Welcome

Computer Aided Production Engineering

04 December 2019

PROJECT PRODUCTION INSTITUTE

Introduction

Computer Aided Production Engineering

04 December 2019

Primavera P6 Professional R16.1 : WELLMONT-17 (Wellmont Substation)

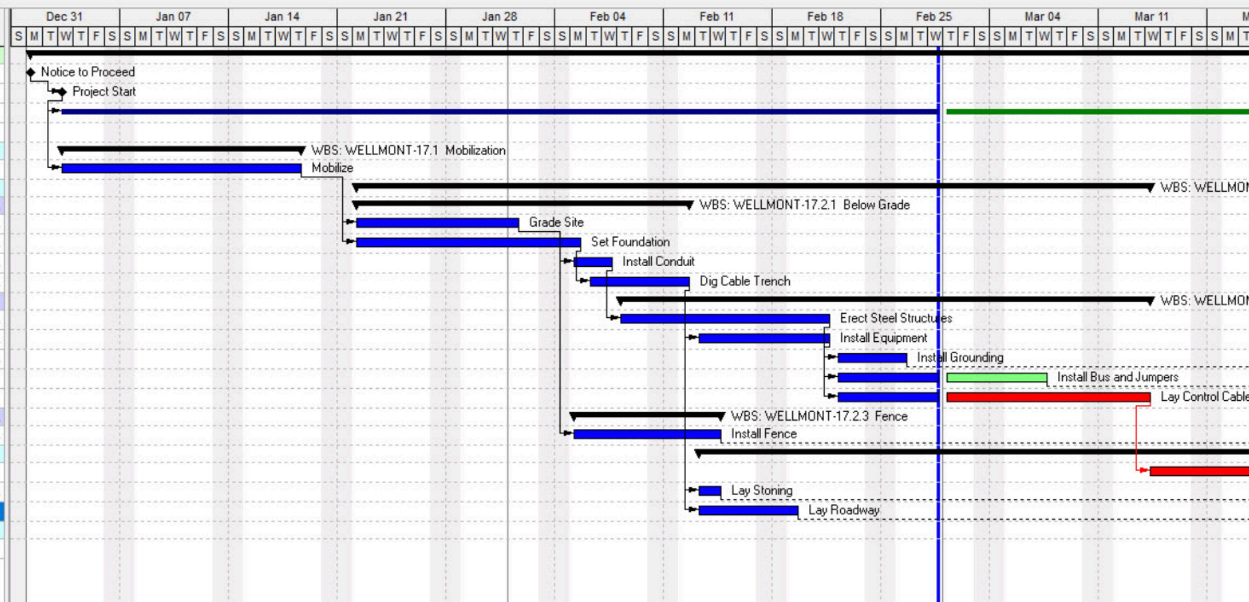
File Edit View Project Enterprise Tools Admin Help

Activities

Projects **Activities**

Layout: Standard Budget Layout — Filter: All Activities

Activity ID	Activity Name	Original Duration	Start	Finish
Project: WELLMONT-17	Wellmont Substation	58.0d	01-Jan-2018 A	10-Apr-2018
W1000	Notice to Proceed	0.0d	01-Jan-2018 A	
W1010	Project Start	0.0d	03-Jan-2018 A	
W1020	Project Management	56.0d	03-Jan-2018 A	10-Apr-2018
W1030	Project Complete	0.0d		10-Apr-2018
WBS: WELLMONT-17.1	Mobilization	10.0d	03-Jan-2018 A	18-Jan-2018 A
W1040	Mobilize	10.0d	03-Jan-2018 A	18-Jan-2018 A
WBS: WELLMONT-17.2	Construction	31.0d	22-Jan-2018 A	14-Mar-2018
WBS: WELLMONT-17.2.1	Below Grade	13.0d	22-Jan-2018 A	12-Feb-2018 A
W1050	Grade Site	8.0d	22-Jan-2018 A	01-Feb-2018 A
W1060	Set Foundation	9.0d	22-Jan-2018 A	05-Feb-2018 A
W1070	Install Conduit	3.0d	05-Feb-2018 A	07-Feb-2018 A
W1080	Dig Cable Trench	4.0d	06-Feb-2018 A	12-Feb-2018 A
WBS: WELLMONT-17.2.2	Above Grade	20.0d	08-Feb-2018 A	14-Mar-2018
W1090	Erect Steel Structures	8.0d	08-Feb-2018 A	21-Feb-2018 A
W1100	Install Equipment	6.0d	13-Feb-2018 A	21-Feb-2018 A
W1110	Install Grounding	2.0d	22-Feb-2018 A	26-Feb-2018 A
W1120	Install Bus and Jumpers	8.0d	22-Feb-2018 A	07-Mar-2018
W1130	Lay Control Cable	12.0d	22-Feb-2018 A	14-Mar-2018
WBS: WELLMONT-17.2.3	Fence	7.0d	05-Feb-2018 A	14-Feb-2018 A
W1140	Install Fence	7.0d	05-Feb-2018 A	14-Feb-2018 A
WBS: WELLMONT-17.3	Site Restoration	22.2d	13-Feb-2018 A	22-Mar-2018
W1150	Remove Equipment	5.0d	14-Mar-2018	22-Mar-2018
W1160	Lay Stoning	2.0d	13-Feb-2018 A	14-Feb-2018 A
W1170	Lay Roadway	4.0d	13-Feb-2018 A	19-Feb-2018 A
WBS: WELLMONT-17.4	Project Closeout	10.0d	22-Mar-2018	10-Apr-2018
W1180	Substantial Completion	10.0d	22-Mar-2018	10-Apr-2018



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Missing?

Advanced Work Packaging (AWP)

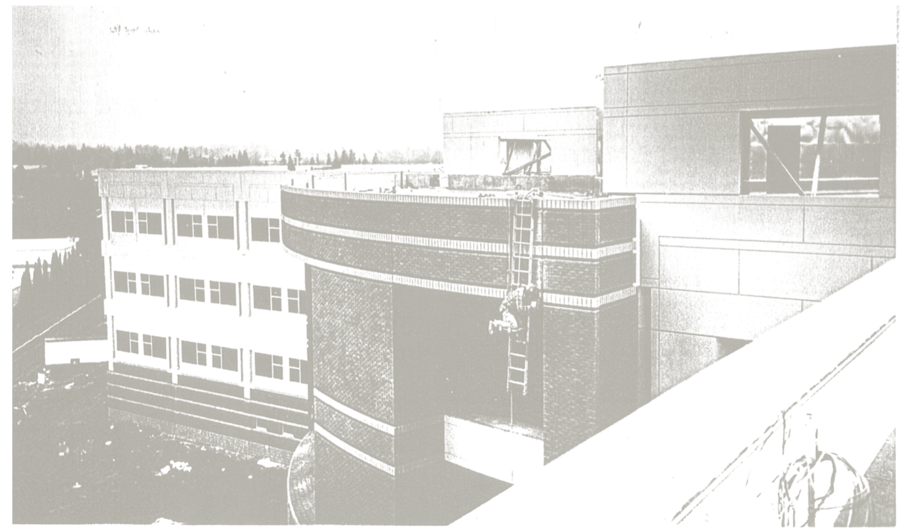
A construction-driven process that adopts the philosophy of “beginning with the end in mind.”

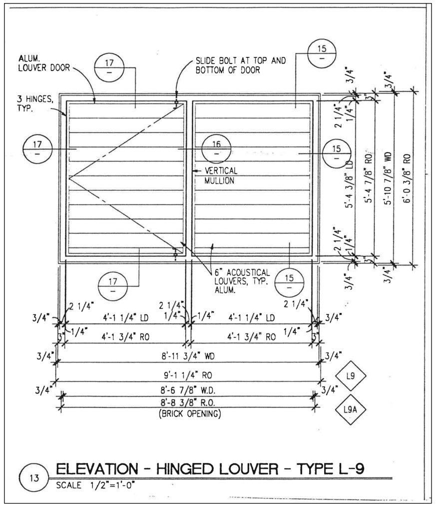
The work packaging and constraint management process removes the guesswork from executing at the workface by tightly defining the scope of all work involved, and by ensuring that all things necessary for execution are in place.

Construction Industry Institute (CII) RT272

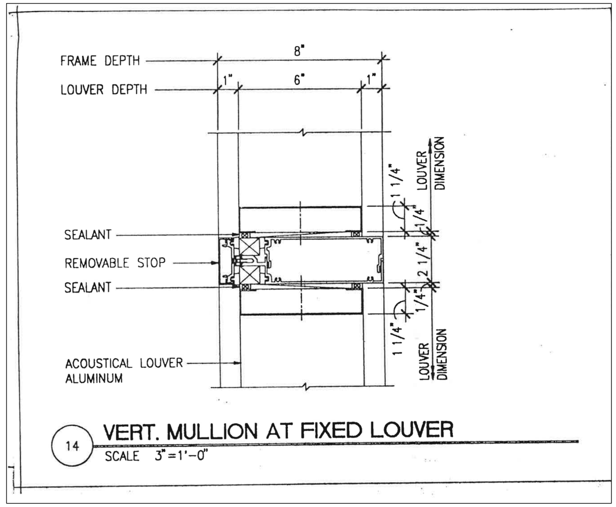
Design something, create a schedule of what, who and when then make sure all that is needed is there

What, who and when

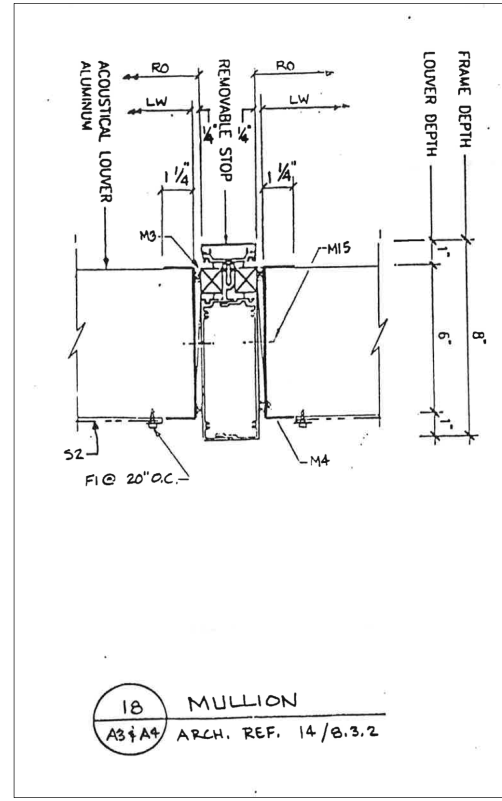




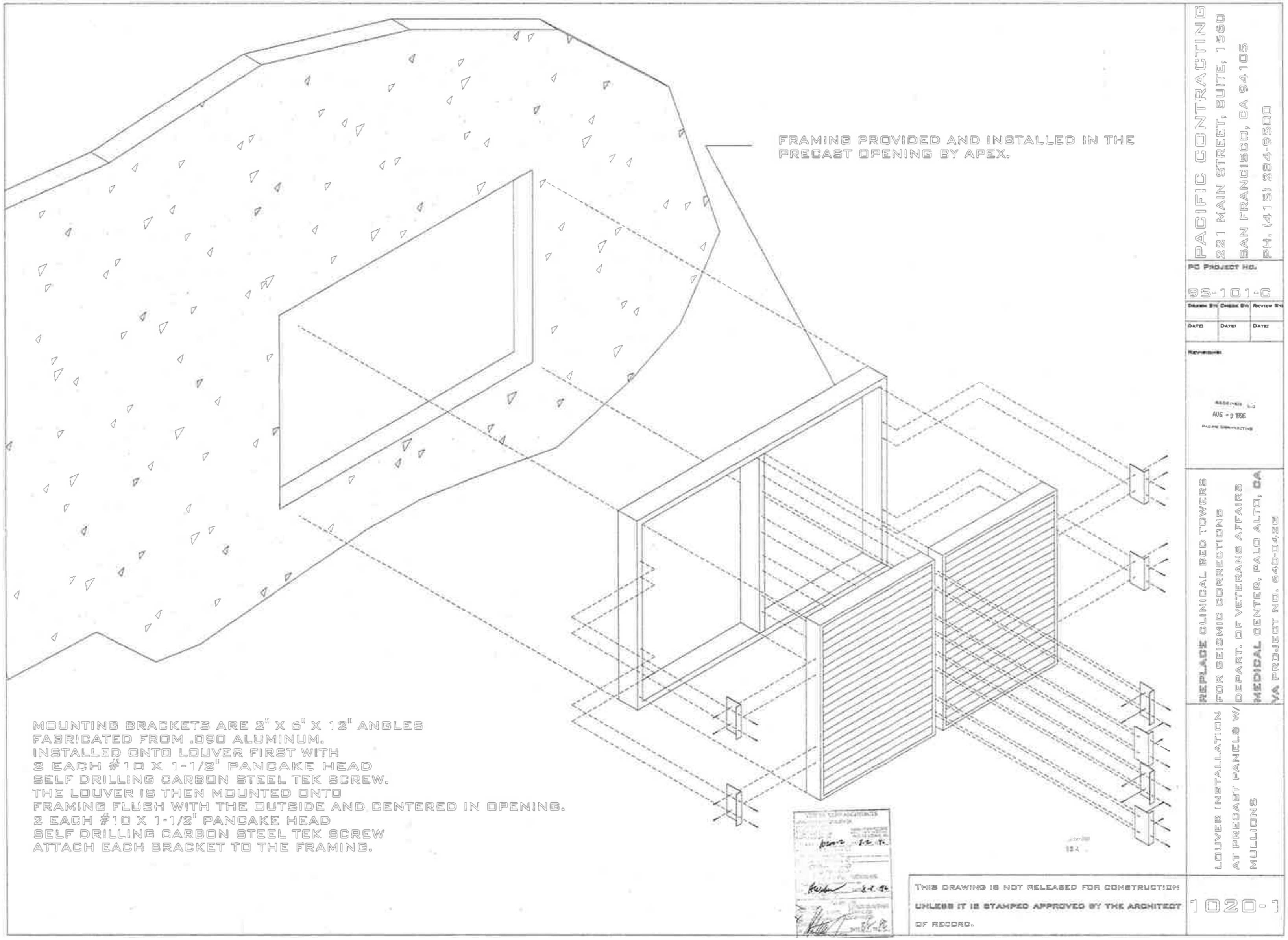
13 ELEVATION - HINGED LOUVER - TYPE L-9
SCALE 1/2"=1'-0"



14 VERT. MULLION AT FIXED LOUVER
SCALE 3"=1'-0"



18 MULLION
A3 & A4 ARCH. REF. 14/8.3.2



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Separate product design from process design

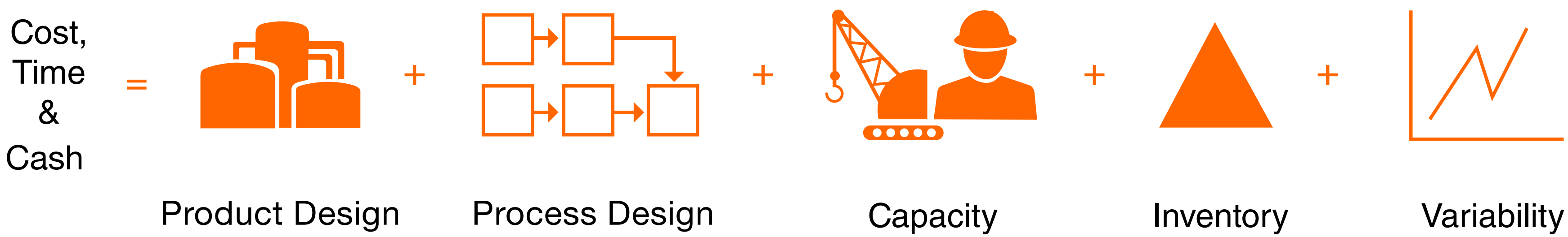
Proliferation of Era 2 project controls

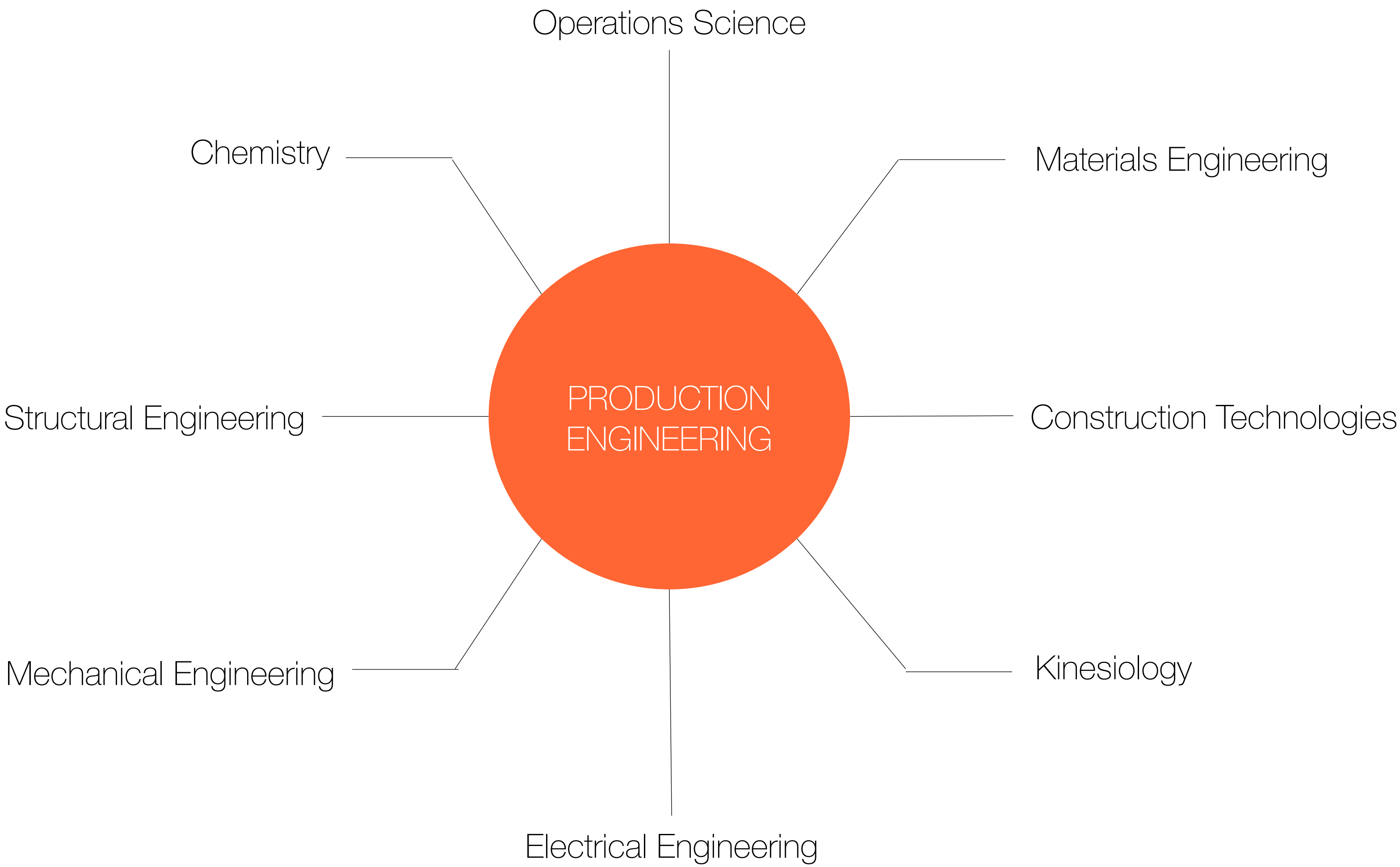
Lack of understanding of fundamental OS

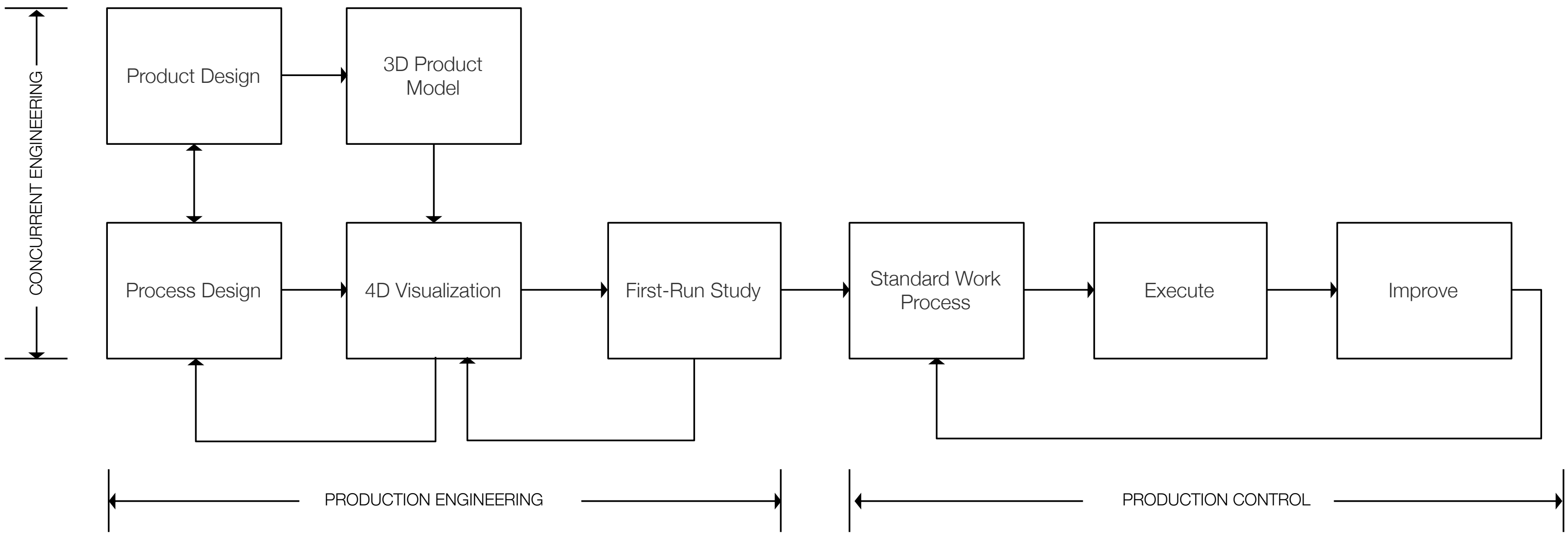
TIME	TOPIC	PRESENTER	VENUE
7:30 - 8:30	Breakfast & Registration		
8:30 - 9:00	Welcome	Ram Shenoy PhD	Plenary – Ballroom
9:00 - 9:45	Call to Action	Gary Fischer	Plenary – Ballroom
9:45 - 10:00	Break		
10:00 - 10:45	Introduction to CAPE	Todd Zabelle	Yerba Buena B
10:45 - 12:00	Digital Prototyping in Support of CAPE	Alex Kunz P.E.	Yerba Buena B
12:00 - 12:45	Lunch		Plenary – Ballroom
12:45 - 1:15	Keynote	Anil Seth	Plenary – Ballroom
1:15 - 1:30	PPI Achievement Award		Plenary – Ballroom
1:30 - 2:30	Process Design & Validation	Roberto Arbulu Craig Evans	Yerba Buena B
2:30 - 2:45	Break		
2:45 - 4:30	Process Design & Validation	Roberto Arbulu Todd Zabelle	Yerba Buena B
4:30 - 5:00	Wrap Up	Plenary – Ballroom	Plenary – Ballroom

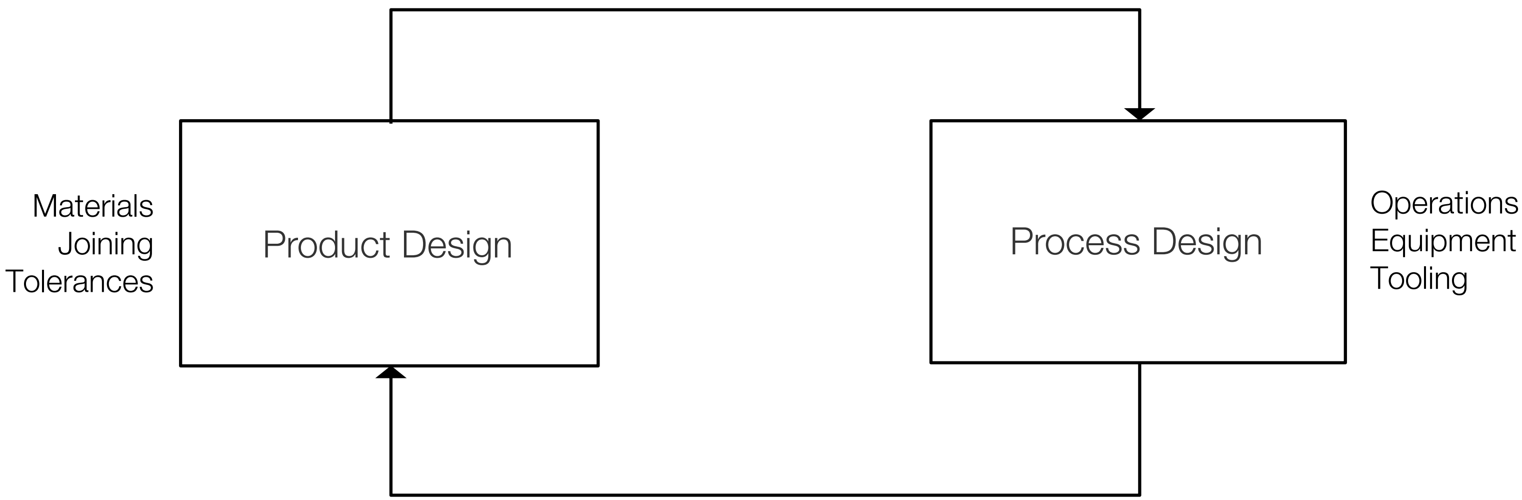
Production Engineering

Application of engineering material science, operations science and related knowledge to define, design and optimize production operations and processes


