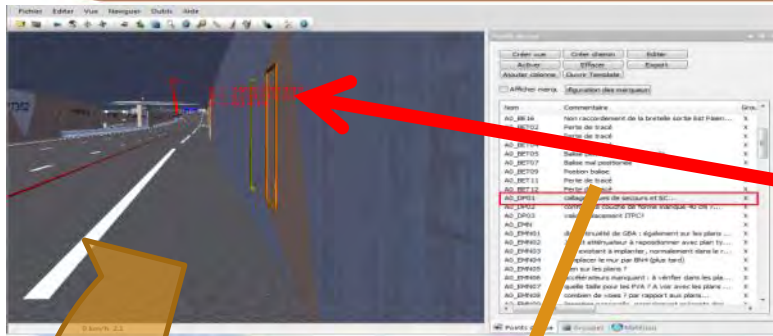


Road gauges analysis

L2 Ring : Dynamic Visibility Check


ANALYSE DE VISIBILITE DYNAMIQUE
L2 NORD – Echangeur des Arnavaux : A7 vers A50 Voie Lente

L2 Ring : Clash management



Model Review

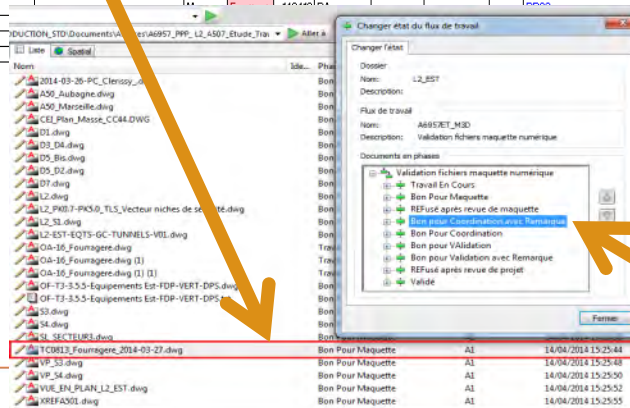
Clash identification concerning location of one emergency exit

SUIVI DES REMARQUES POUR LA MNL2_EST DU										04/04/2014	A0								
Entité concernée par le pdv	Nom du pdv dans PV	Commentaires	Lien vers Sources concernées	Type de problème (Conception/Contractuel)	Priorité	Etat	Date	Nom créateur de la vue	Résolu par	Commentaire de résolution	Temp. vers l'image								
BET02	A0_BET02	Perte de tracé			Fort	En attente	14/04/2014	IA											
BET03	A0_BET03	Perte de tracé			Fort	En attente	14/04/2014	IA											
BET04	A0_BET04	Perte de tracé			Fort	En attente	14/04/2014	IA											
BET05	A0_BET05	Balise peut être mal positionnée			Fort	En attente	14/04/2014	IA											
BET07	A0_BET07	Balise mal positionnée			Fort	En attente	14/04/2014	IA											
BET09	A0_BET09	Position balise			Fort	En attente	14/04/2014	IA											
BET11	A0_BET11	Perte de tracé			Fort	En attente	14/04/2014	IA											
BET12	A0_BET12	Perte de tracé			Fort	En attente	14/04/2014	IA											
BE10	A0_BE10	Non raccordement de la bretelle sortie Est Florian (bretelle C1)			Fort	En attente	14/04/2014	RL											
BE11	A0_BE11	Non raccordement de la bretelle entrée Est Faïenciers (bretelle C1)			Fort	En attente	14/04/2014	RL											
BE12	A0_BE12	Non raccordement de la bretelle sortie Est Saint Julien (bretelle B2)			Fort	En attente	14/04/2014	RL											
BE13	A0_BE13	Non raccordement de la bretelle sortie Ouest Caillols (bretelle B4)			Fort	En attente	14/04/2014	RL											
BE14	A0_BE14	Non raccordement de la bretelle sortie Ouest Faïenciers (bretelle C2)			Fort	En attente	14/04/2014	RL											
BE15	A0_BE15	Non raccordement de la bretelle entrée Ouest Faïenciers (bretelle C3)			Fort	En attente	14/04/2014	RL											
BE16	A0_BE16	Non raccordement de la bretelle sortie Est Faïenciers (bretelle C4)			Fort	En attente	14/04/2014	RL											
BE05	A0_BE05	Collision plateforme et dalle A50			Fort	En attente	14/04/2014	RL											
BE06	A0_BE06	Non raccordement de la bretelle entrée Est Saint Julien (bretelle B1)			Fort	En attente	14/04/2014	RL											
BE07	A0_BE07	Dérivellation de PL à faire			Fort	En attente	14/04/2014	RL											
BE08	A0_BE08	Non raccordement de la bretelle entrée Ouest Faïenciers (bretelle A6)			Fort	En attente	14/04/2014	RL											
BE09	A0_BE09	Non raccordement de la bretelle entrée Ouest Caillols (bretelle B3)			Fort	En attente	14/04/2014	RL											
DP01	A0_DP01	Callage issues de secours et SC Ech. Faïenciers	TC0813_Fouragere_2014-03-27	Contractuel	Fort	En attente	14/04/2014	RA											
DP02	A0_DP02	conformité couche de forme manque 40 cm ? Ech. st Julien																	
DP03	A0_DP03	valider placement ITPC?																	
EMN20	A0_EMN20	SV décalée																	
EMN15	A0_EMN15	alignement SC bretelle																	