Cost,
Time
&
Cash
=
Product Design
+
Process Design
+
Capacity
+
Inventory
+
Variability


Operations Science
Chemistry
Materials Engineering
Structural Engineering
PRODUCTION ENGINEERING
Construction Technologies
Mechanical Engineering
Kinesiology
Electrical Engineering


CONCURRENT ENGINEERING
Product Design
3D Product Model
Process Design
4D Visualization
First-Run Study
Standard Work Process
Execute
Improve
PRODUCTION ENGINEERING
PRODUCTION CONTROL


Materials
Joining
Tolerances
Product Design
Process Design
Operations
Equipment
Tooling

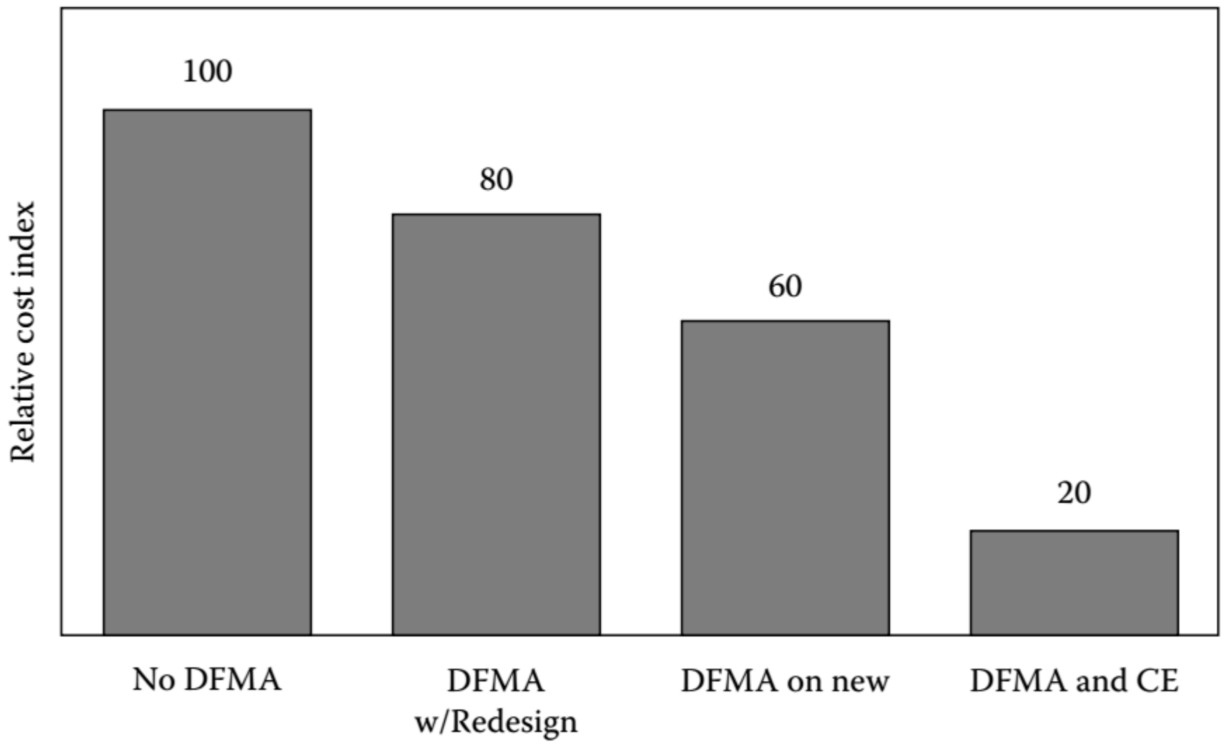
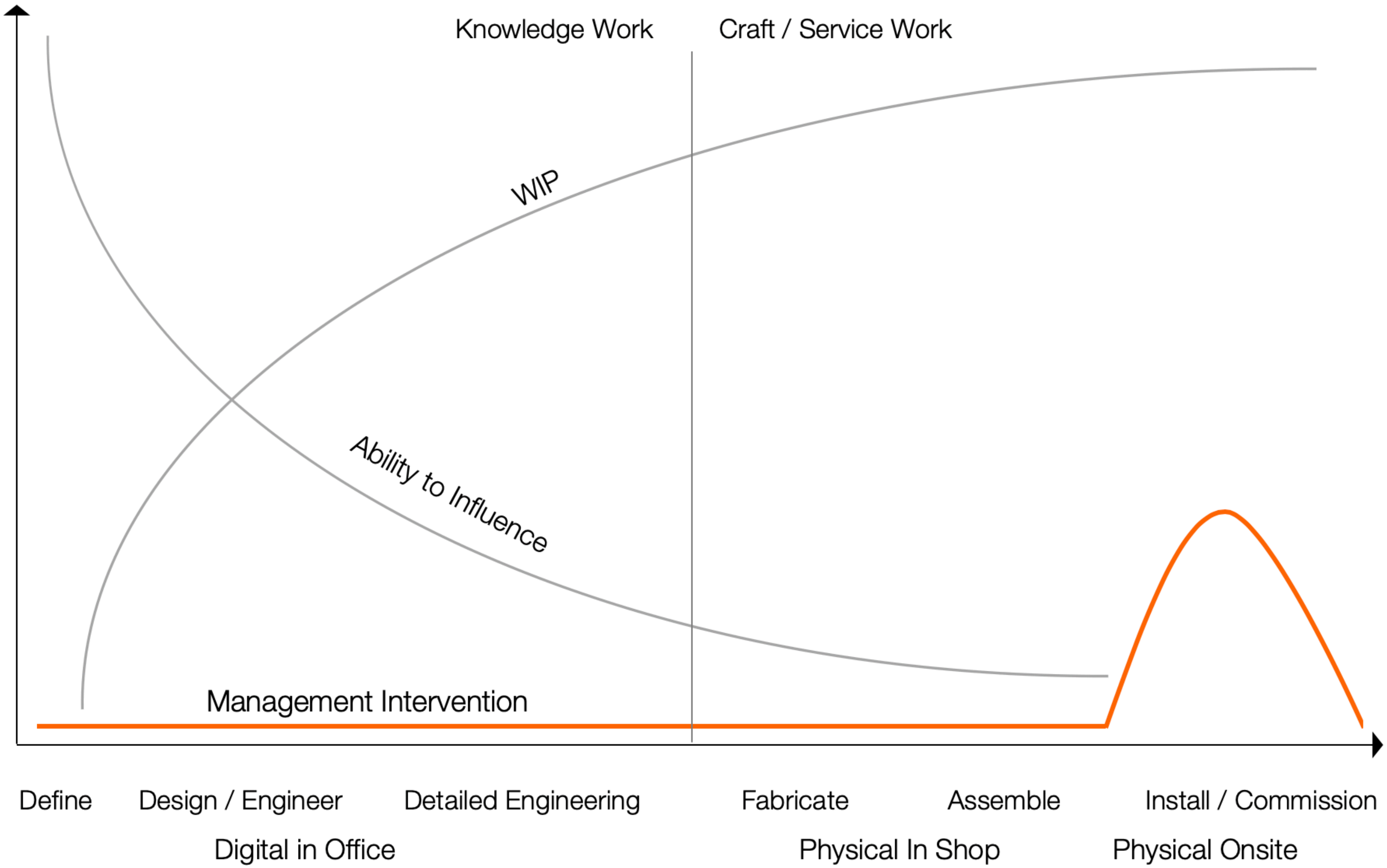


FIGURE 1.7
Effects of DFMA and CE on product cost at Hewlett Packard. (Adapted from Williams, R.A. *Successful Implementation of Engineering Products and Processes*. Van Nostrand, New York, 1994.)



Ability to Influence Curve adapted from Gluck & Foster HBR September 1975

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Computer Aided Production Engineering (CAPE)

Application of various computer tools including 4D visualization, discrete-event simulation, etc. to define, design and optimize production processes and systems

Role of CAPE in PPM?

Production System Optimization

Production Engineering

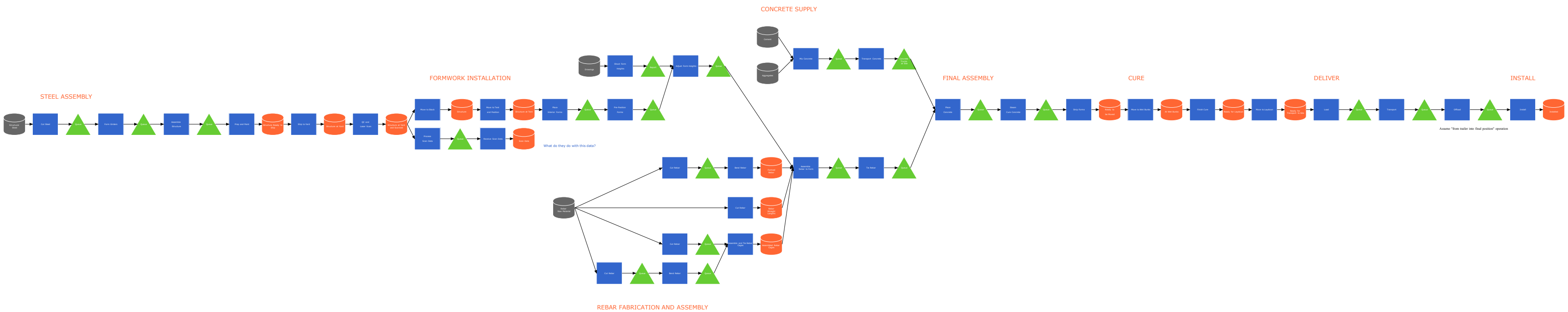
Project Production Control

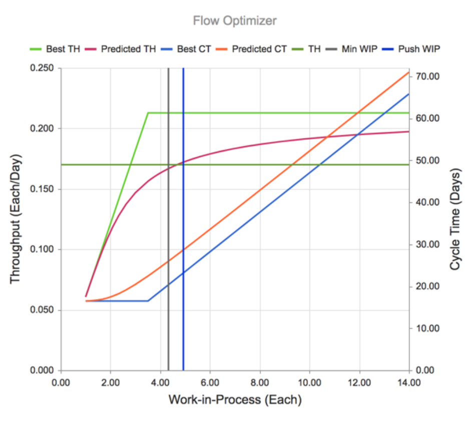
Apply?

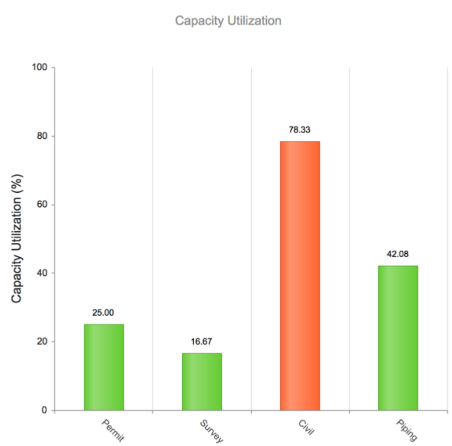
Bottleneck

Critical

Repetitive







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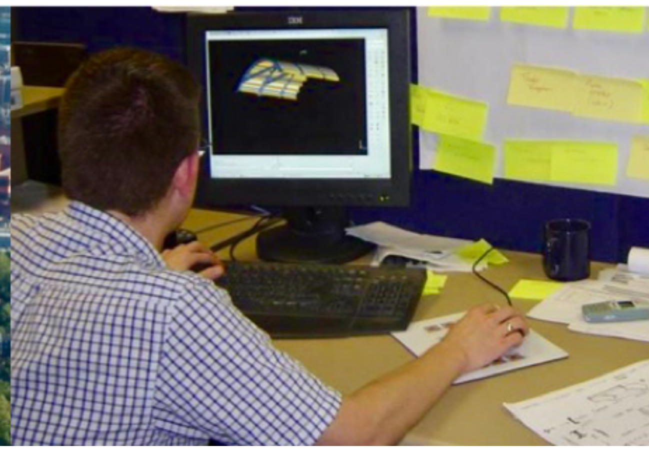


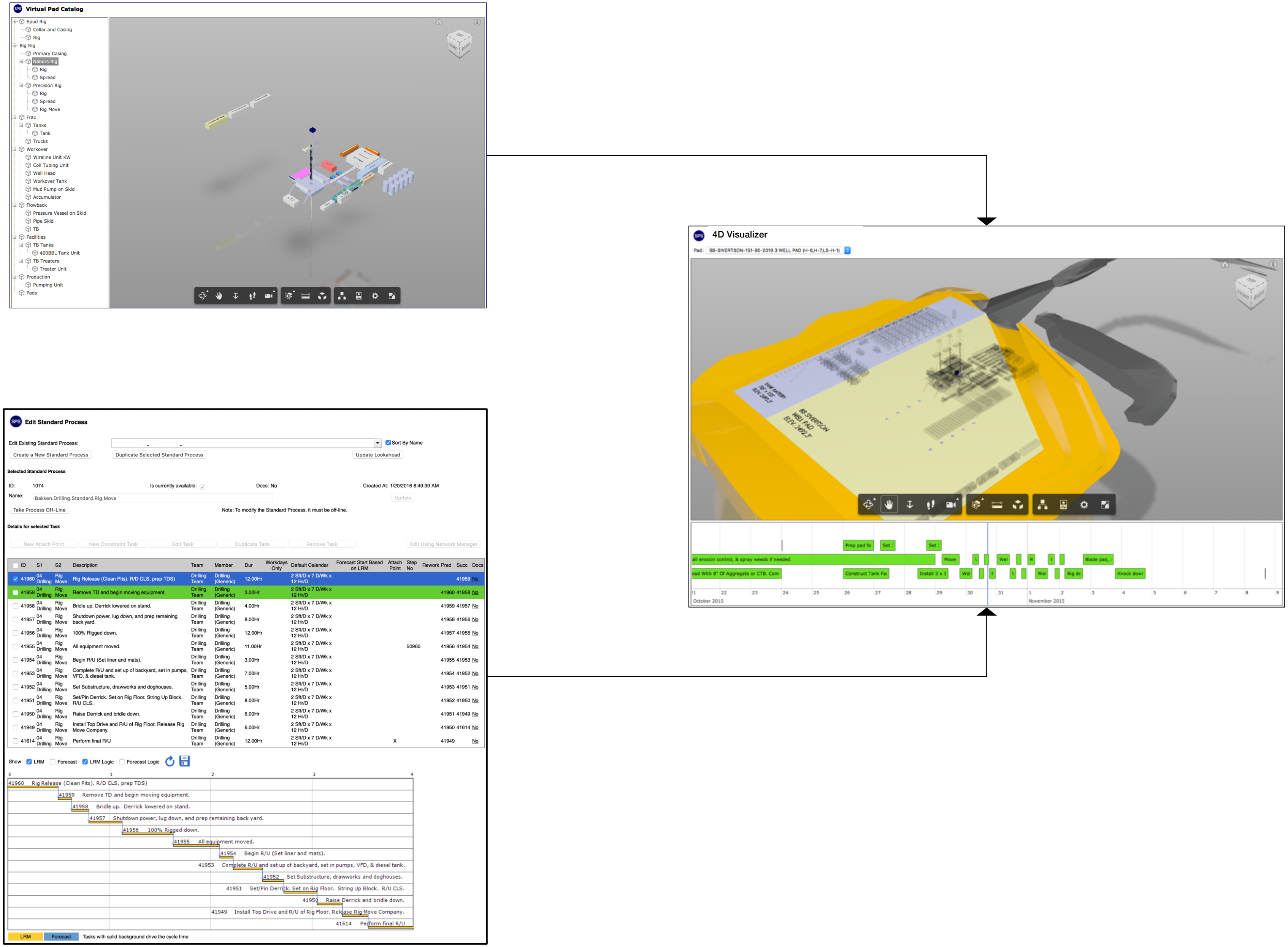

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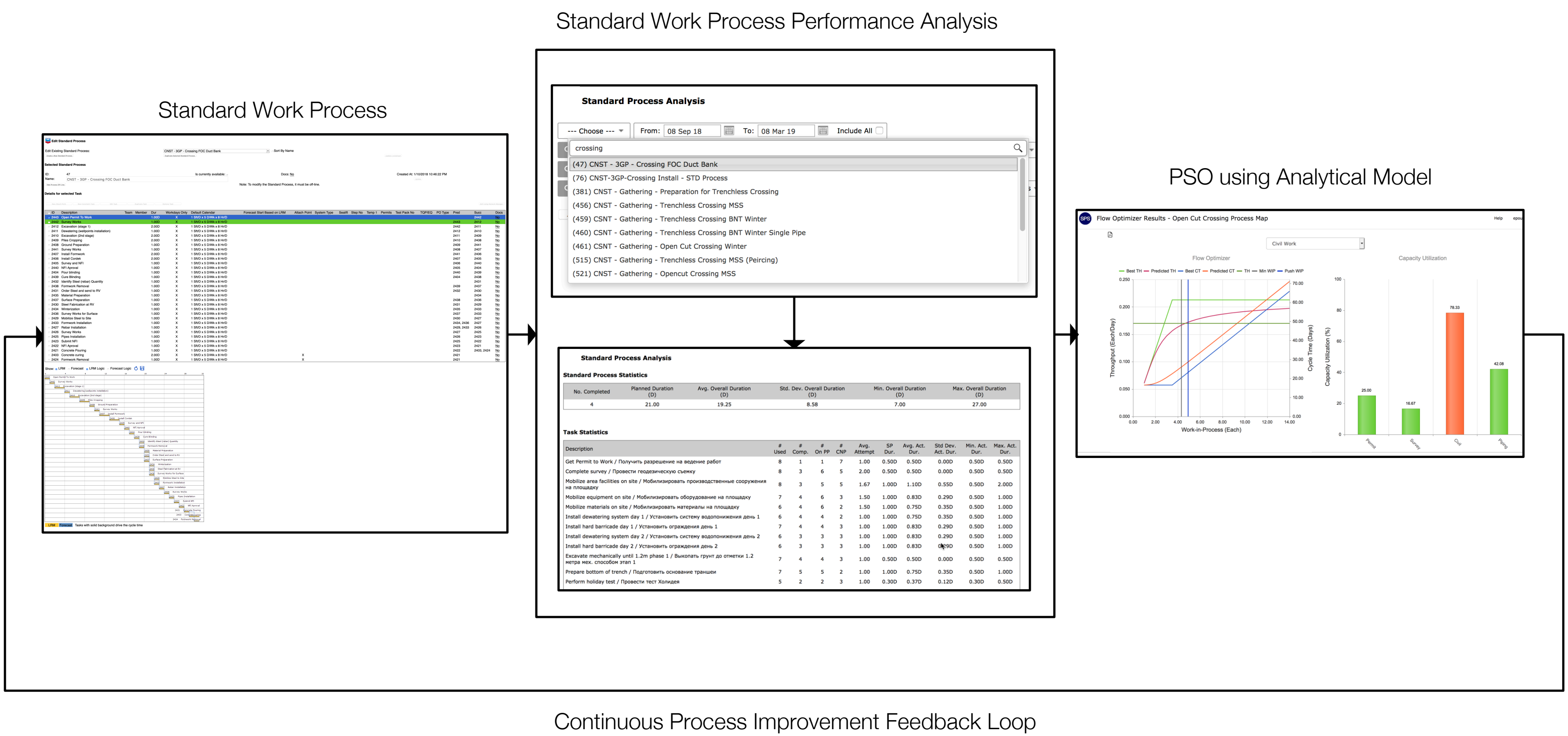
Design, control and improve



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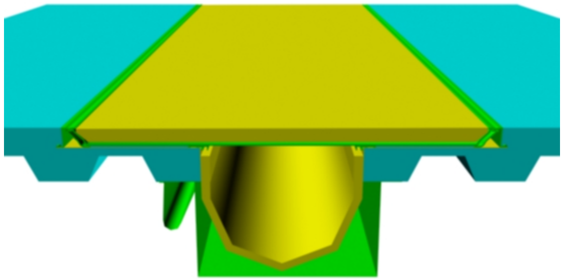
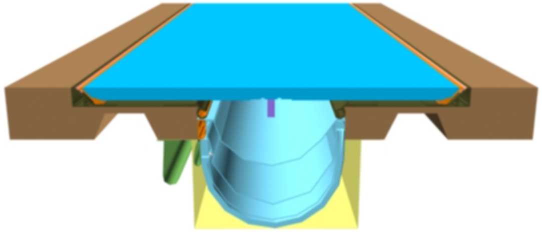
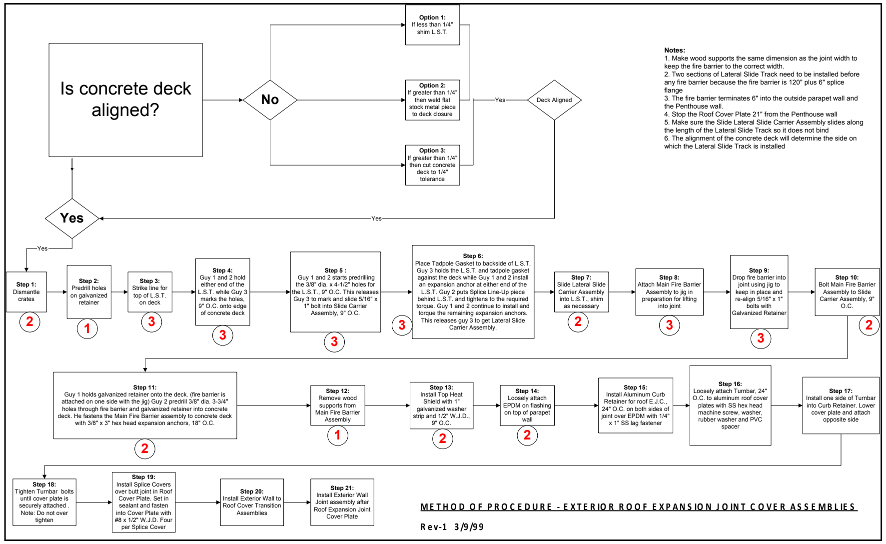
Machine Learning

Robotic Process Automation







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Pacific Contracting

Step No.	Description	Time per activity
	Dismantel crate before predrilling	
	Predrill holes on galvanized retainer (10' length)	3 mins
1	Strike line for top of L.S.T. on concrete deck	done
2	Mark holes for L.S.T. onto concrete deck	done
3	Predrilling 3/8" dia. x 4-1/2" holes for L.S.T. into deck	
	Predrill retainer and attach jig	4 mins 38 sec
4	Tape tadpole gasket to backside of L.S.T.. Guy 3 installs expansion anchors	
	and splice line-up piece.	
5	Slide Lateral Slide Carrier Assembly into Lateral Slide Track	6 mins 10 sec
6	Slide 5/16" x 1" bolts into Slide Carrier Assembly	5mins
	Realign bolts in Slide Carrier Assembly	2 mins
7	Drop fire barrier into joint and align bolts with Galvanized Retainer	2 mins 48 sec
8	Bolt main Fire Barrier assembly to Slide Carrier Assembly	
9	Predrill 3/8" dia. x 3-3/4" holes through fire barrier into concrete deck	31 mins 01 sec
	anchor and fasten	
10	Remove wood supports from Main Fire Barrier Assembly	6 min 18 sec
	Caulk the joint between the fire barrier	14 min 57 sec
11	Install Top Heat Shield to Galvanized Retainer	7 mins 50 sec
12	Loosely attach EPDM to parapet wall	
13	Install Aluminum Curb Retainer over EPDM onto parapet wall	
14	Attach turnbar assembly to aluminum curb retainer	
15	Fasten Splice covers to Roof Cover Plate	

Digital Prototype

Computer Aided Production Engineering

04 December 2019

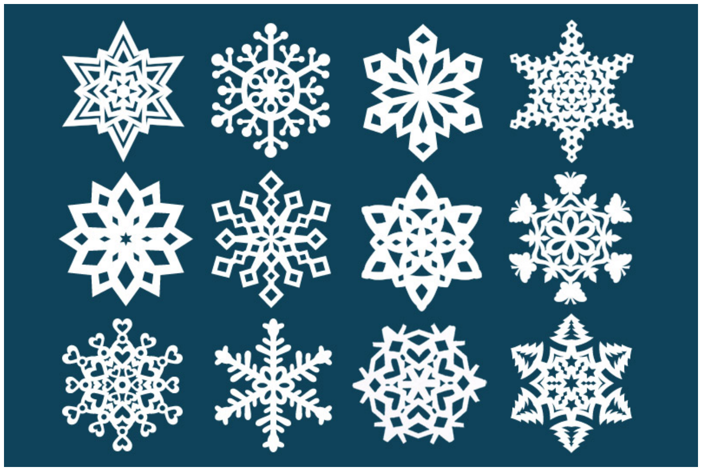
1. Current state approach vs Data-driven (Print drawings vs. Program robots)

2. Requirements: How to organize the data (use cases, product structure)

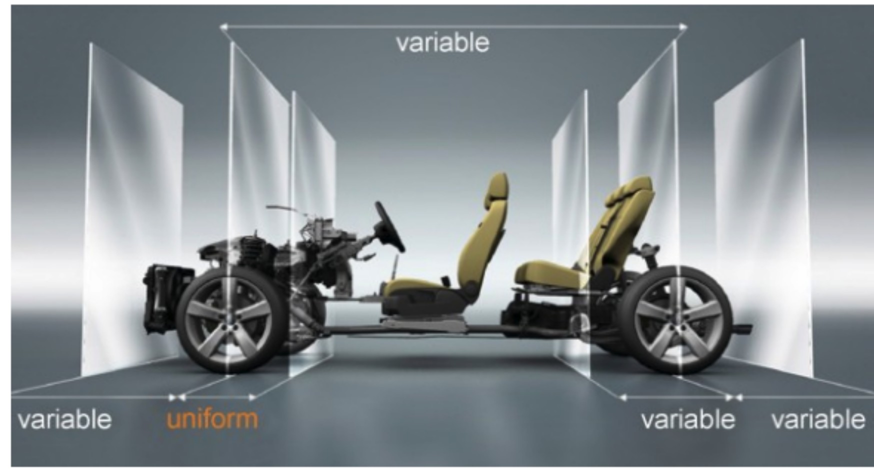
3. Product Data Management (Catalogs, reuse, taxonomies)

4. Interfaces & Precision

What does a program catalog look like

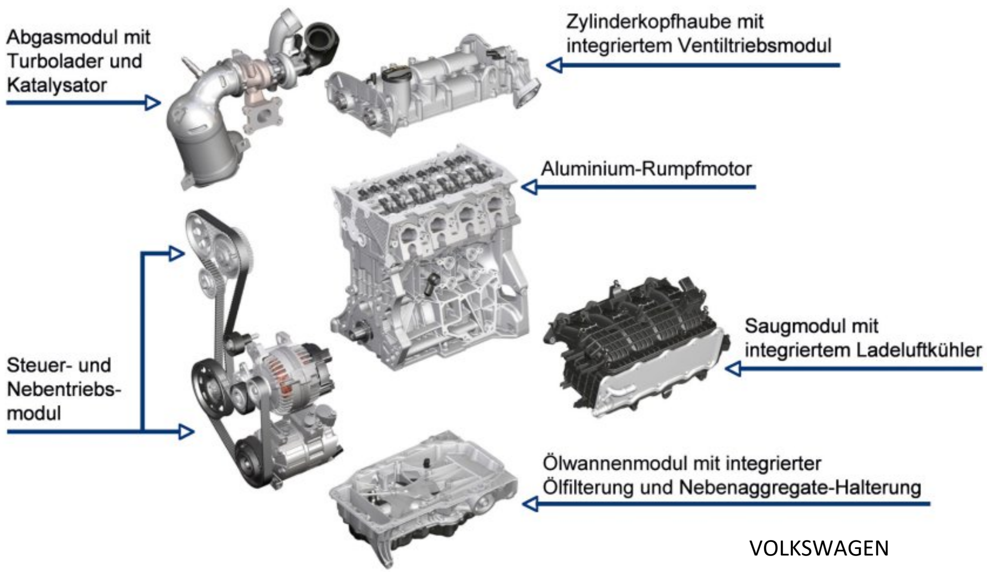


There's no time – get it built

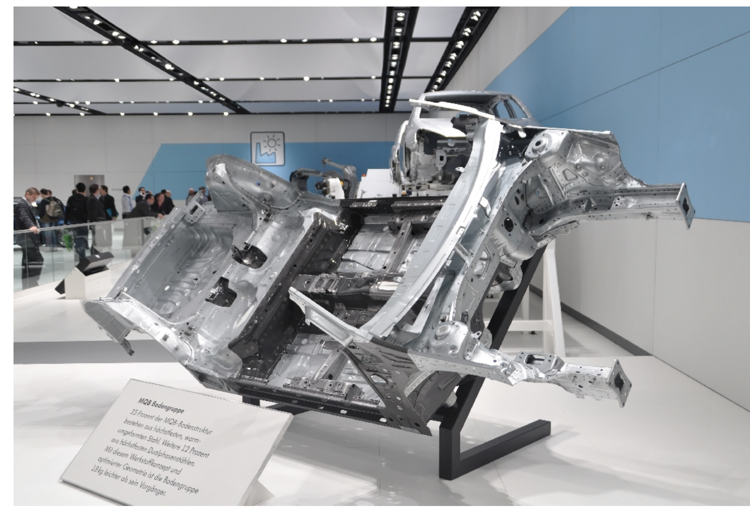


VW MQB platform used as basis for up to sixty vehicle designs

What does a program catalog look like

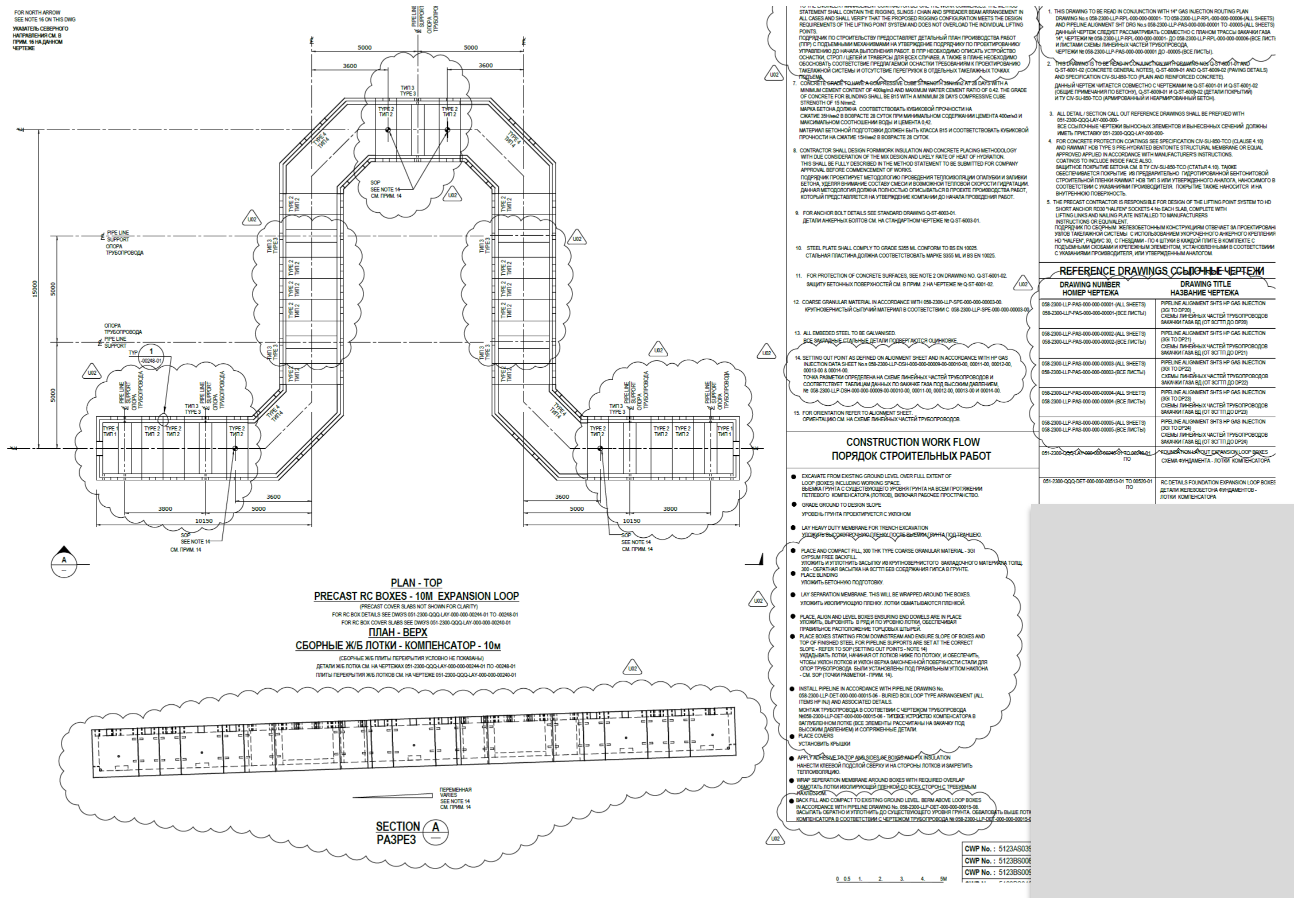


VOLKSWAGEN



VOLKSWAGEN

What does design data look like



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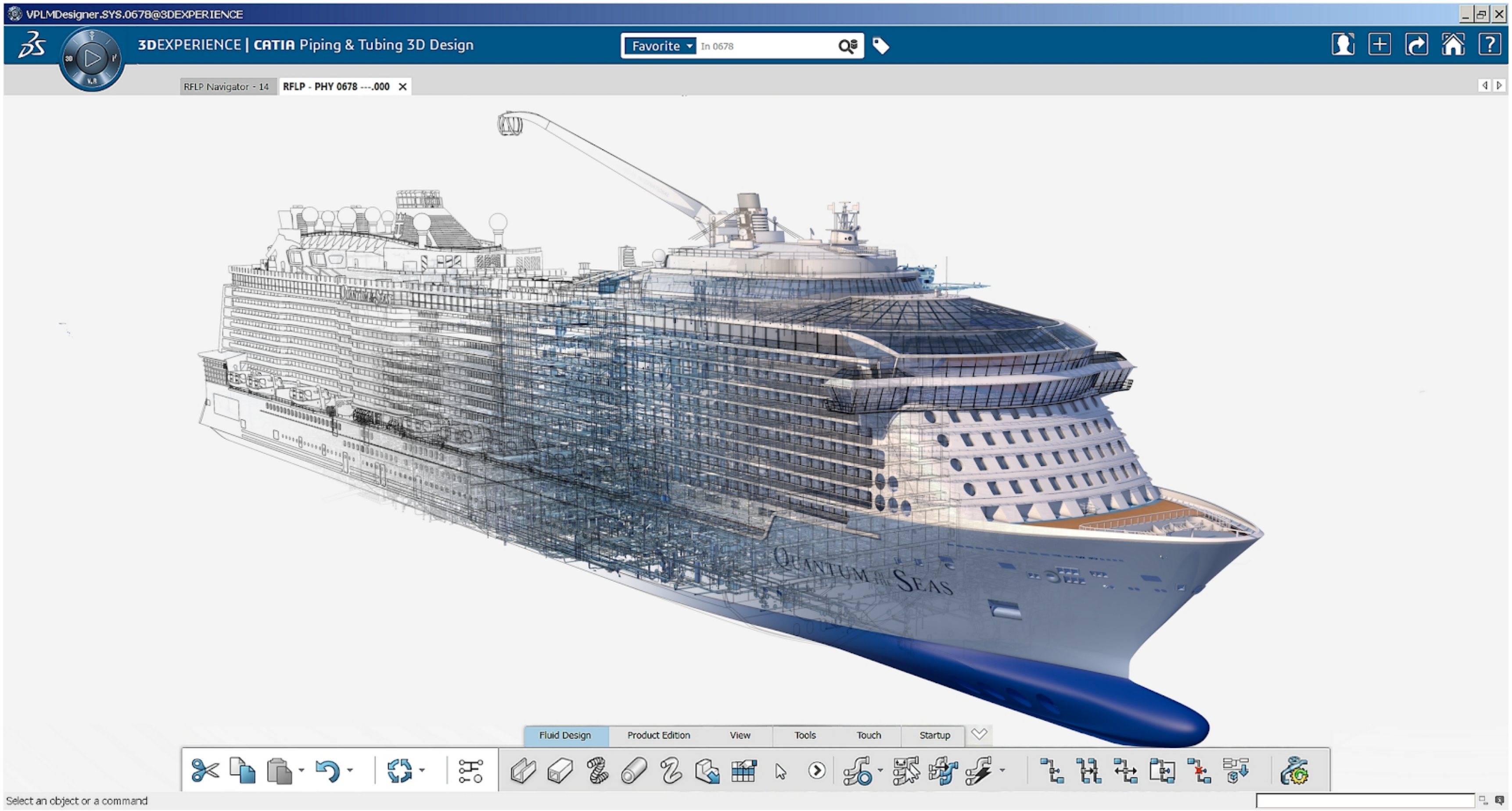
What does design data look like



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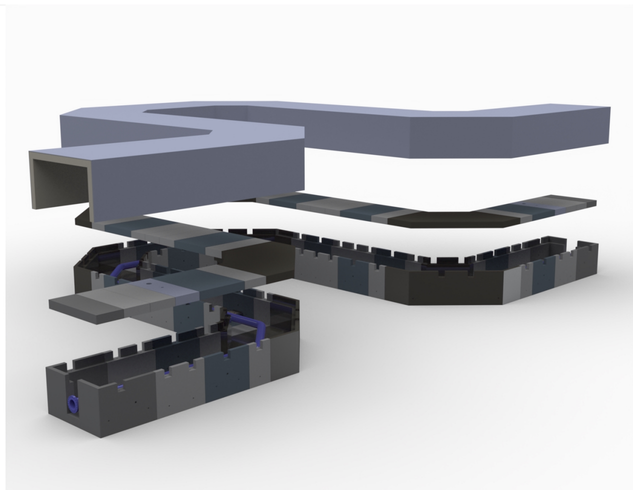
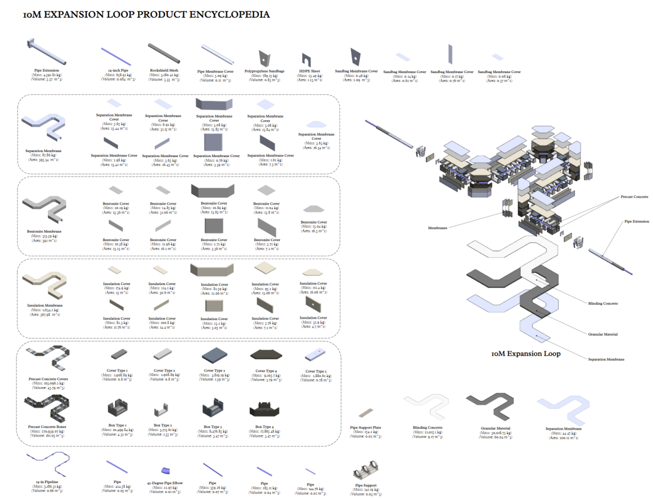
What does design data look like

Total Number of Components in 10M_EXPANSION_LOOP:	152
Parts:	
Part Components:	142
Unique Part Files:	16
Unique Part Configurations:	16
Number Of Bodies:	151
Subassemblies:	
Subassembly Components:	10
Unique Subassembly Configurations:	3
Unique Subassembly Files:	3
Components:	
Resolved Documents:	20
Number Of Top Level Components:	65
Resolved Components:	152
Lightweight Components:	0
Graphics Components:	0
Suppressed Components:	0
Hidden Components:	1
Virtual Components:	0
Envelope Components:	0
Assembly	
Maximum Depth:	2
Number Of Total Evaluated Mates:	0
Top Level Mates:	178
Flexible Subassembly Mates:	0





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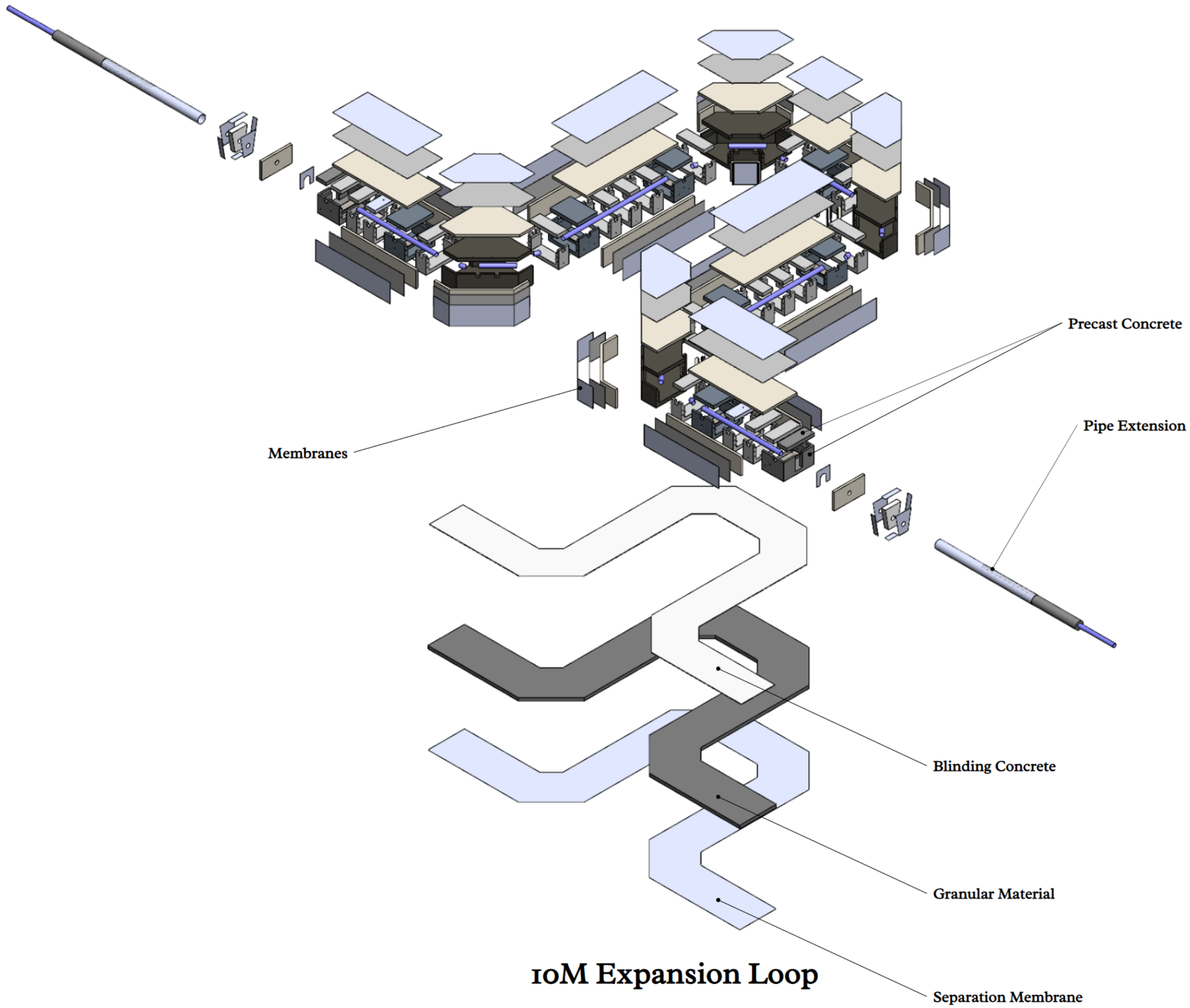
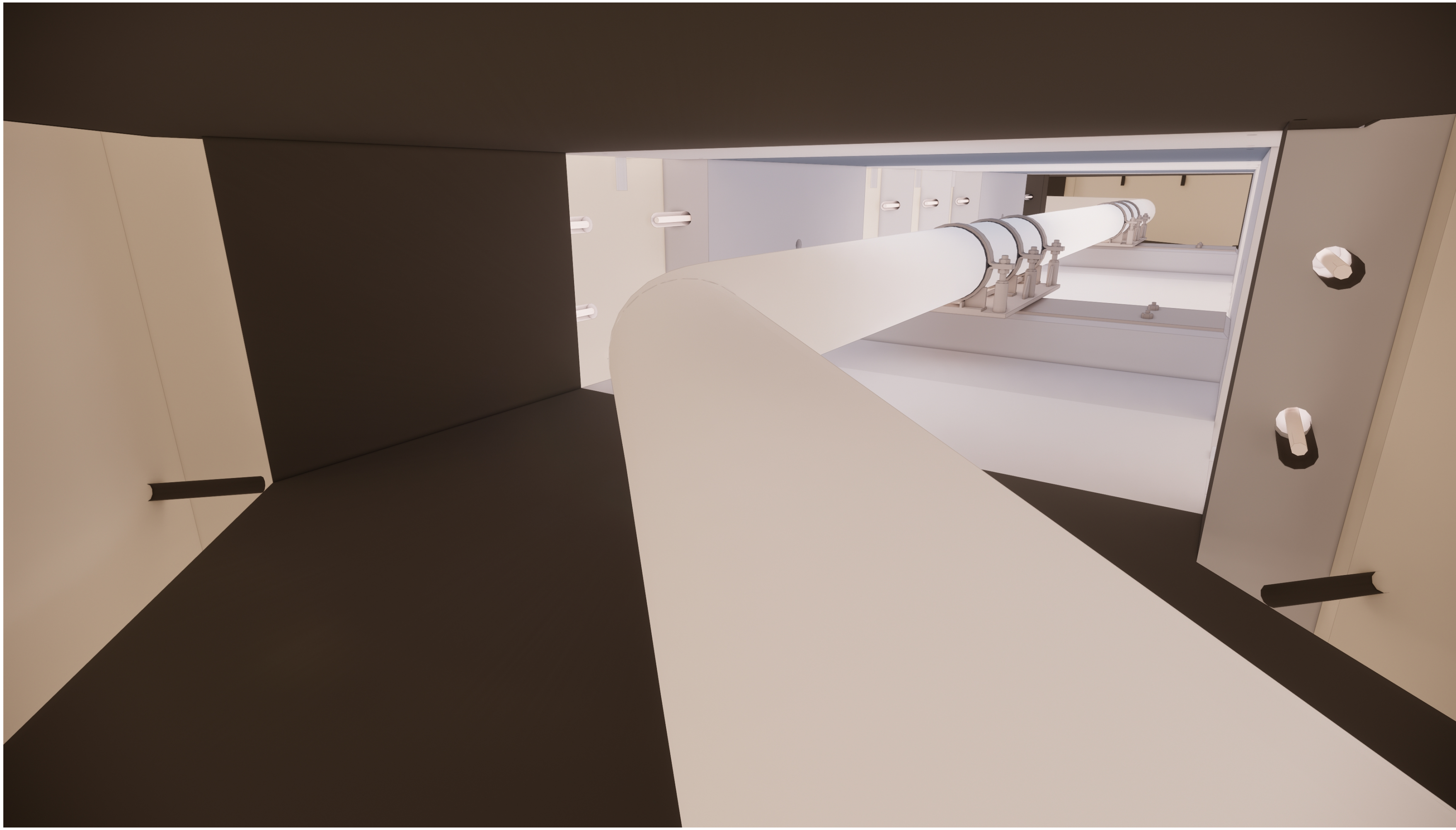
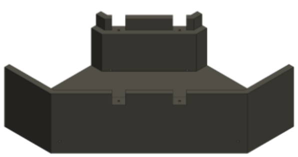


10M Expansion Loop

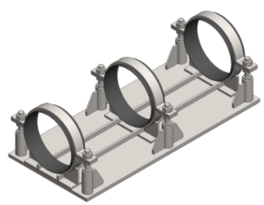


Cover Type 4
(Mass: 9,105.7 kg)
(Volume: 3.79 m^3)

Pipe-Support Plate
(Mass: 154.2 kg)
(Volume: 0.02 m^3)

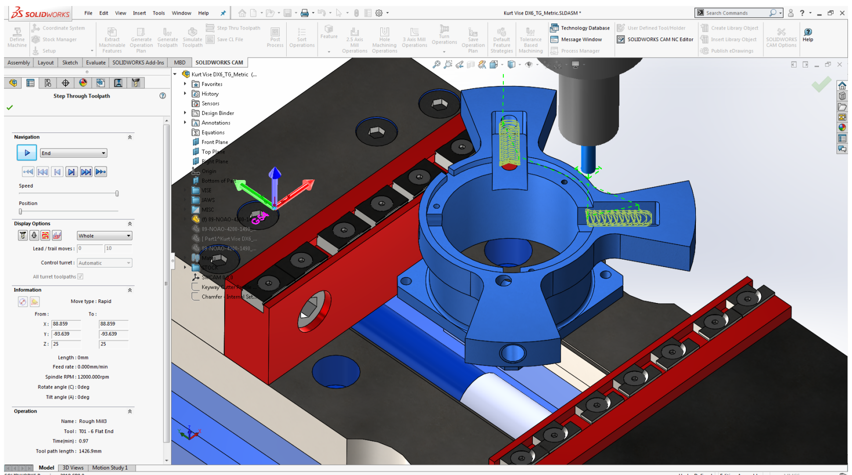


Box Type 4
(Mass: 17,865.48 kg)
(Volume: 3.47 m^3)

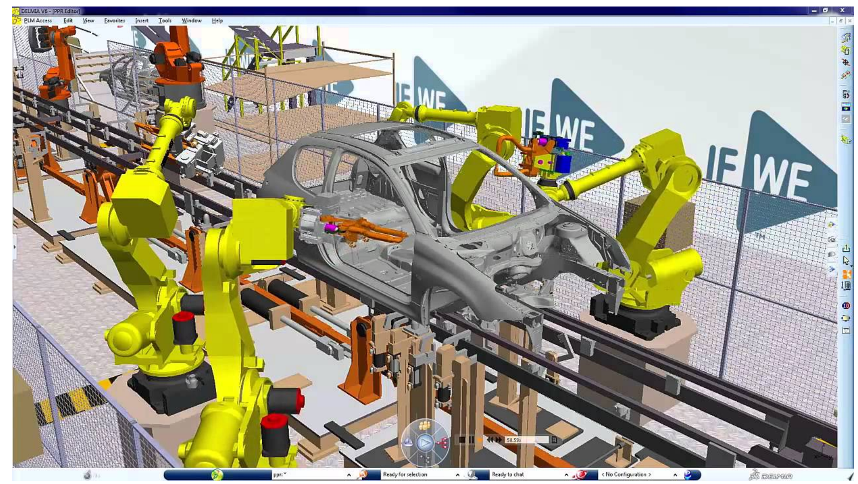


Pipe Support
(Mass: 241.19 kg)
(Volume: 0.03 m^3)