Clash follow-up

Management In Project Wise

Status of the concerned file in the catalogue of native files

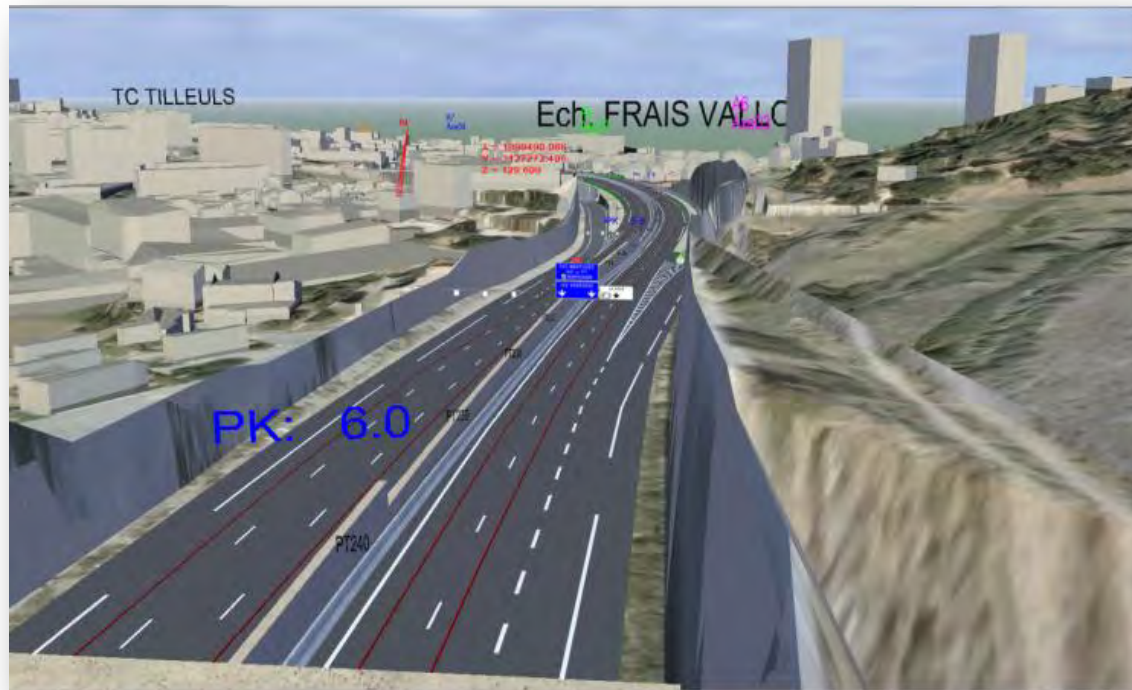


L2 Ring : On-going developments

From Conceptual Design to Workshop Design with the same processes

“Geographic” data integration

- Geographic information: hydraulics
- Simulation data: Noise maps
- Information to residents: work sequences and diversions



Agenda

- Bouygues Construction
and Main current projects
- BIM for Buildings
(Philharmonie of Paris)
- BIM for Infrastructures
(L2 Ring around Marseilles)
- **National Project MINnD and openINFRA initiative**
- Conclusion - Questions