Take the data to NC



NC manufacture



NC assemble

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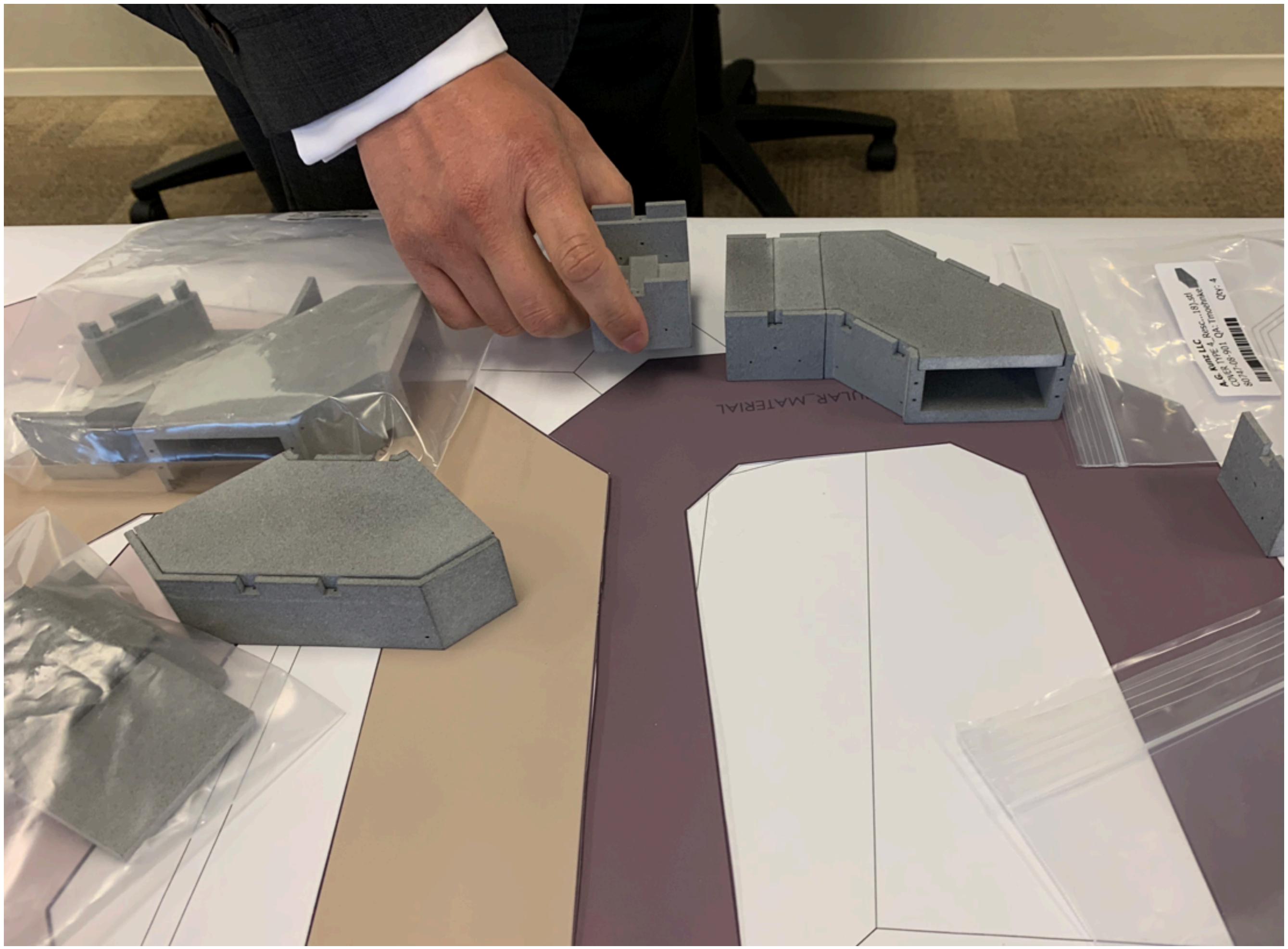
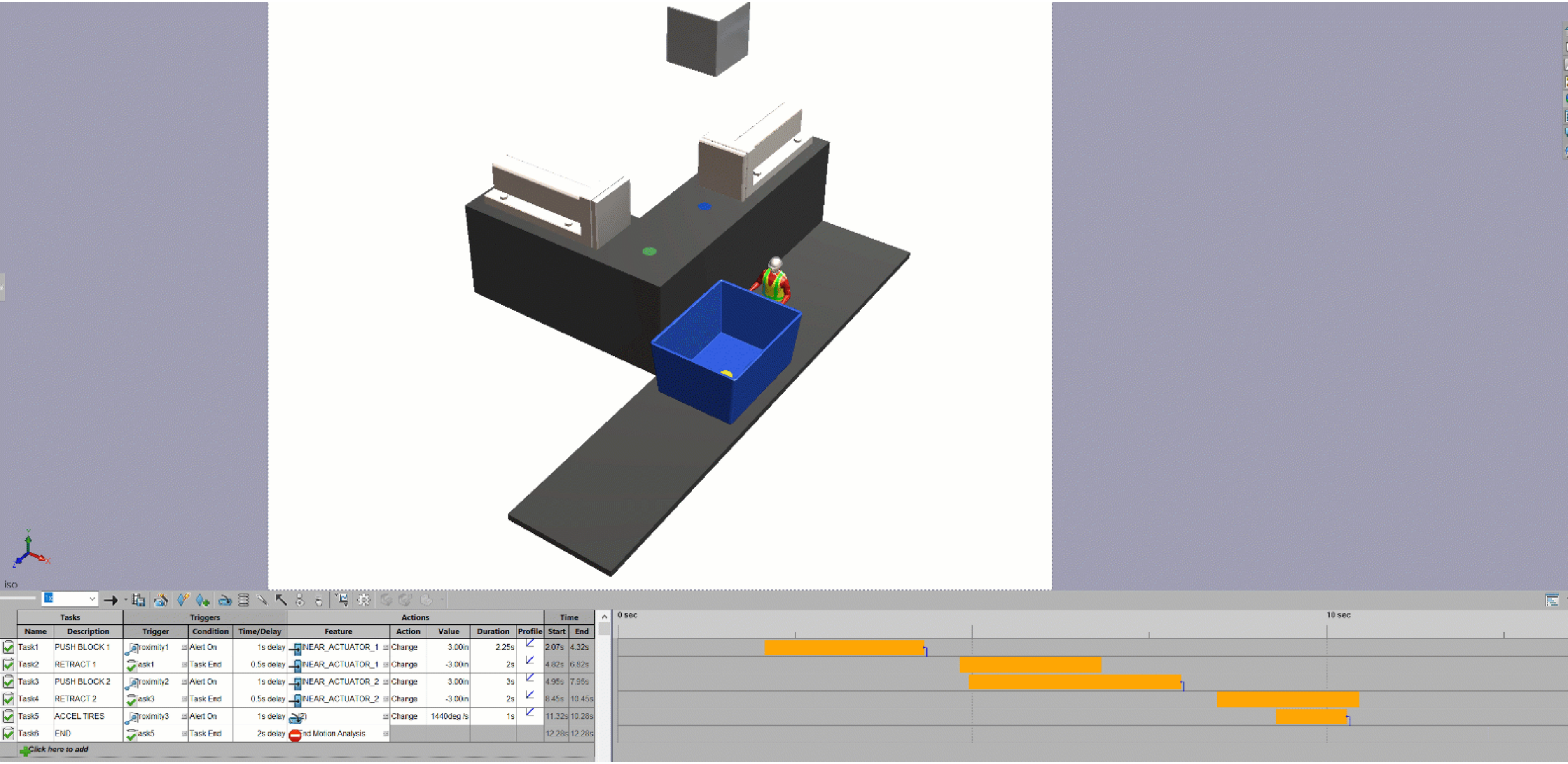
Or additive





Event-based motion

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Requirements

What are the use-cases for the data

How do we get to it

What is the product architecture

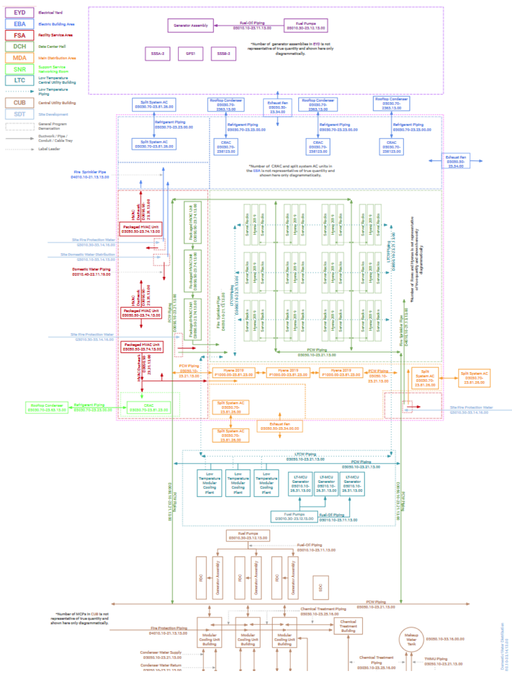
How do we evaluate it

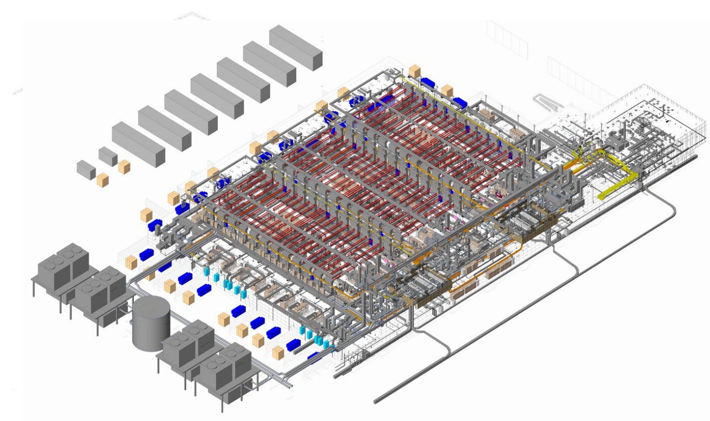
Requirements

Where is it and when does it get built?	What is it and what system does it belong to?	How do I measure and compare this across projects?	How much does it cost?

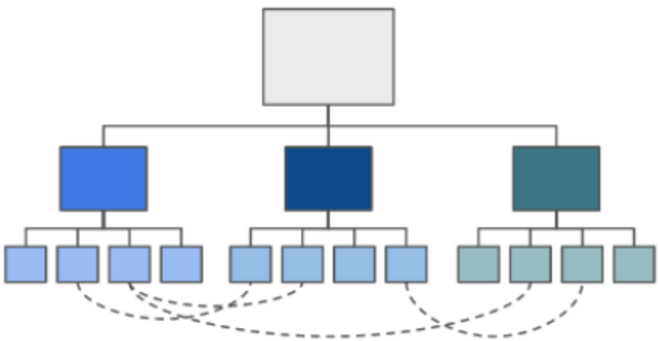
AREA	ZONE	FLOOR	PHASE	UNIFORMAT	MASTERFORMAT	VPCID	COST ID
CNR	Z01	F02	CON03	D6010.00	27.11.19.00	0010	0002

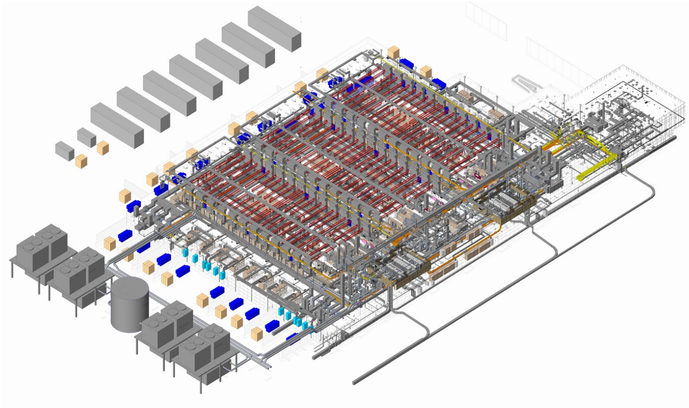
Requirements



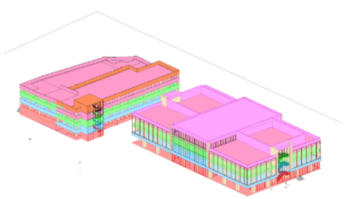


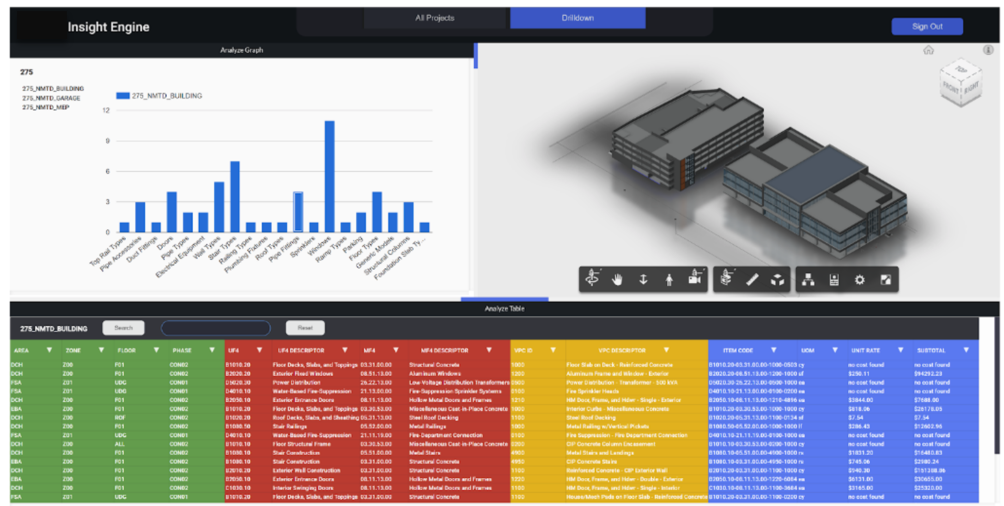
Requirements





Requirements





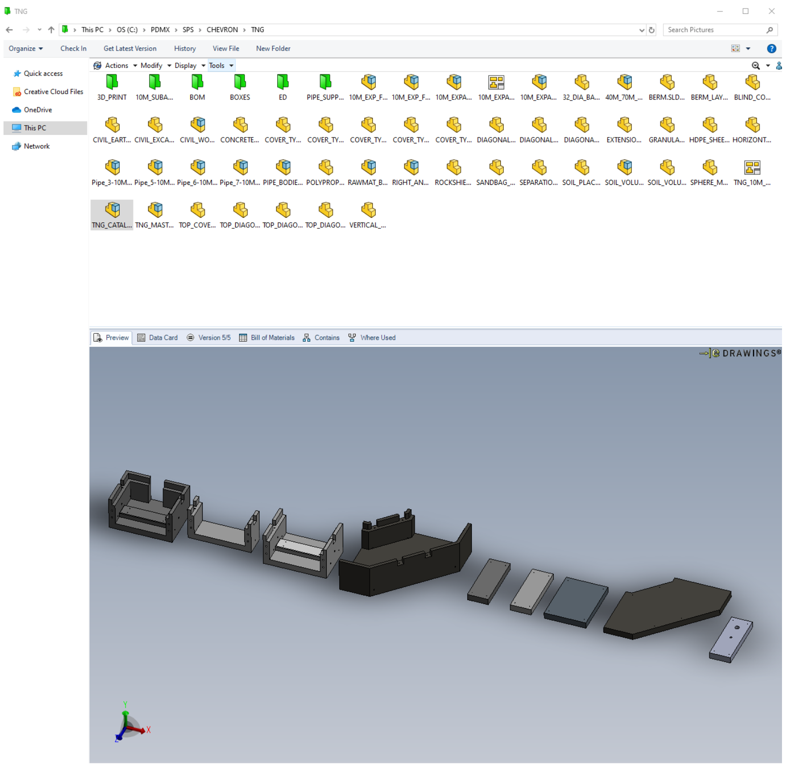
Product Data Management

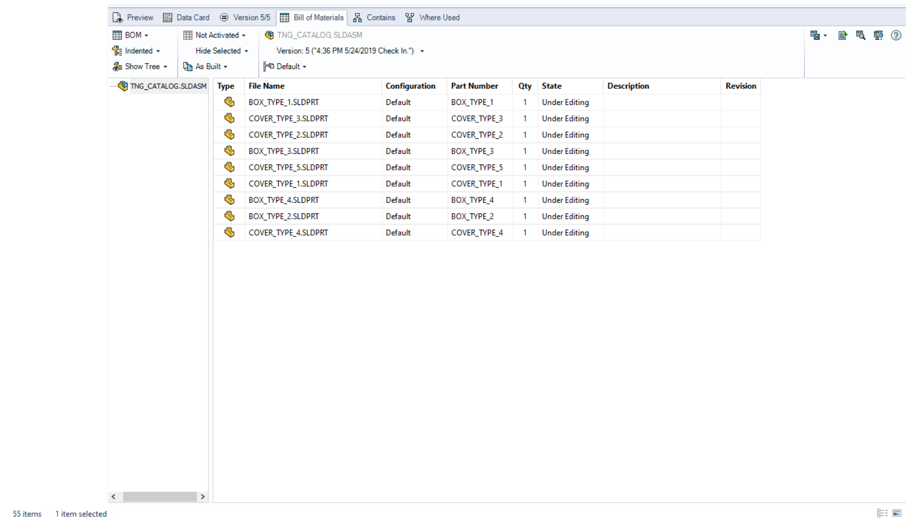
Expose the WIP

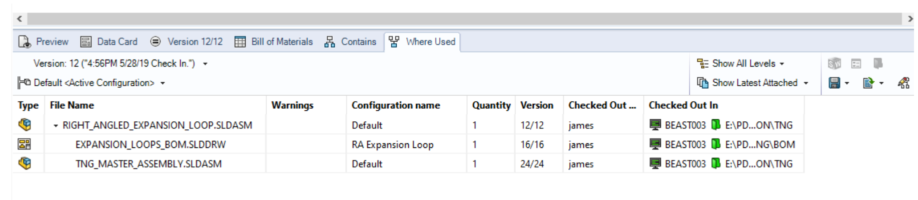
Just enough version control

Managed re-use

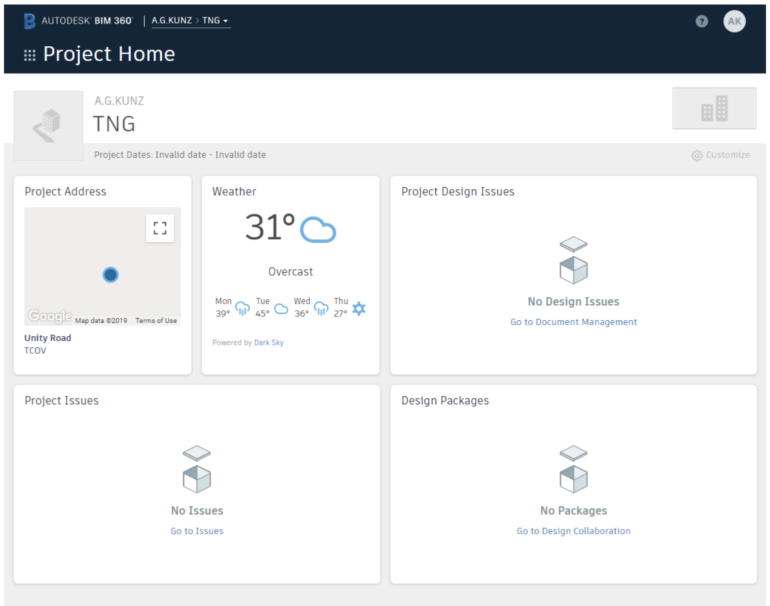
Product Data Management

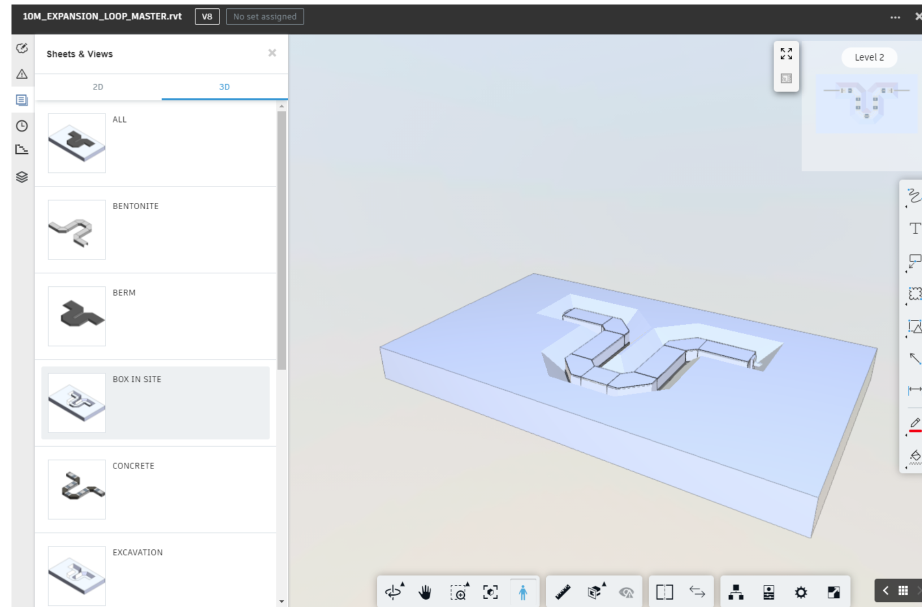






Product Data Management





Interfaces & Precision

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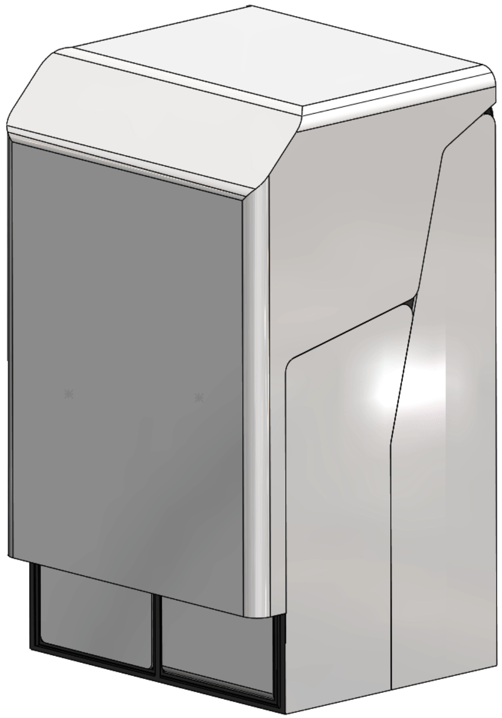
Interfaces & Precision

Interfaces & Precision



Interfaces & Precision

Lunch

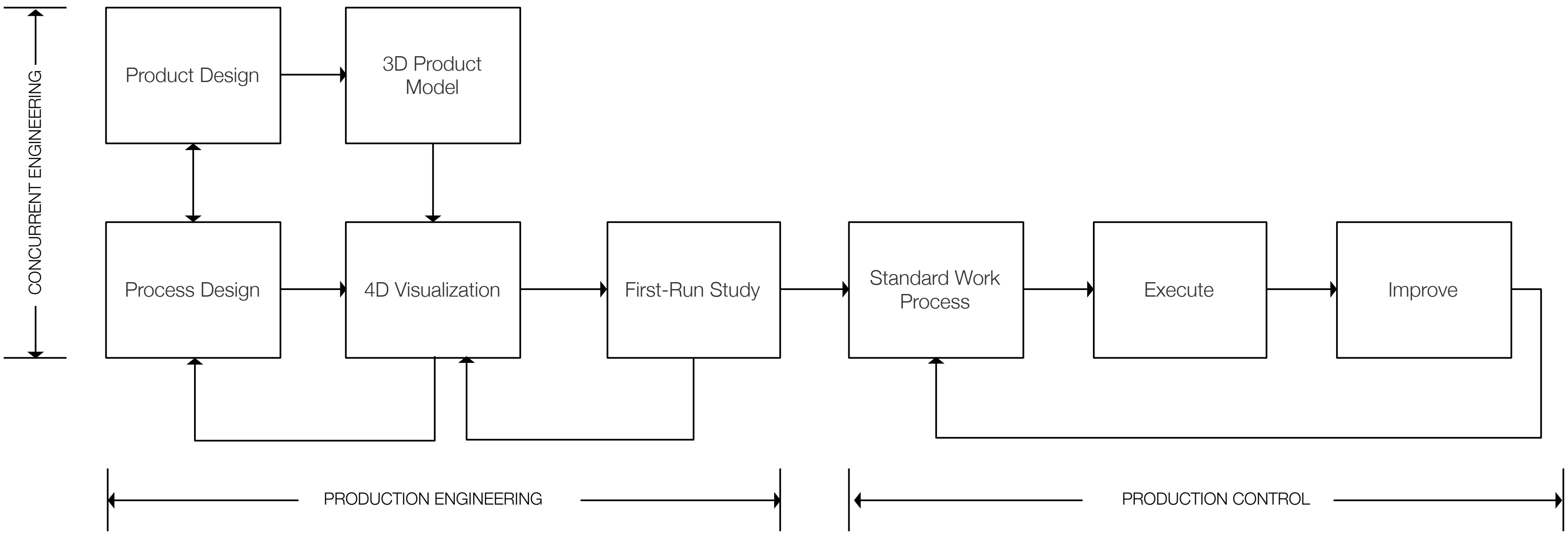
Computer Aided Production Engineering

04 December 2019

Process Design

Computer Aided Production Engineering

04 December 2019



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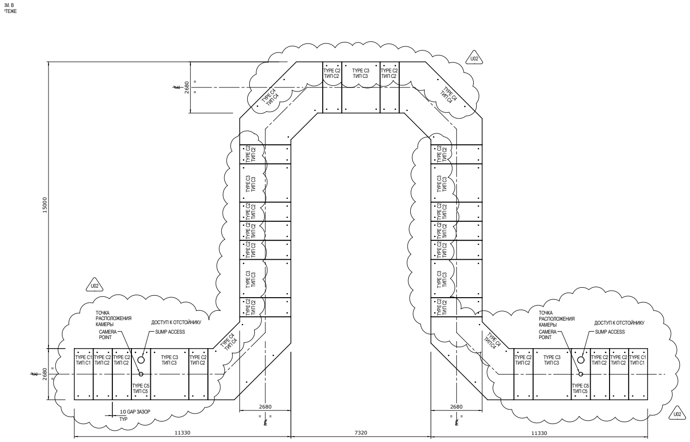
OIL PIPELINE EXPANSION LOOPS

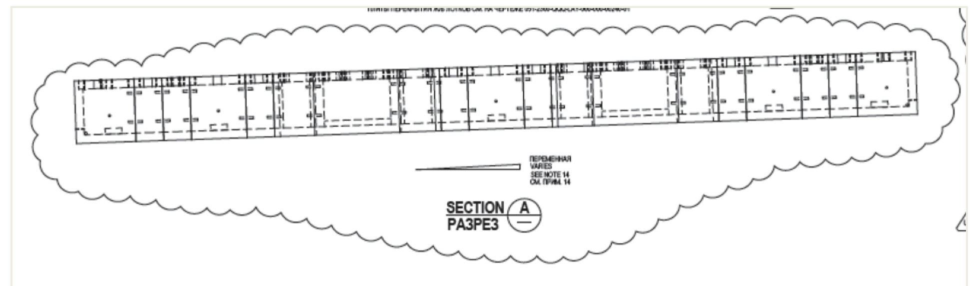
93 loops

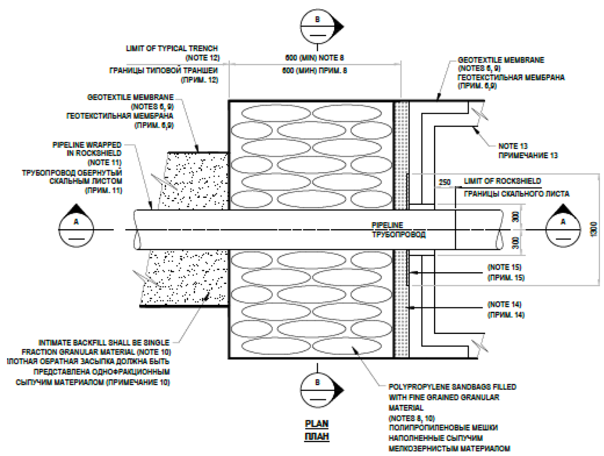
PROJECT PRODUCTION INSTITUTE

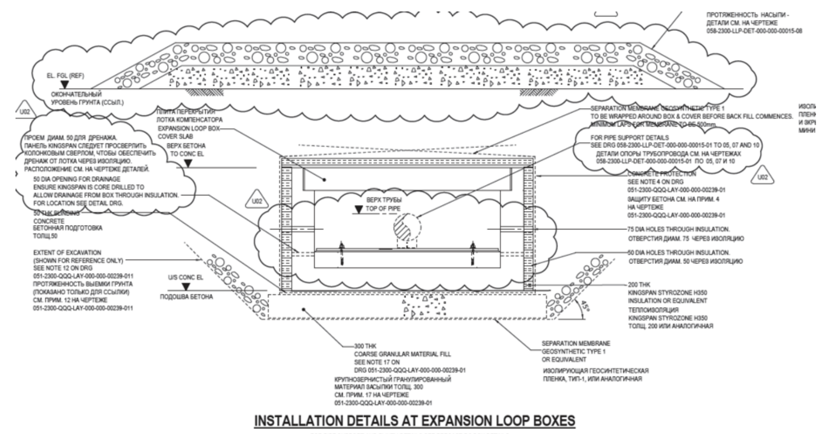
3,300 Precast Boxes

~ 8 Tons Each



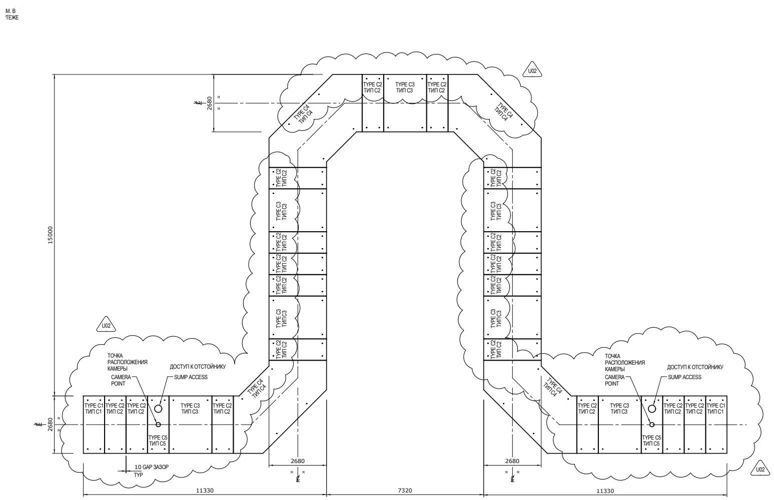






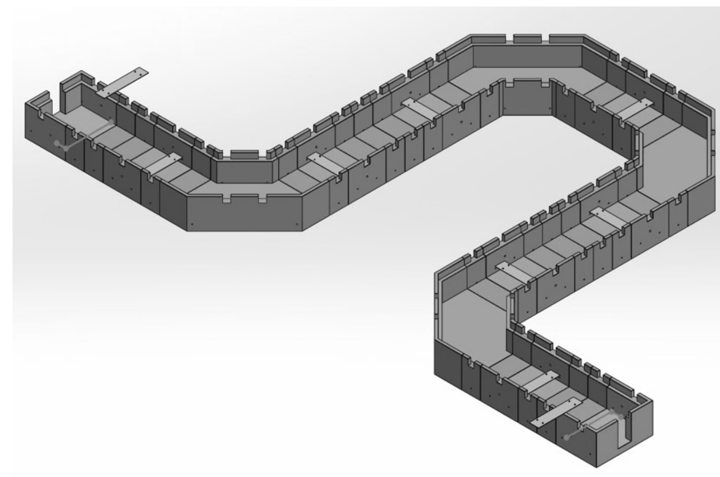
Product Design

PROJECT PRODUCTION INSTITUTE



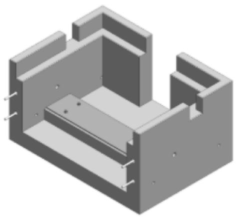
Product Design

(2D Drawings)

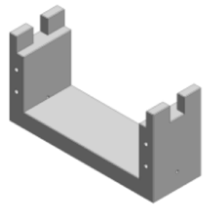


Digital Prototype

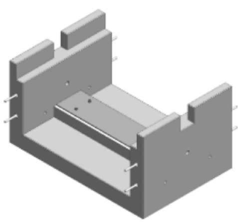
PROJECT PRODUCTION INSTITUTE



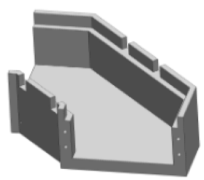
Box Type 1



Box Type 2

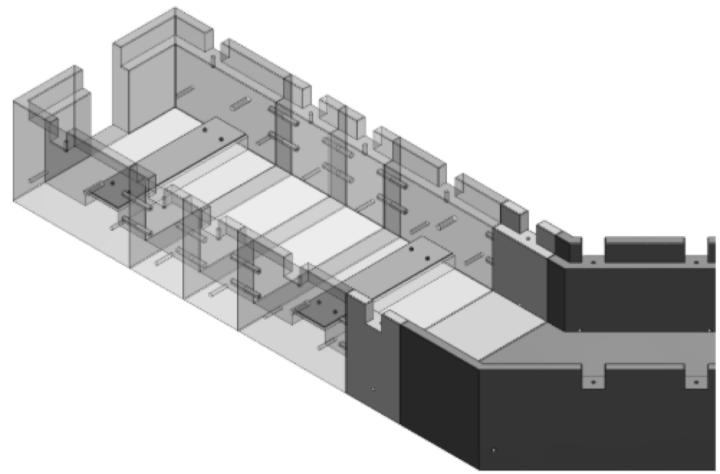


Box Type 3

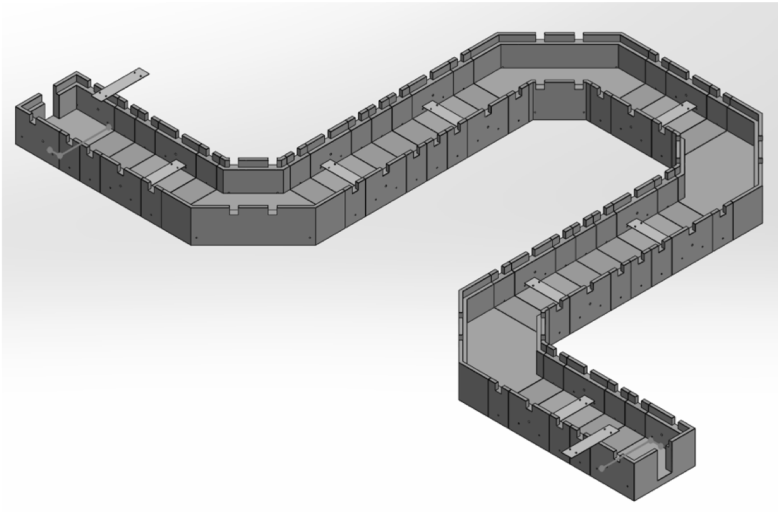


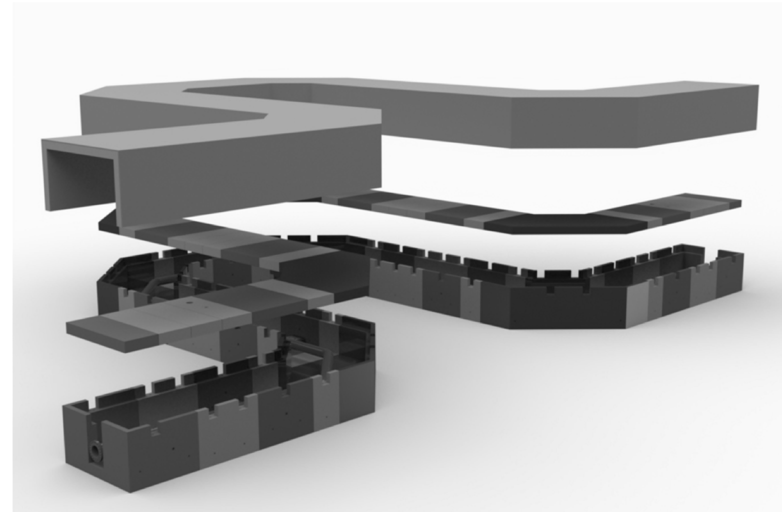
Box Type 4

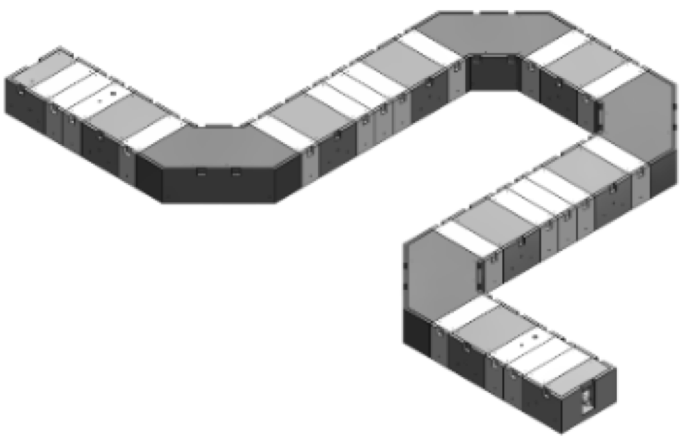
Precast boxes

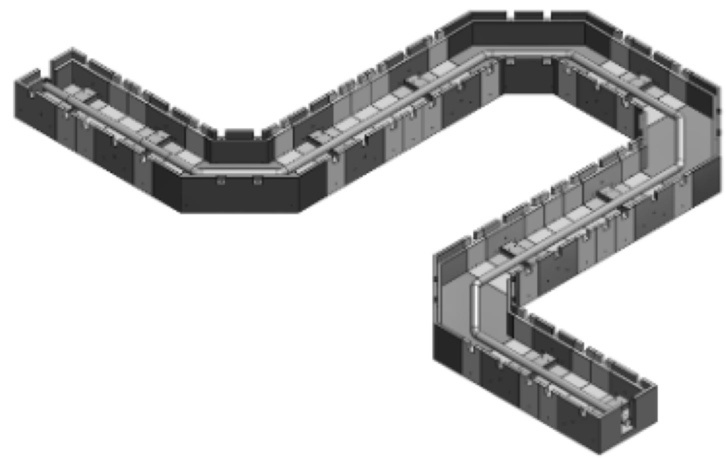


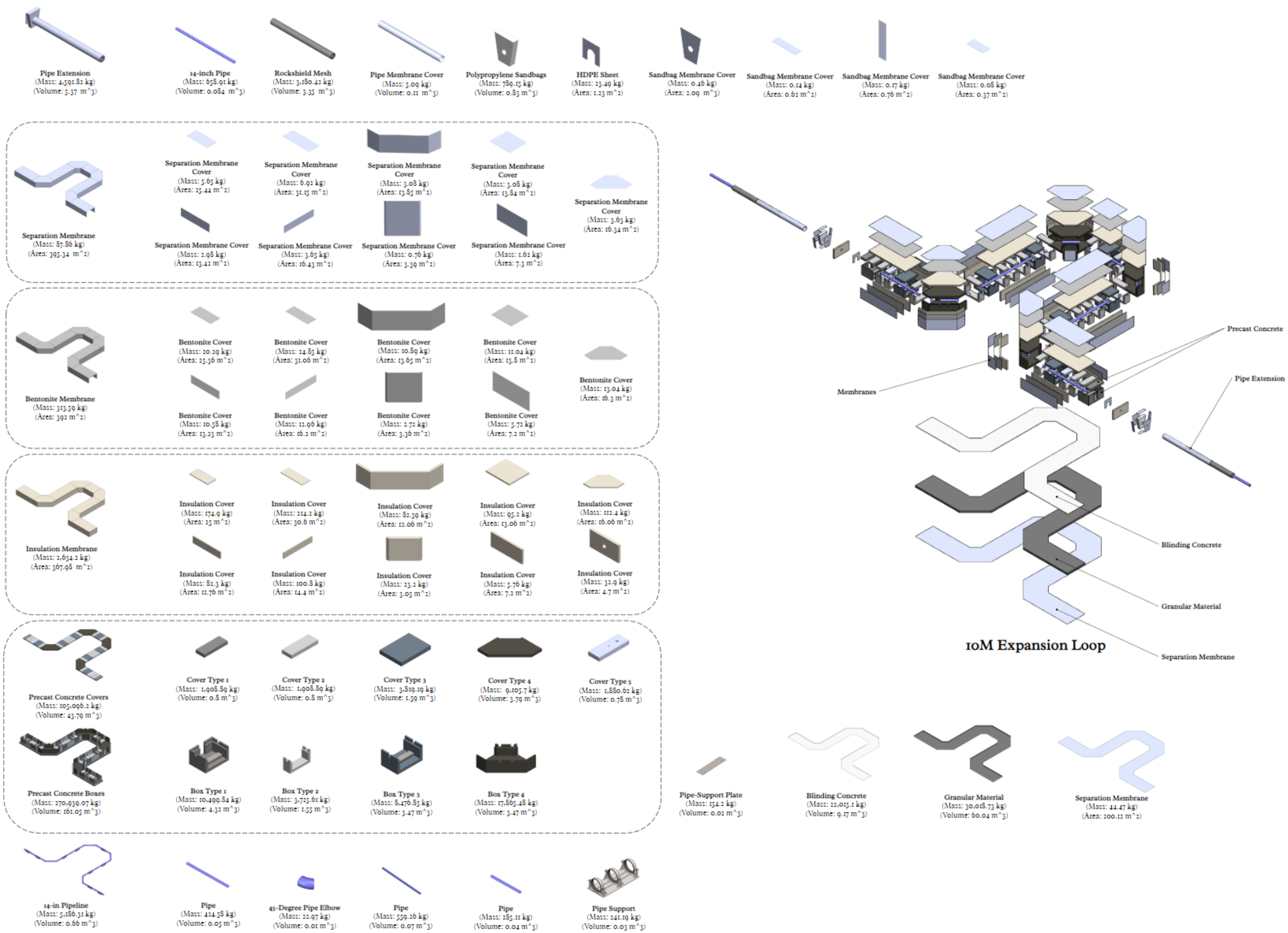
Use of precast boxes for loop assembly











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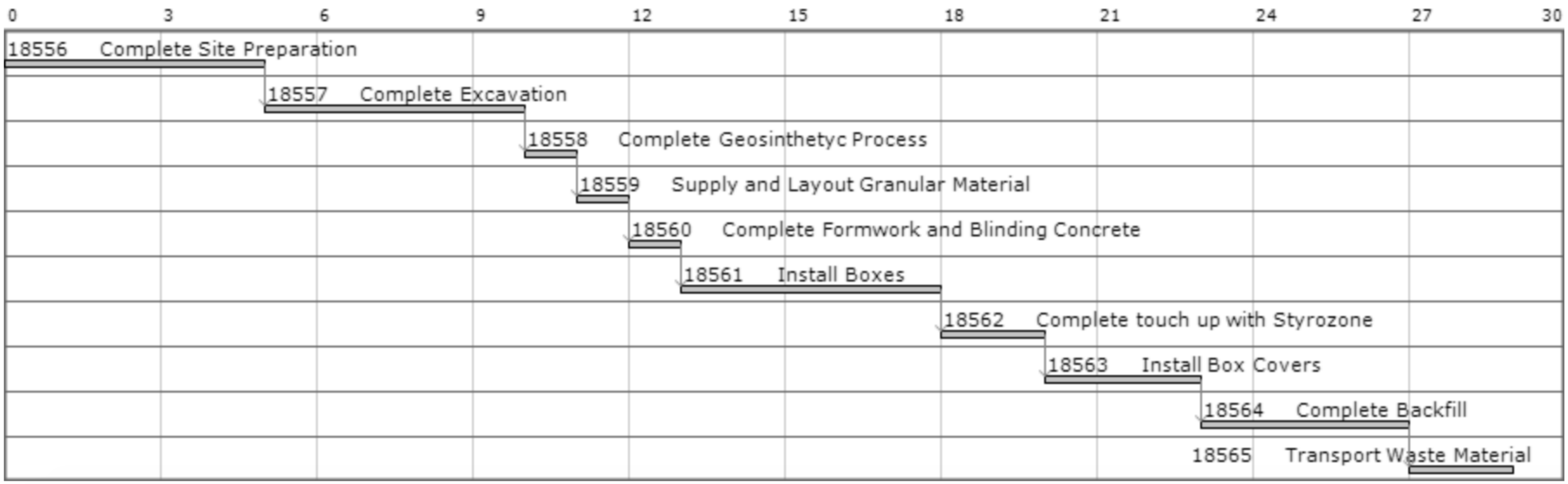
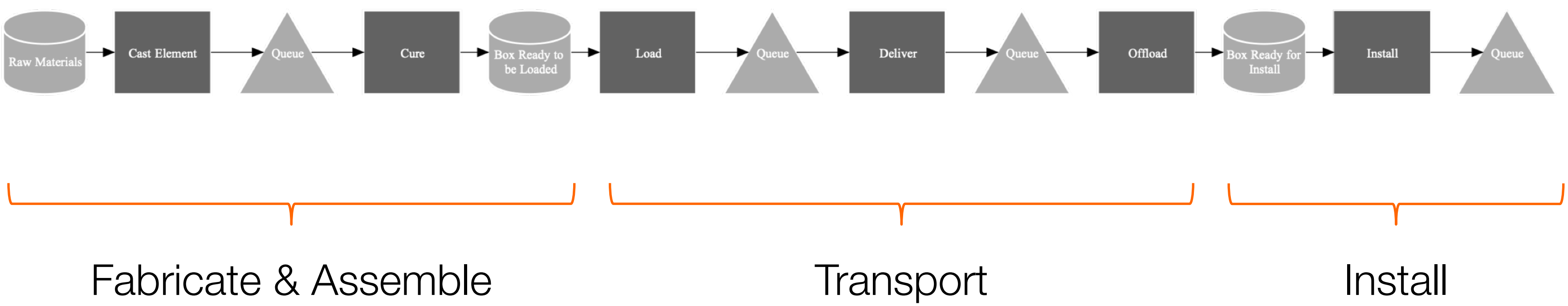
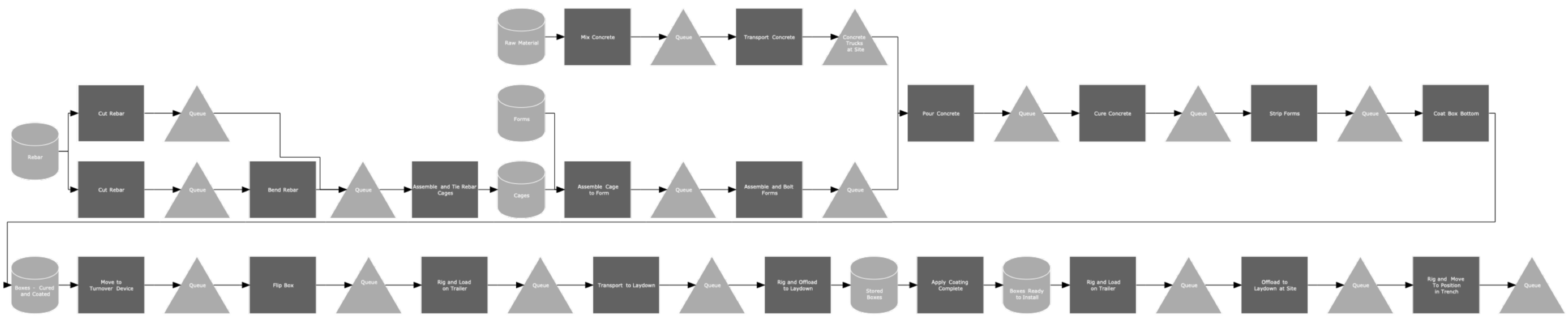
How are you planning to build it?