Modeling of INteroperable INformation for sustainable INfrastructures in nD



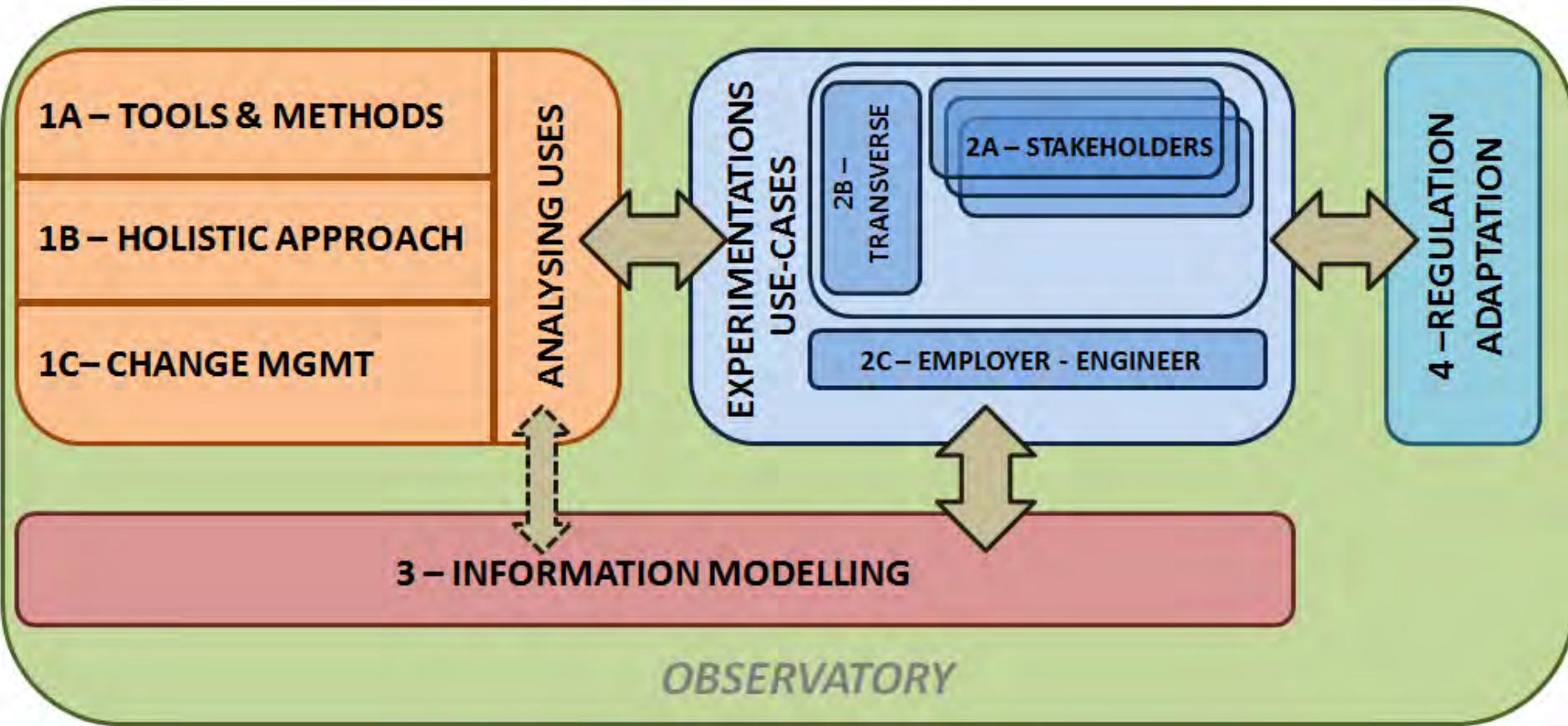
Modélisation des INformations INteropérables
pour les INfrastructures Durables