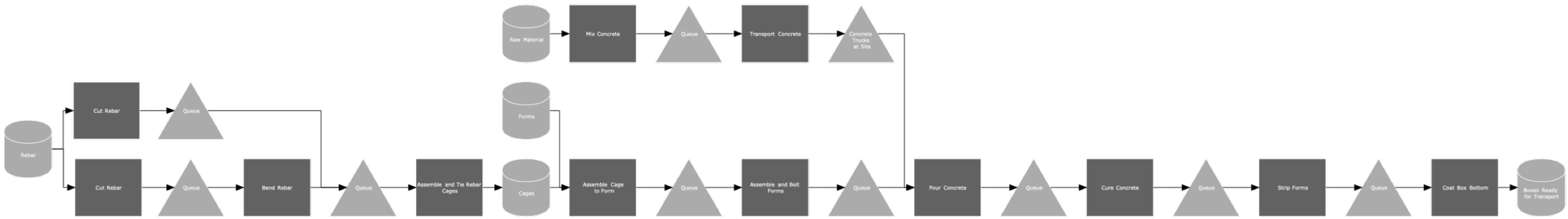

0
3
6
9
12
15
18
21
24
27
30
18556 Complete Site Preparation
18557 Complete Excavation
18558 Complete Geosinthetyc Process
18559 Supply and Layout Granular Material
18560 Complete Formwork and Blinding Concrete
18561 Install Boxes
18562 Complete touch up with Styrozone
18563 Install Box Covers
18564 Complete Backfill
18565 Transport Waste Material

What we got


Raw Materials
Cast Element
Queue
Cure
Box Ready to be Loaded
Load
Queue
Deliver
Queue
Offload
Box Ready for Install
Install
Queue
Fabricate & Assemble
Transport
Install


Raw Material
Mix Concrete
Queue
Transport Concrete
Concrete Trucks at Site
Rebar
Cut Rebar
Queue
Forms
Cut Rebar
Queue
Bend Rebar
Queue
Assemble and Tie Rebar Cages
Cages
Assemble Cage to Form
Queue
Assemble and Bolt Forms
Queue
Pour Concrete
Queue
Cure Concrete
Queue
Strip Forms
Queue
Coat Box Bottom
Boxes - Cured and Coated
Move to Turnover Device
Queue
Flip Box
Queue
Rig and Load on Trailer
Queue
Transport to Laydown
Queue
Rig and Offload to Laydown
Stored Boxes
Apply Coating Complete
Boxes Ready to Install
Rig and Load on Trailer
Queue
Offload to Laydown at Site
Queue
Rig and Move To Position in Trench
Queue

Concrete & Curing

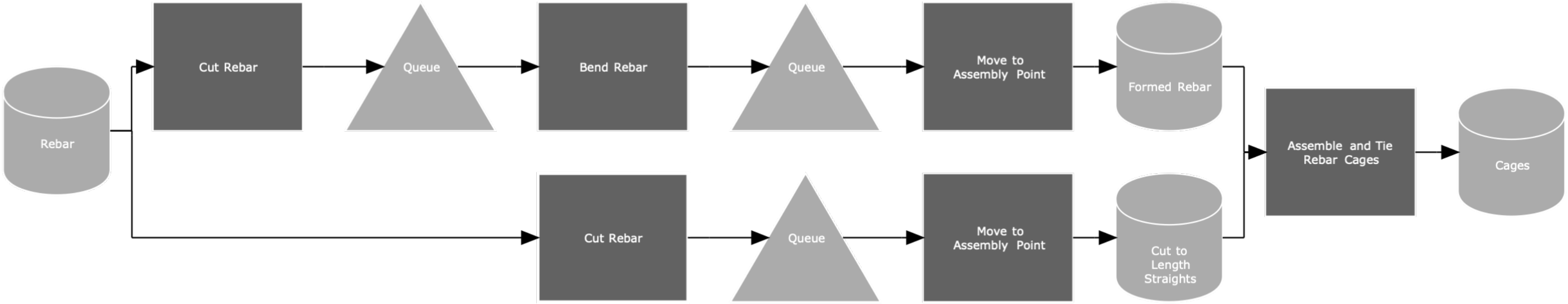


Rebar & Formwork

Bottom Coating

Process output = Precast ready for transport =

Fabricate & Assemble Rebar Cage



Process time per cage: 2 hours 58.6 min.

Aggregated Steps	Detailed Process Steps	Tools / Equipment	# of Workers per Step	Process Time (min.)	Amount of Work Per Cage	Process Time Per Cage	Worker Minutes Per Cage
1. Cut Rebar	Move Stock Bar to Cutoff (1 bar = 3 cut pieces)	--	2	0.43	28 bars	12.0	24.0
	Measure, Cut and Place on the Ground	Positioning Gage Stand, Rebar Shear	2	0.20	86 cuts	17.2	34.4
2. Bend Rebar	Move Stock To Bender (6 Pieces at a time)	--	2	0.46	14	6.4	12.8
	Measure, Bend and Place on the Ground	Tape Measure, Rebar Bender	2	0.46	82	37.7	75.4
3. Assemble Cage	Move Rebar to Assembly Position	--	3	11.30	1	11.3	33.9
	Measure, Layout and Mark (Bottom grid + 1 side times 2)	Tape Measure, Paint Pen	4	3.42	2	6.8	27.2
	Get Rebar and Position	--	2	0.27	86	23.2	46.4
	Tie Rebar (256 ties per cage)	Hand Tie-Wire Twist Tool	2 (1 Tie, 1 Hold)	0.25	256	64.0	128
					TOTAL	**178.6**	**382.1**

Rebar cutting operation requires excessive bending and lifting movements (ergonomics) for two workers

Less than optimal rebar surplus observed - no material optimization effort

Automatic Rebar Bending Machine is not tooled for all forms of geometry, so machine capacity utilization is almost zero

Rebar position placement for assembly operation (high repetition) not gaged

Rebar tying tool is antiquated and can be further optimized

Rebar position placement not gaged

Current Rebar Tying Tool

Better tooling

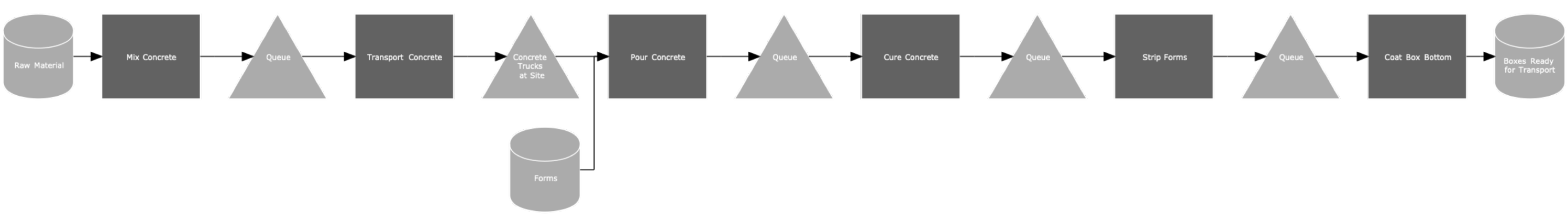
Place Concrete & Strop Forms

Place concrete

Unbolt form / take exterior sides off

Apply bitumen coating

Strip form and load to trailer



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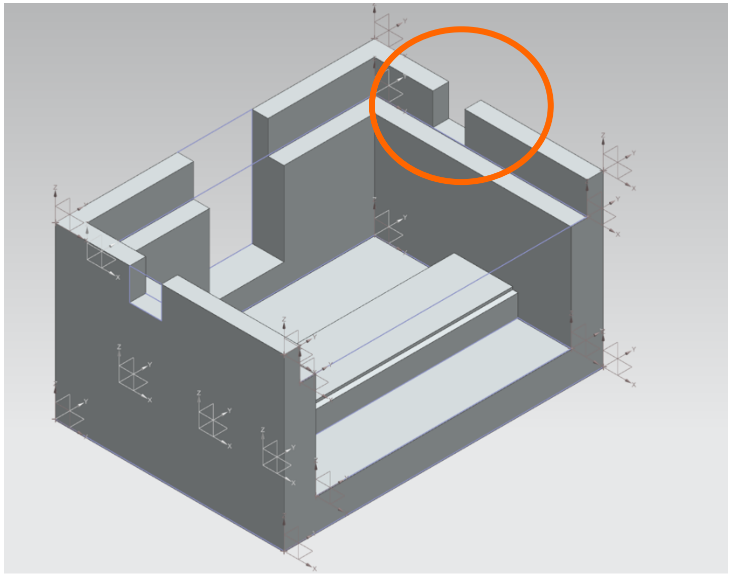
Aggregated Steps	Detailed Process Steps	Tools / Equipment	# of Workers per Step	Process Time (min.)	Amount of Work Per Box	Process Time Per Box (min.)	Worker Minutes Per Box
1. Place Concrete	Move Truck to Position		6	1.21	1	1.2	7.2
	Pour and Vibrate Concrete	Shovel, Concrete Vibrator	5	13.6	1	13.6	68.0
	Screed and Finish Top	Straight Edge	2	62	1	6.2	12.4
2. Cure	Cure		0	2 Days	1	2 Days	0
3. Apply Bitumen to Box Bottom	Roll On Bitumen Coating	Roller	1	28.4	1	28.4	28.4
4. Strip Form	Remove Bolt	Box End Wrench, Breaker Bar	1	.78	112	87.4	87.4
	Rig Rack to Box	Lifting Rack	2	3.0	1	3.0	6.0
	Lift Box from Form, move to trailer & Decouple	Lifting Rack, Crane	4: 3 ground, 1 operator	6..4	1	6.4	25.6
					TOTAL	146.2 *	235.0

Formwork sides being manually placed, which required six workers plus being an operation exposed to safety risks. Better to use crane and the Lift Hooks provided (if so, crane utilization levels must be checked)

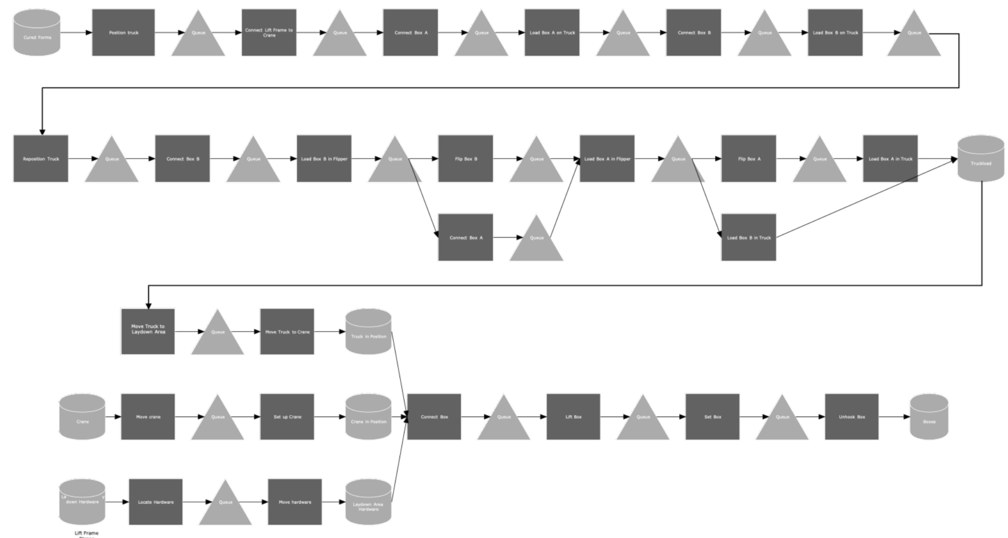
Safer work at height procedures needs to be observed during concrete placement operations (e.g., no straddling forms, use rolling platform, etc.)

Use impact guns for formwork bolt up instead of wrench and breaker bar



Product Design – Corner Box

Final Corner Box

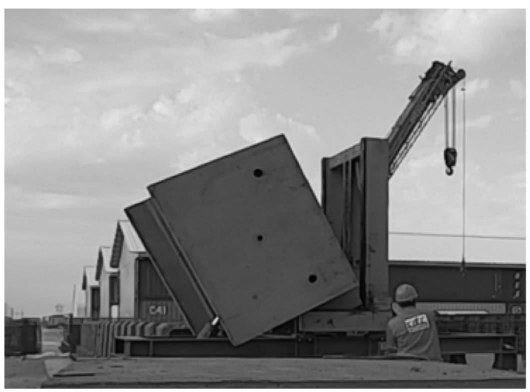


Loading / Offloading

Connect frame to box

Load box on truck

Transport to flipper and load box on flipper

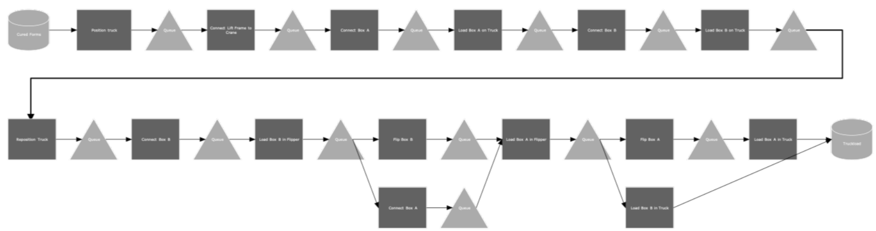


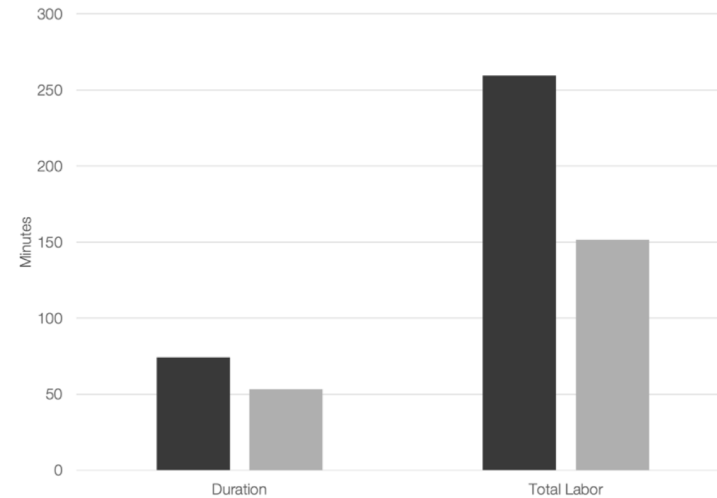
Raise box 90 degrees

Lower box 90 degrees

Load flipped box on truck

Current (15 steps)





Lift and flip (8 steps)

28% cycle time reduction

42% labor time reduction

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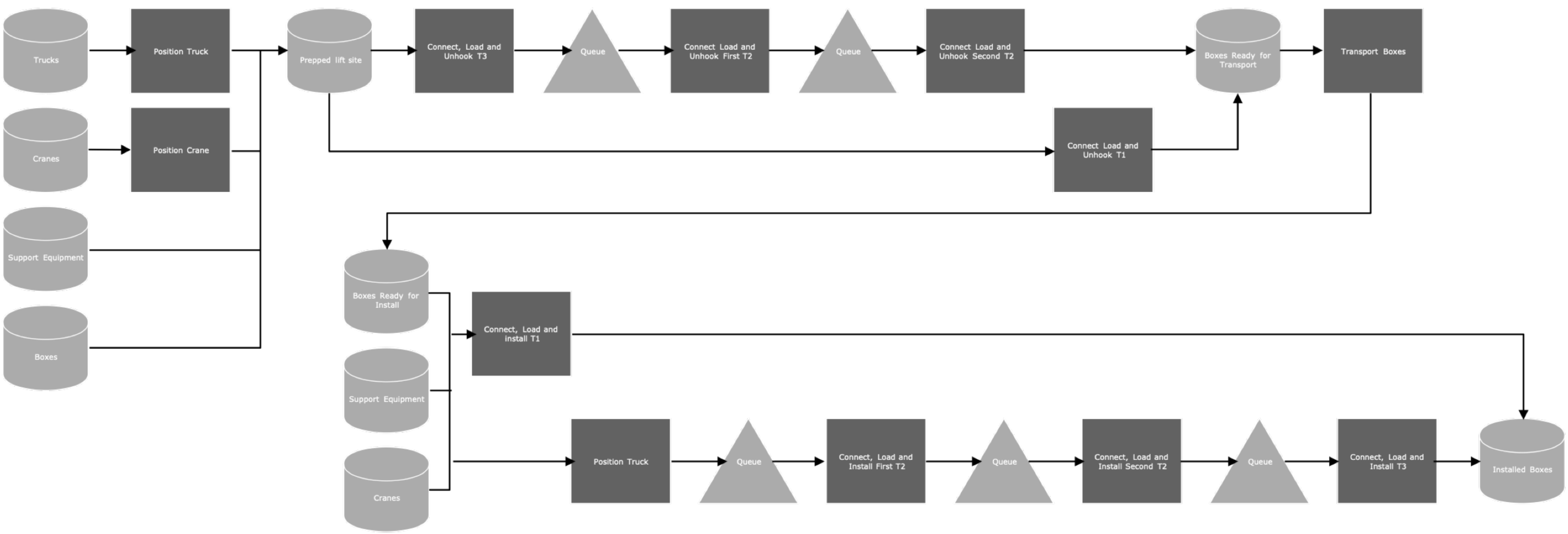
Install

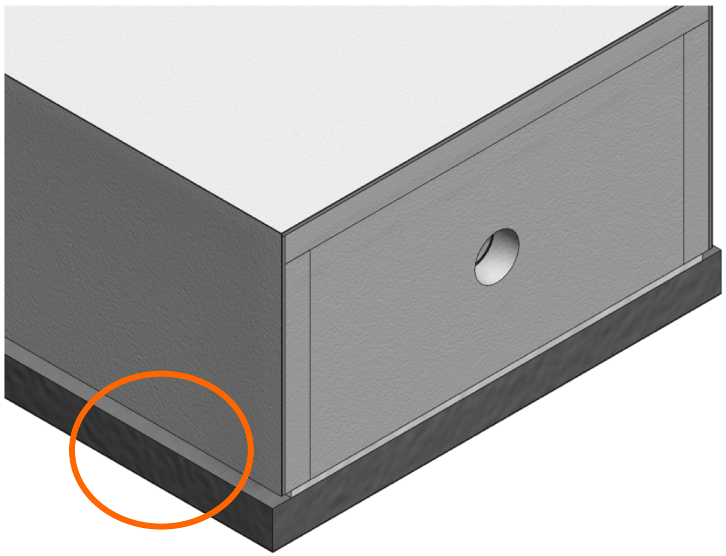

Trucks
Position Truck
Cranes
Position Crane
Support Equipment
Boxes
Prepped lift site
Connect, Load and Unhook T3
Queue
Connect Load and Unhook First T2
Queue
Connect Load and Unhook Second T2
Boxes Ready for Transport
Transport Boxes
Connect Load and Unhook T1
Boxes Ready for Install
Support Equipment
Cranes
Connect, Load and install T1
Position Truck
Queue
Connect, Load and Install First T2
Queue
Connect, Load and Install Second T2
Queue
Connect, Load and Install T3
Installed Boxes

Install – 4 boxes

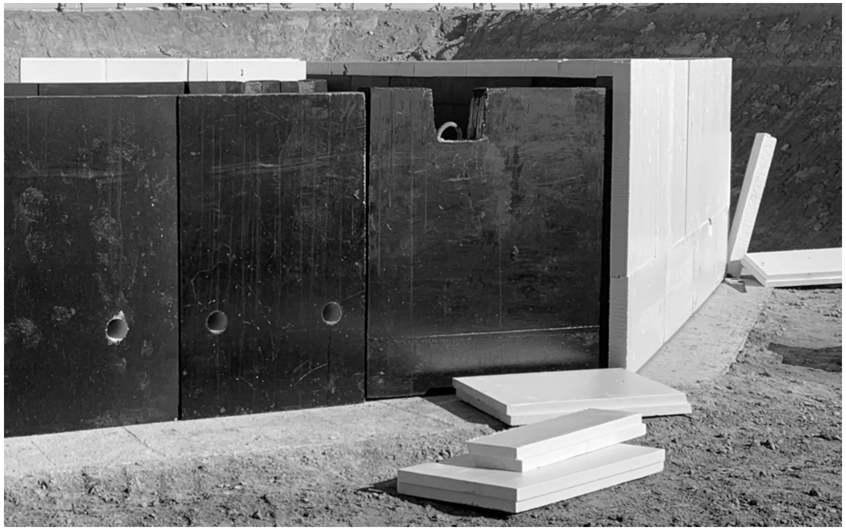
Aggregated Steps	Detailed Process Steps	Tools / Equipment	# of Workers per Action	Total Minutes Per Step	Total Worker Minutes Per Step
1. Prep Install Site (in parallel)	Position crane	Crane	2	25	50
	Position T1 truck	Truck	2	3	6
	Supply support equipment	Slings, hook tool, Lift frame, Spacer blocks, Ladder, Tag Lines	1	10	10
2. Unload T1 Truck	Hook, lift, place, unhook T1 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	6.4	38.4
2. Prep Install Site	Position T3/T2 truck	Truck	2	3	6
4. Unload T2/T3 Truck	Hook, lift, place with dowels, unhook first T2 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	17.8	106.8
	Hook, lift, place, unhook second T2 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	11.6	69.6
	Hook, lift, place, unhook T3 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	11.5	69.0
			TOTAL	88.3	355.8

Lift Frame

Light Lift Frame & Slings



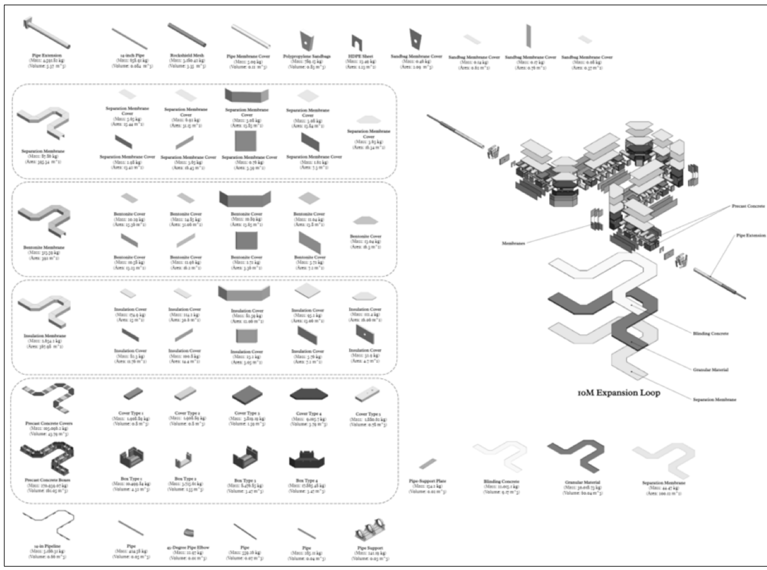
Product Design – Blinding Concrete



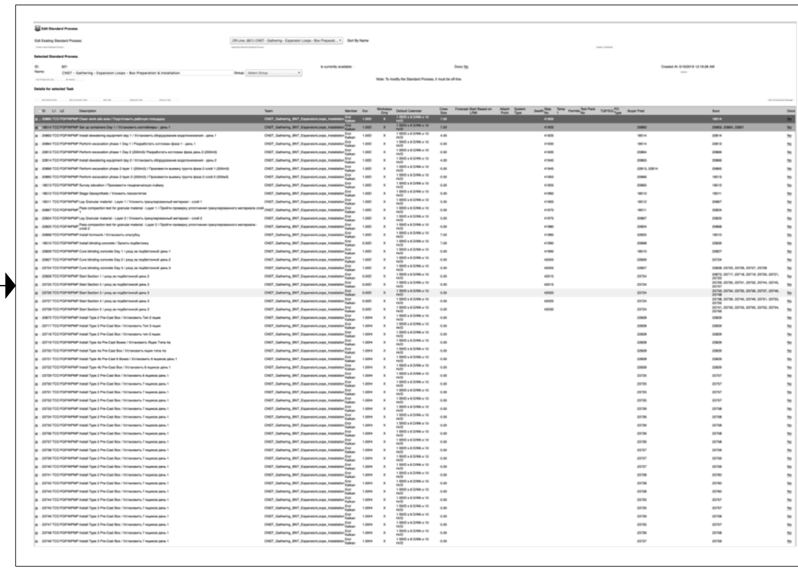
Blinding Concrete - Field

Hand tool to position dowels

Move dowel into position between boxes



Bill of Material (BOM)



Bill of Process (BOP)

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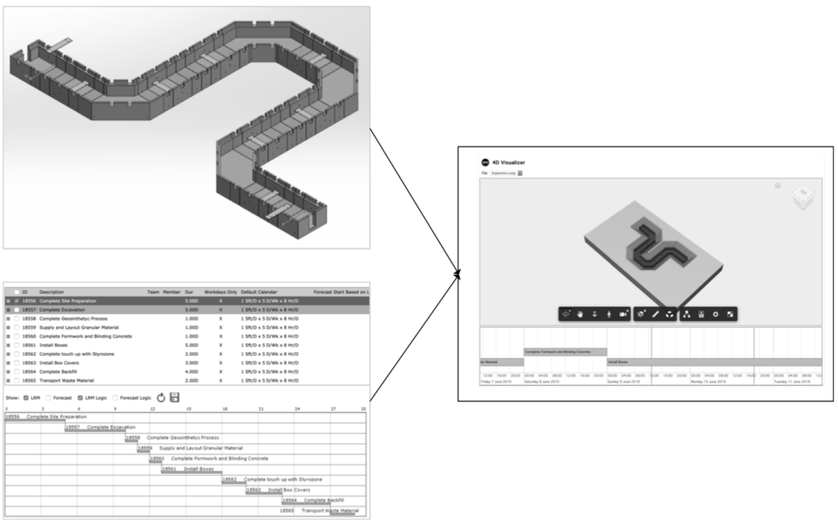
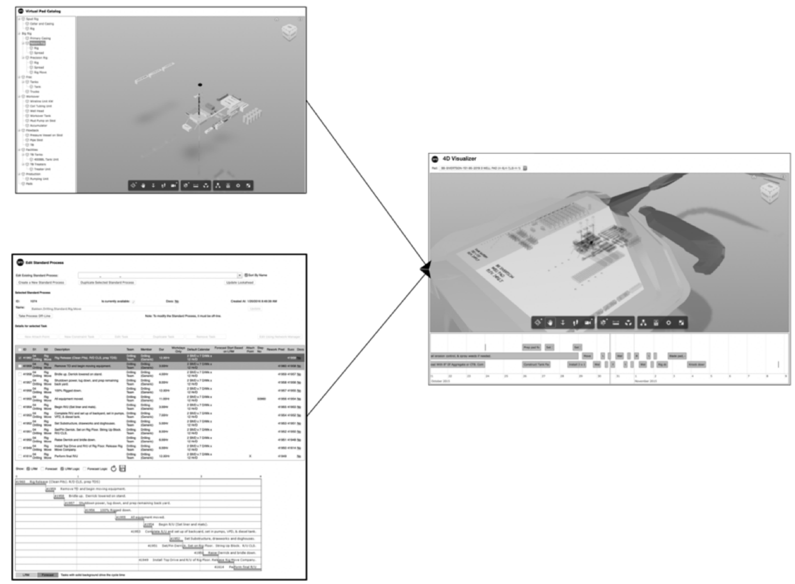
4D Visualizations



Construction Process



Equipment Use (Space / Time Conflict)