A 4 year French “National Project”, dedicated to Infrastructures

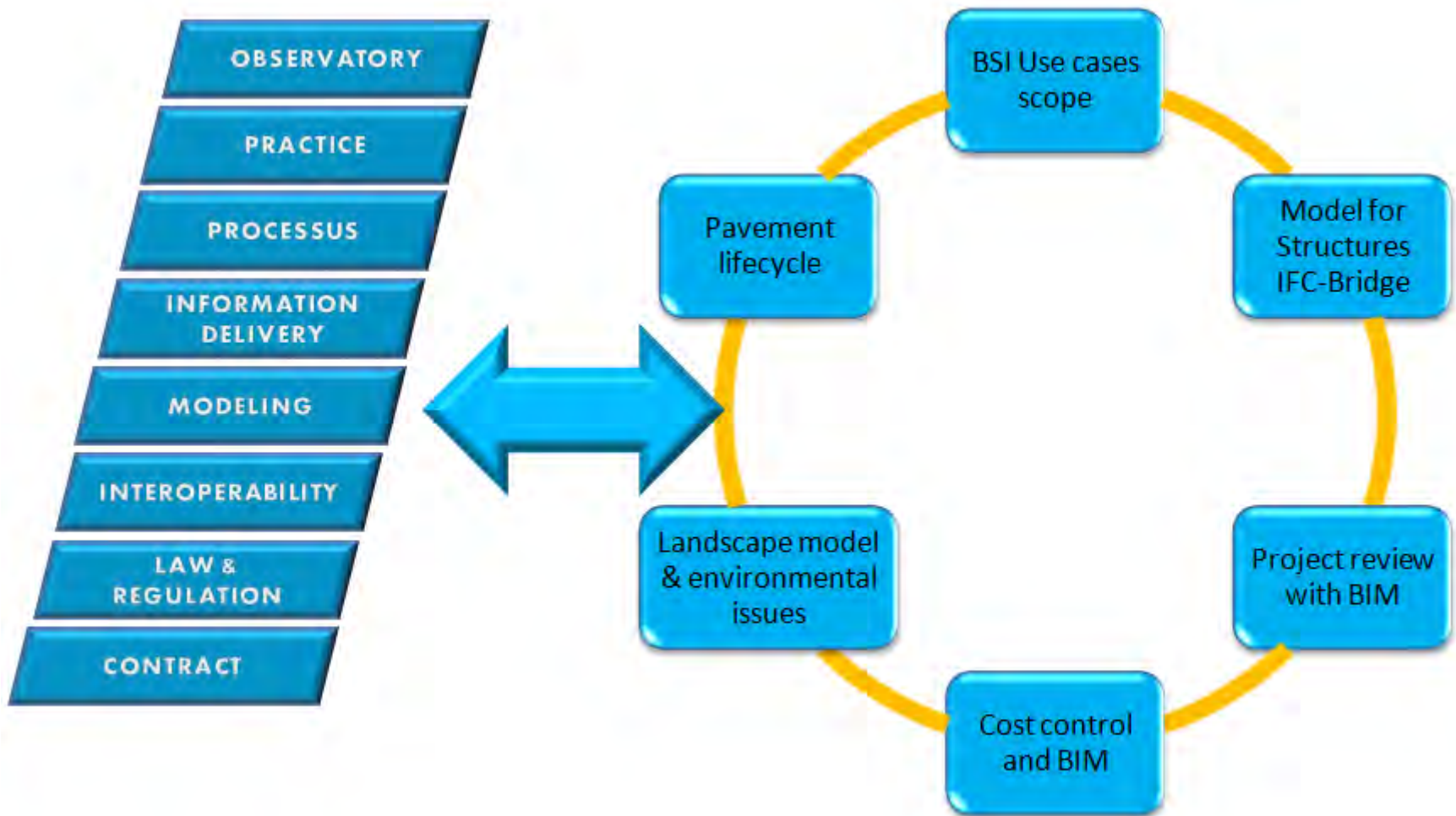
Ambition

- Structure information to be exchanged
- Define requirements for software editors
- Propose French regulation adaptation

MINⁿD : Research themes



MINⁿD : Use Cases & Work Packages



1st part: 18 month

6 first practical Use Cases to bring materials to the MINnD themes

MINⁿD : Partners





***Data model and IFC
For Infrastructure***

An international initiative, supported by BuildingSmart International

Ambition

- Define:
 - IDM (Information Delivery Manual)
 - MVD (Model View Definition)
 - IFC4 – ISO 16739 (Industry Foundation Classes)
to facilitate interoperability
- Consistent with IFC-Alignment and IFC-Roads Work Packages



Agenda

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BIM Main concerns

Not on the tool level !

But on the process level:

- Trust between partners based on quality and reliability

And on the contractual level:

- Efficiency
- Cost and Time table control
- Data sustainability and durability



Questions



Shaping a better life, a reality...

To discover
in our Corporate Report 2013 on
www.bouygues-construction.com



... and the BIM Revolution
« Building before Building » on
www.bimgeneration.com



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