Break

Computer Aided Production Engineering

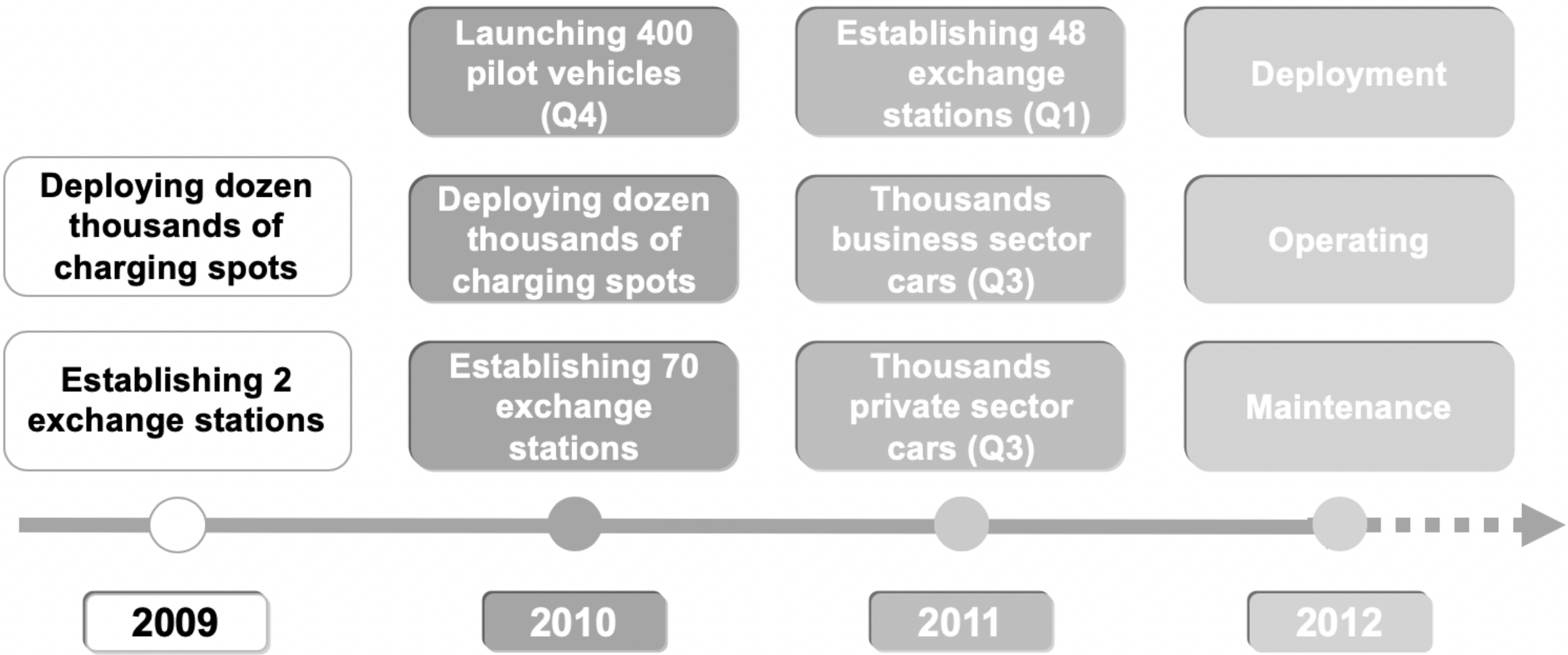
04 December 2019

Process Design

Computer Aided Production Engineering

04 December 2019

Large Scale & Global Deployment of EV Infrastructure

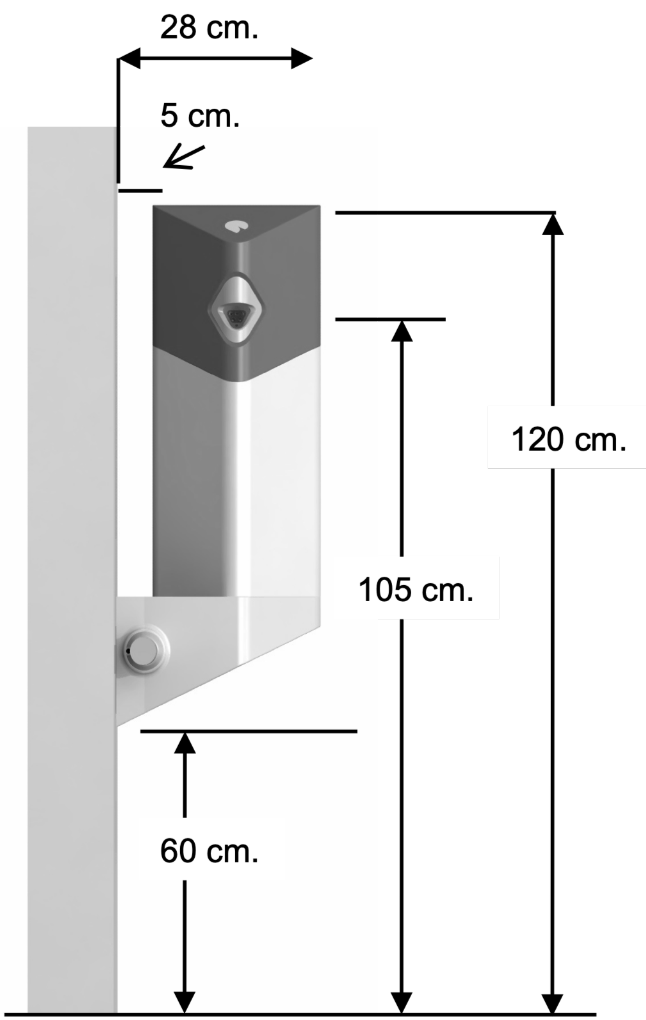

Launching 400 pilot vehicles (Q4)
Establishing 48 exchange stations (Q1)
Deployment
Deploying dozen thousands of charging spots
Deploying dozen thousands of charging spots
Thousands business sector cars (Q3)
Operating
Establishing 2 exchange stations
Establishing 70 exchange stations
Thousands private sector cars (Q3)
Maintenance
2009
2010
2011
2012

Deploy a site in one day

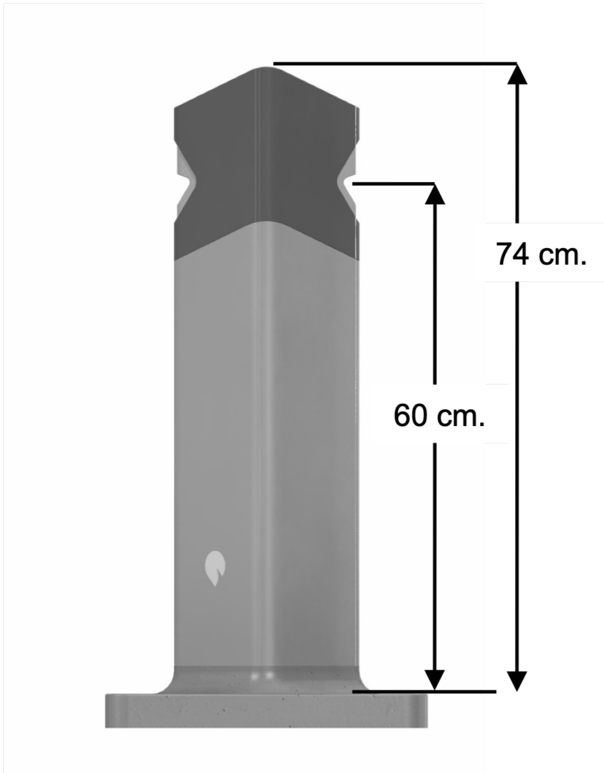
Construction

Manufacturing

Software



Wall Mount



Internal Footprint – 18 cm. x 18 cm.

Pole Mount

Site Visit

Field Studies & Product Analysis (v0)

Process Design Optimization & Product Analysis (V0 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (V1)

First Run Study / Proof of Concept LDSC - Denmark

Site Visit

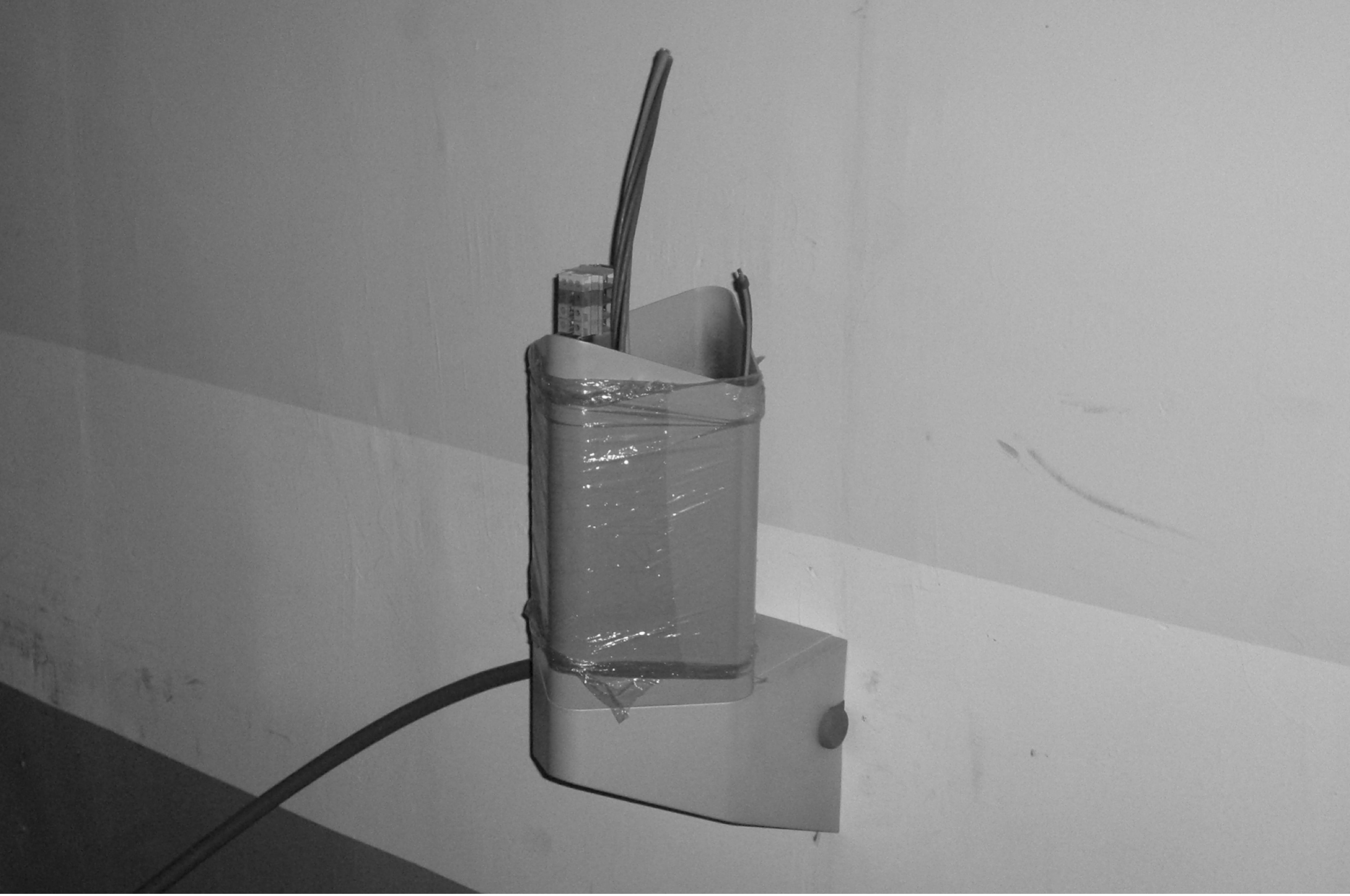
Field Studies & Product Analysis (v1)

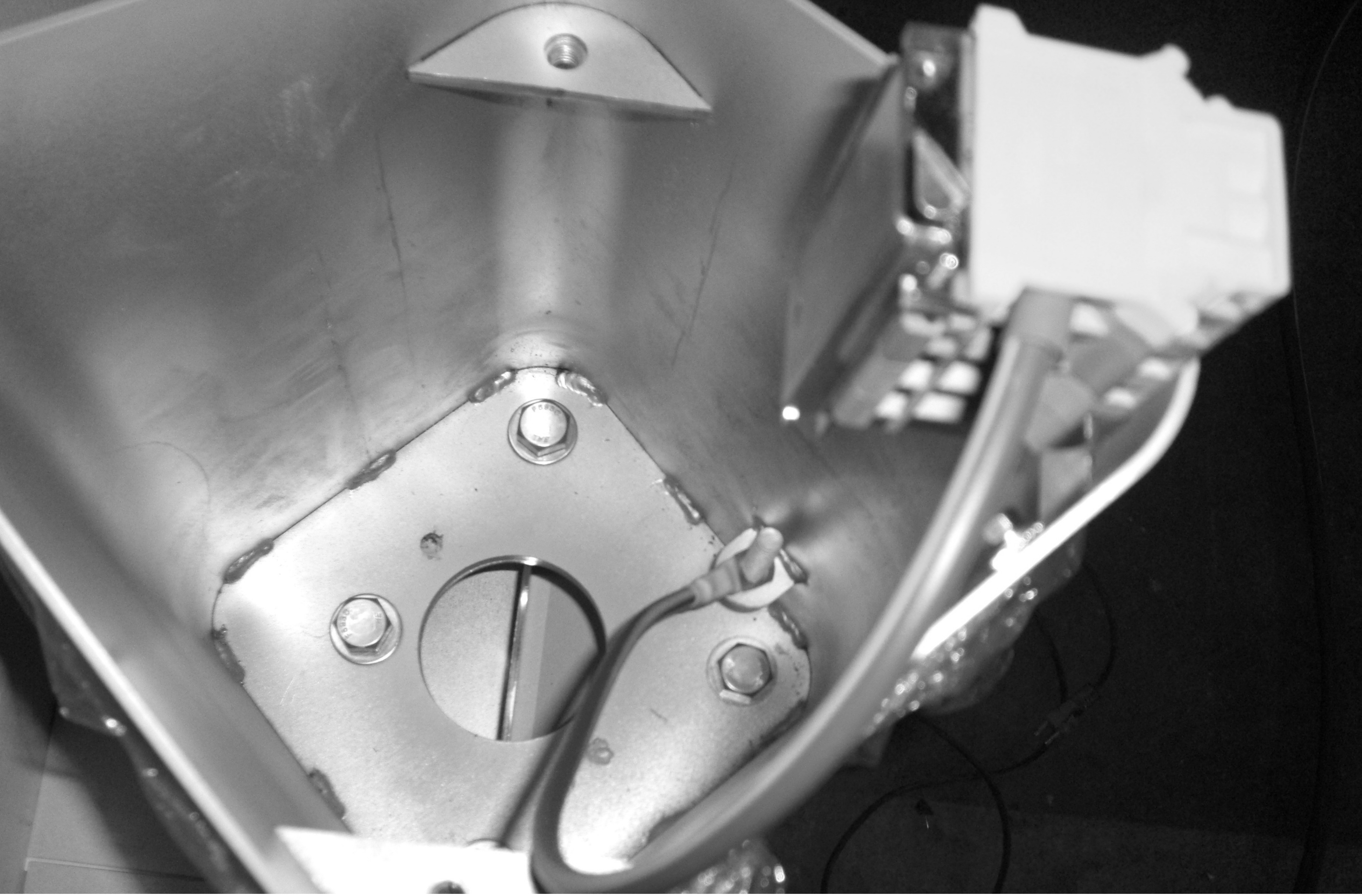
Process Design Optimization & Product Analysis (V1 bracket)

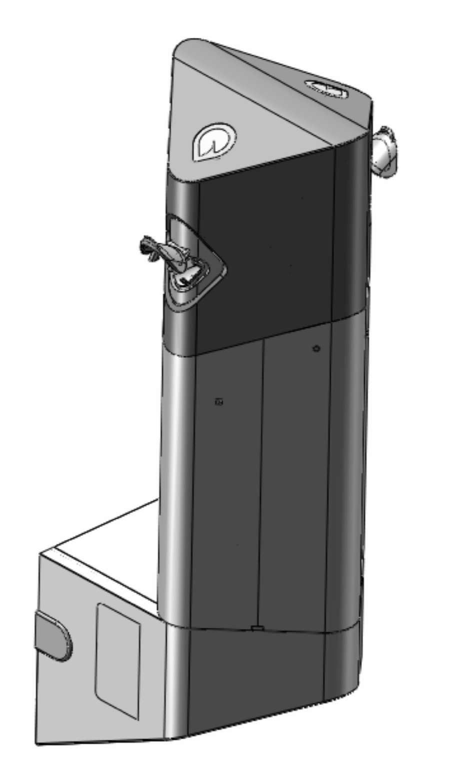
First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

First Run Study / Proof of Concept LDSC - Denmark

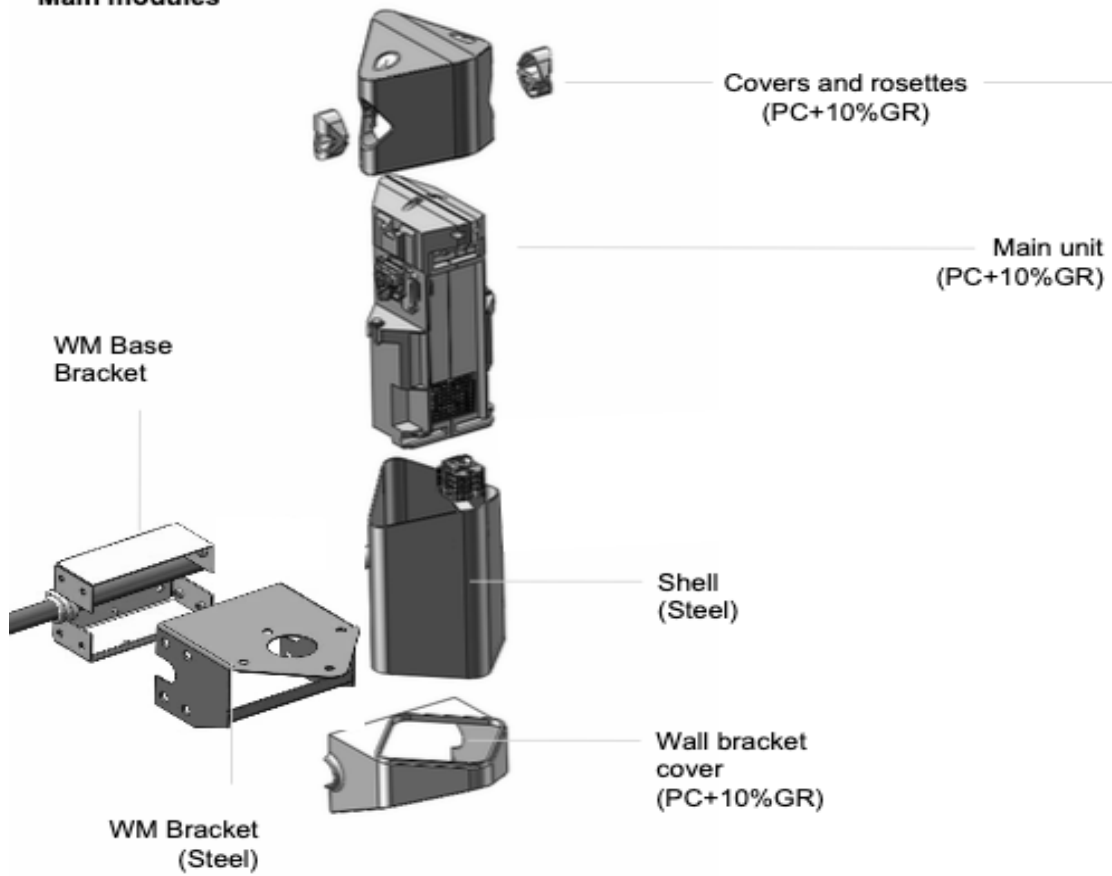






Installation

Main modules

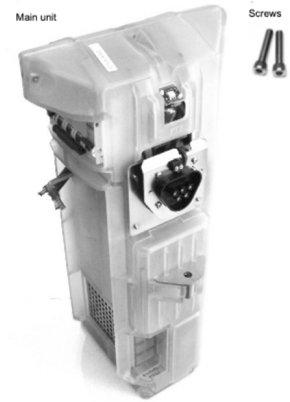


Wall mounted CS

CSA1A00 :MAIN UNIT

Main unit – wired and closed.
Attached: 2 main spacers + 2 screw plates

Screws
2 X M8x40 socket head screw



CSA4B00 : WM SHELL

WM Shell
Attached: Top terminal bracket with 2 X M5 nuts.
Inside WM bracket WM base bracket
Cable gland and cap

Cable:
1 X yellow with one ending and one cable shoe 3/8" 40cm

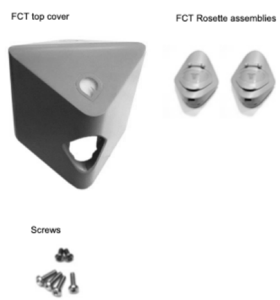
Screws:
4X ½" UNC hex screws
4X ½" Flat washer
8X M8x20 flat head screws

Grounding
4X 3/8" Flat washer
2X 3/8" Spring washer
2X 3/8" Hex nut

CSA3A00 : COVER

FCT top cover
Inside 2 X FCT Rosette assembly

Screws:
4 X M3x8 screws
2 X M3x6 Torx security screw

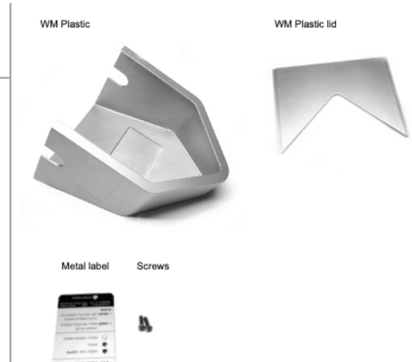


CSA5A00 : WM PLASTIC

WM Plastic
Inside WM Plastic lid

Screws:
2 X M4x20 Torx security screw

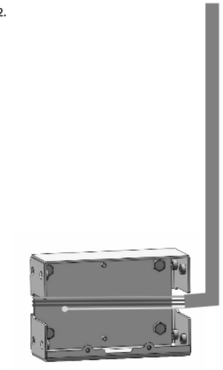
WM metal label



1.

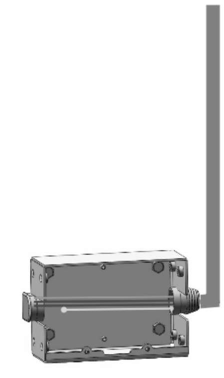
•Drill 4 leveled holes
•Insert 4 dibels
•Insert the electricity wires throw the tube.
The length of the wires extending from the end:
•Blue + 2 Brown – 50 cm – with ending,
•Yellow – 35 cm – with cable shoe 3/8"

2.



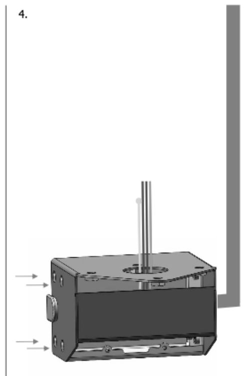
•Attach the WM base bracket to the wall with 4 X M10 screws.

3.



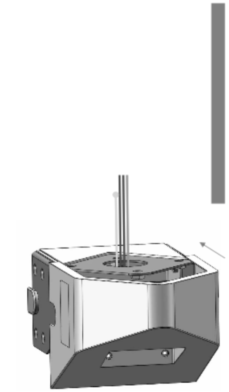
•Cut the cable gland to the right size.
•Insert the cables and the tube throw it.
•Insert the cable gland and the cap to the WM base Bracket.

4.



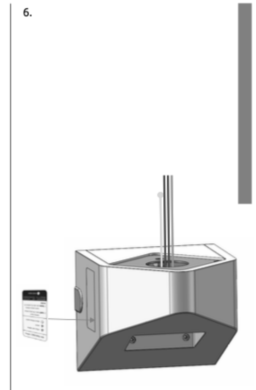
•Attach the WM bracket to the WM base bracket throw the glands with 8 X M10 screws.
•Take out the cables throw the WM bracket top.

5.



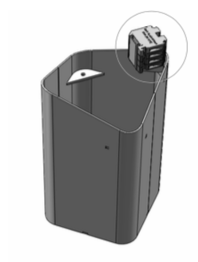
•Place the WM plastic lid
•Slide the WM plastic throw the glands
•Attach with 2 X M4 Torx screws.

6.



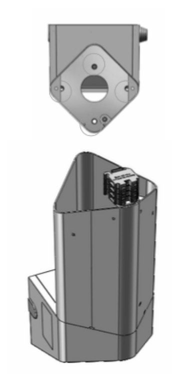
•Stick the metal label in place

5.



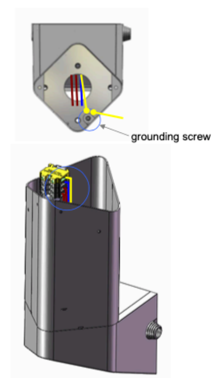
•Flip upside down the top terminal bracket.
•Reattach the top terminal bracket with 2 M5 hex nuts.

6.



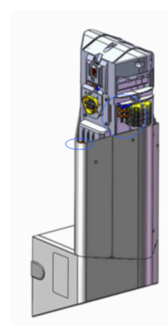
•Place the shell on the bracket, the terminal block should be in front.
•Take out the cables throw the WM shell
•Attach the WM shell with 4 X ½" screws and flat washers.

7.



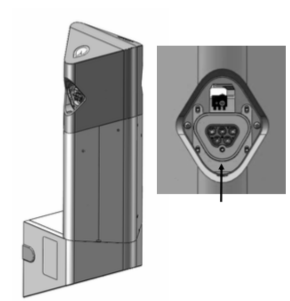
•Attach the grounding cables to the grounding screw inside the shell with the grounding nuts.
•Attach the yellow, blue and brown cables to the right side of the terminal bracket

8.



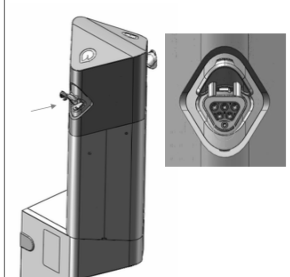
•Insert the Main unit – the cables should face the front.
•Attach with 2X M8 screws
•Attach the main unit cables to the terminal block.
•Turn on all the switches

9.

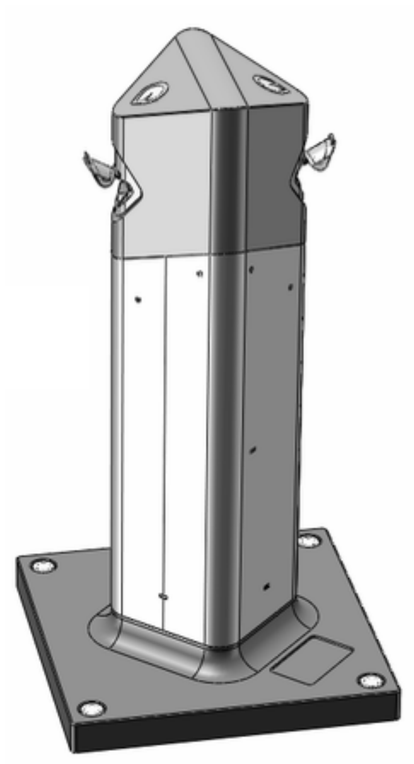


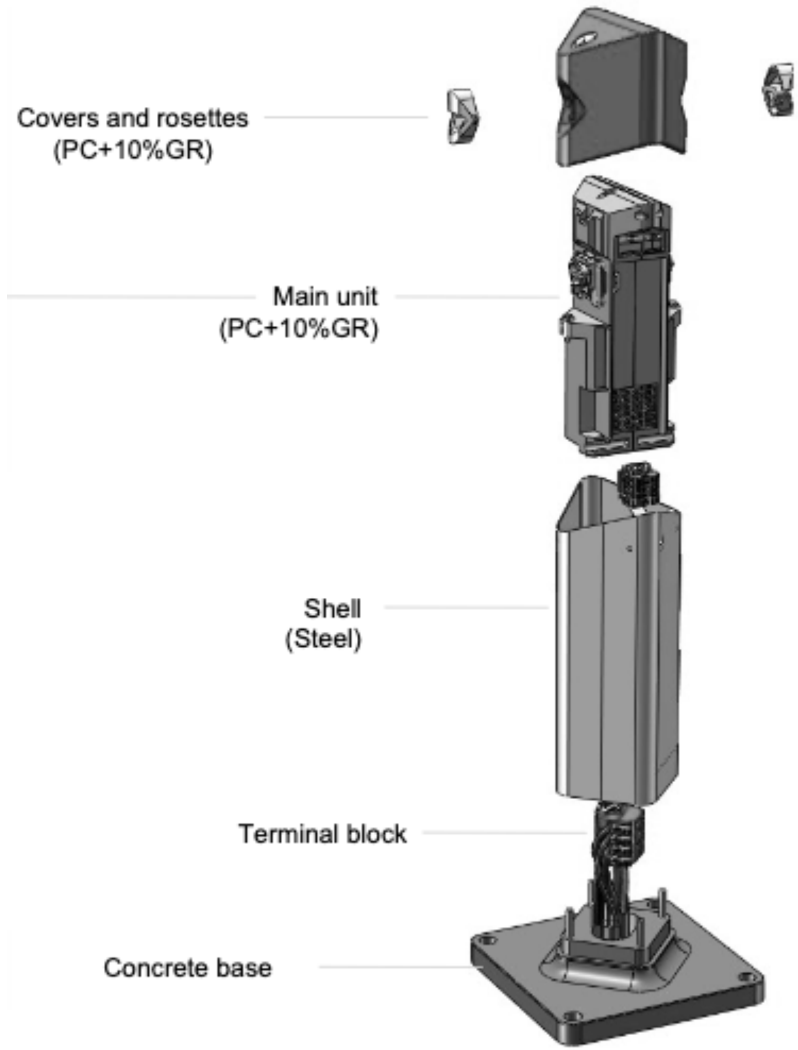
•Slide in the top cover – avoid interference with the micro switch wires while sliding.
•Loosen the 4 screws that attach the socket.
•Push upwards the socket till the screw holes on the cover aligns with the holes on the socket plate.
•Tighten the 4 screws that attach the socket.
•Attach the cover with 2XM3 screws on both sides.

10.



•Insert the rosettes on both sides attach with 2 X M3 Torx security screw.



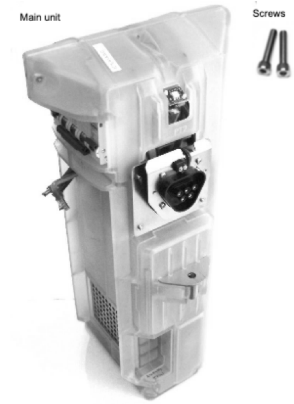


Covers and rosettes
(PC+10%GR)
Main unit
(PC+10%GR)
Shell
(Steel)
Terminal block
Concrete base

CSA1A00 :MAIN UNIT

Main unit – wired and closed.
Attached: 2 main spacers + 2 screw plates

Screws
2 X M8x40 socket head screw



CSA2A00 : PM SHELL

PM Shell
Attached: Top terminal bracket with 2 X M5 nuts.
Terminal block in a separate package

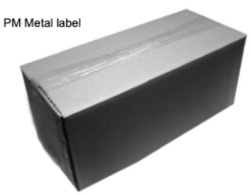
Cables:
2 X brown + 1 X blue with ending - 50 cm.
1 X yellow with an ending and a cable shoe 3/8" - 40 cm

1 X Canadian fastener

Screws:
8X ½" UNC hex nuts
4X ½" Flat washer
2X M5x6 screw

Grounding
4X 3/8" Flat washer
2X 3/8" Spring washer
2X 3/8" Hex nut

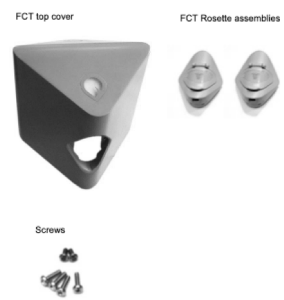
PM Metal label

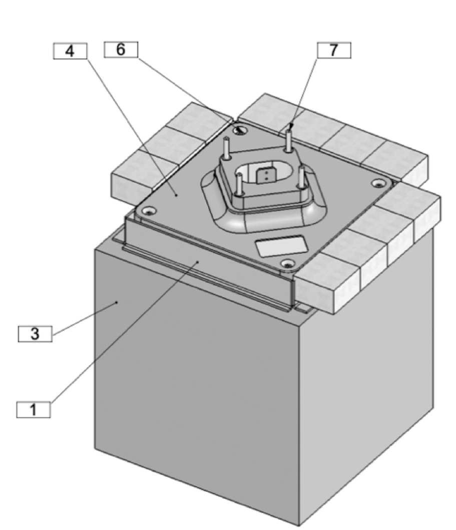


CSA3A00 : COVER

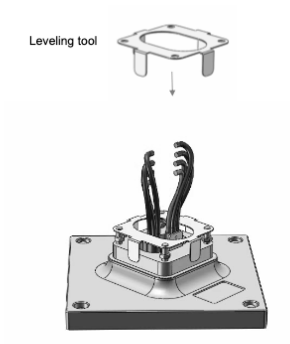
FCT top cover
Inside 2 X FCT Rosette assembly

Screws:
4 X M3x8 screws
2 X M3x6 Torx security screw





1.

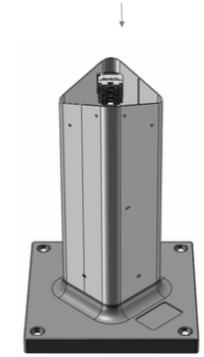


•Screw in 4X ½" Hex nuts
•Place the leveling tool
•Level the 4 nuts and remove the tool.

2.

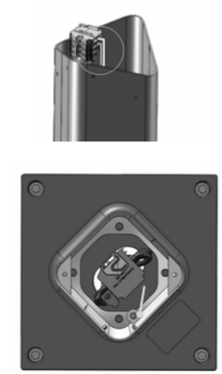
•Attach the terminal block to the concrete base with 2 X M5 screws.
•Connect the Infrastructure cables to the terminal block
•Connect 2 X brown, 1 X blue cables.
•Connect the Canadian fastener to the grounding cables* (only in case of continues grounding).

3.



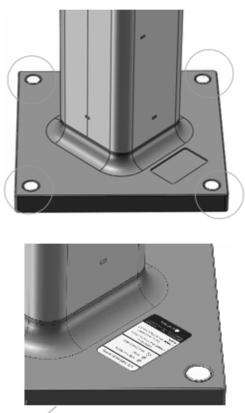
•Flip upside down the top terminal bracket.
•Reattach the top terminal bracket with 2 M5 hex nuts.
•Place the shell on the concrete.
•Attach the PM shell with 4 X ½" nuts and flat washers.

4.



•Attach the grounding cables to the grounding screw inside the shell with the grounding nuts.
•Attach the yellow, blue and brown cables to the right side of the terminal bracket

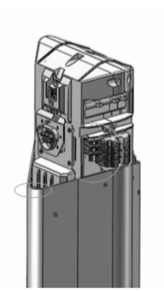
5.



Car parking

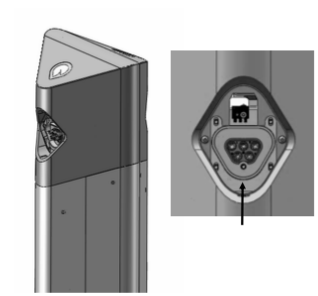
•Insert in 4 screw caps on the 4 corners of the concrete.
•Clean the label cavity on the concrete.
•Stick the label orienting to the car parking.

6.



•Insert the Main unit – the cables should face the front.
•Attach with 2X M8 screws
•Attach the main unit cables to the terminal block.
•Turn on all the switches

7.



•Slide in the top cover – avoid interference with the micro switch wires while sliding.
•Loosen the 4 screws that attach the socket.
•Push upwards the socket till the screw holes on the cover aligns with the holes on the socket plate.
•Tighten the 4 screws that attach the socket.
•Attach the cover with 2XM3 screws on both sides.

8.

•Insert the rosettes on both sides attach with 2 X M3 Torx security screw.

Site Visit

Field Studies & Product Analysis (v1)

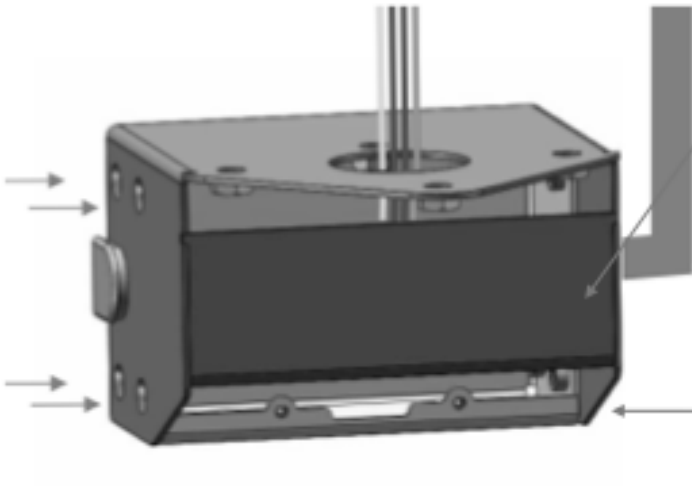
Process Design Optimization & Product Analysis (V1 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

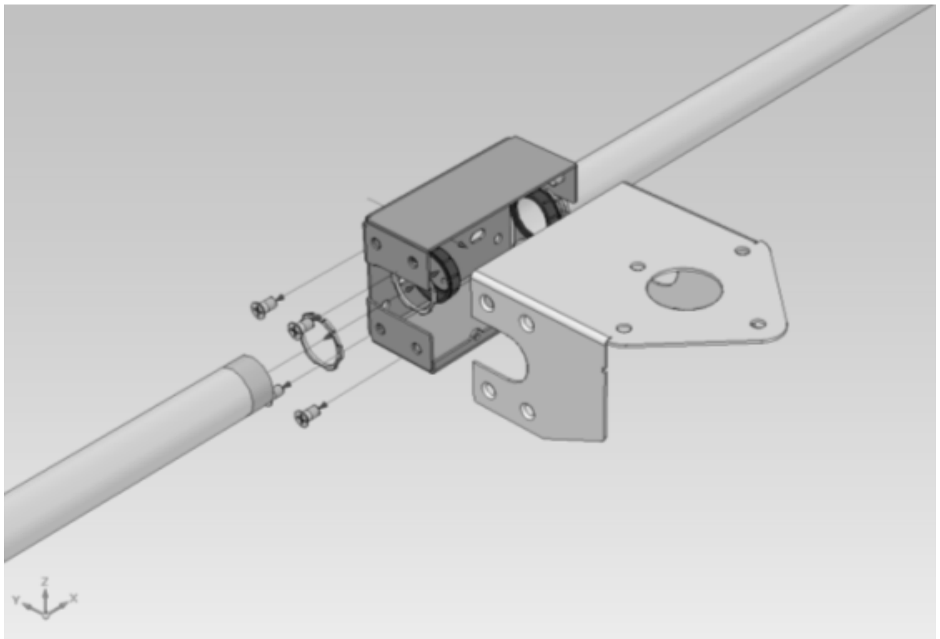
First Run Study / Proof of Concept LDSC - Denmark

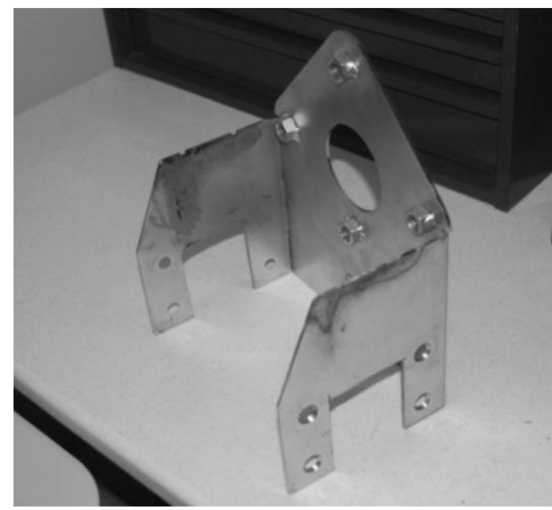

CSA3ADO
COVER
CSA1ADO
MAIN UNIT

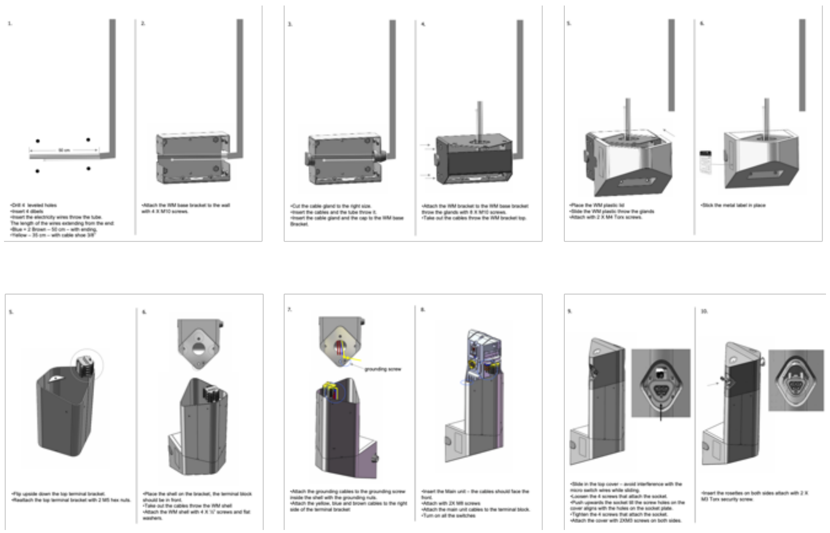


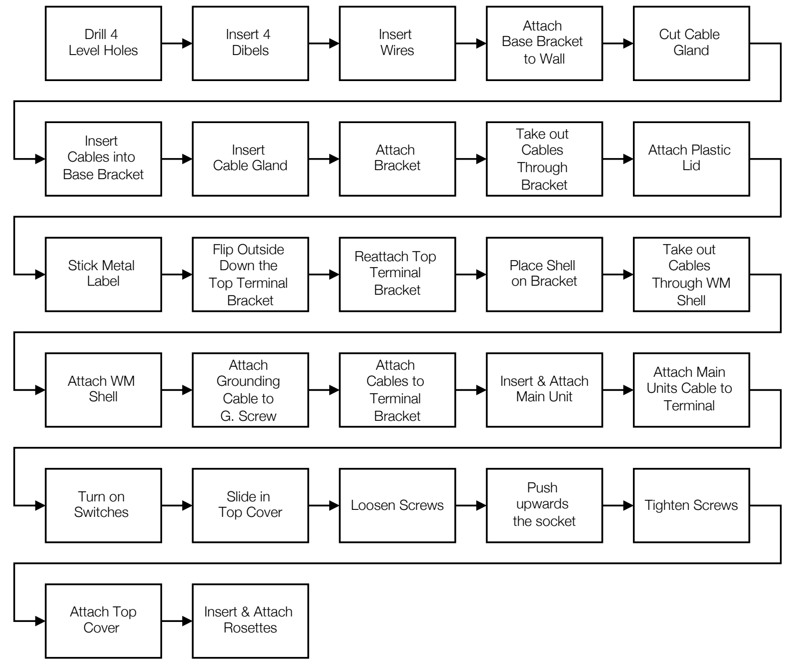
Remove stiffener plate. This will allow for sliding CSU pre-assembly over junction box and efficient electrical connections.

Is stiffener plated needed? Does not the walls of the junction box act as stiffener once bracket is attached and fastener tightened to specified torque? If stiffener plate is needed – can it be placed across diagonal cut-out?.



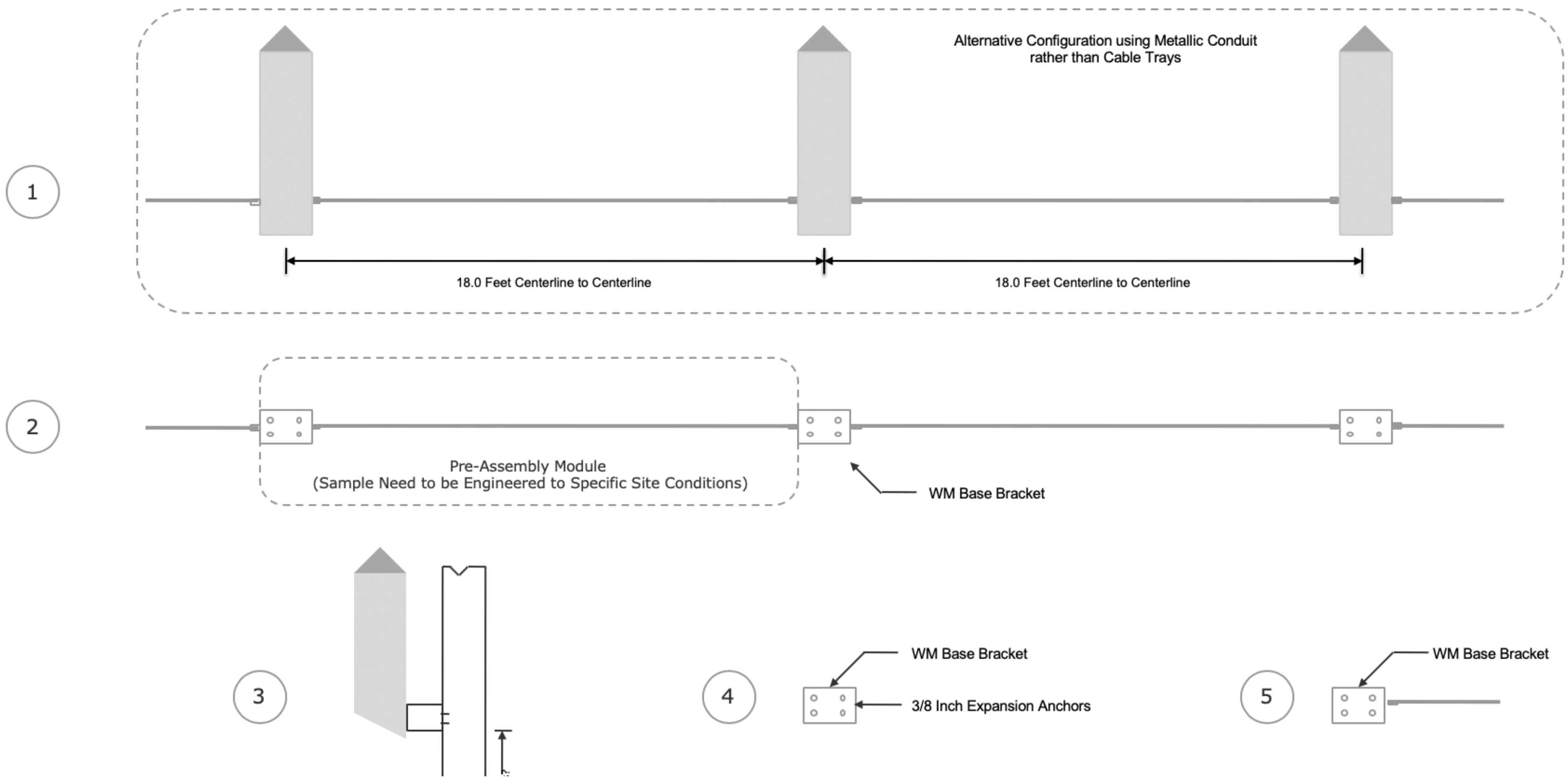




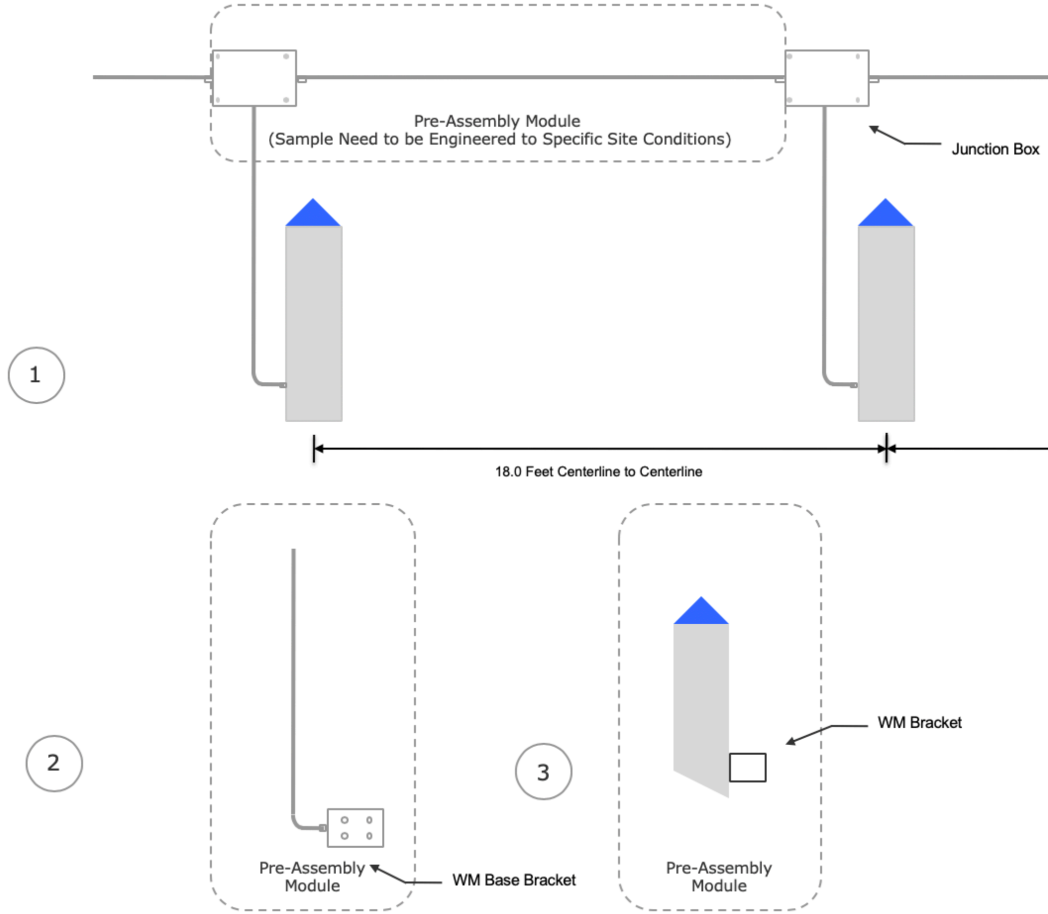


PROJECT PRODUCTION INSTITUTE

2.1 Pre-Assembly Strategy - No Drop

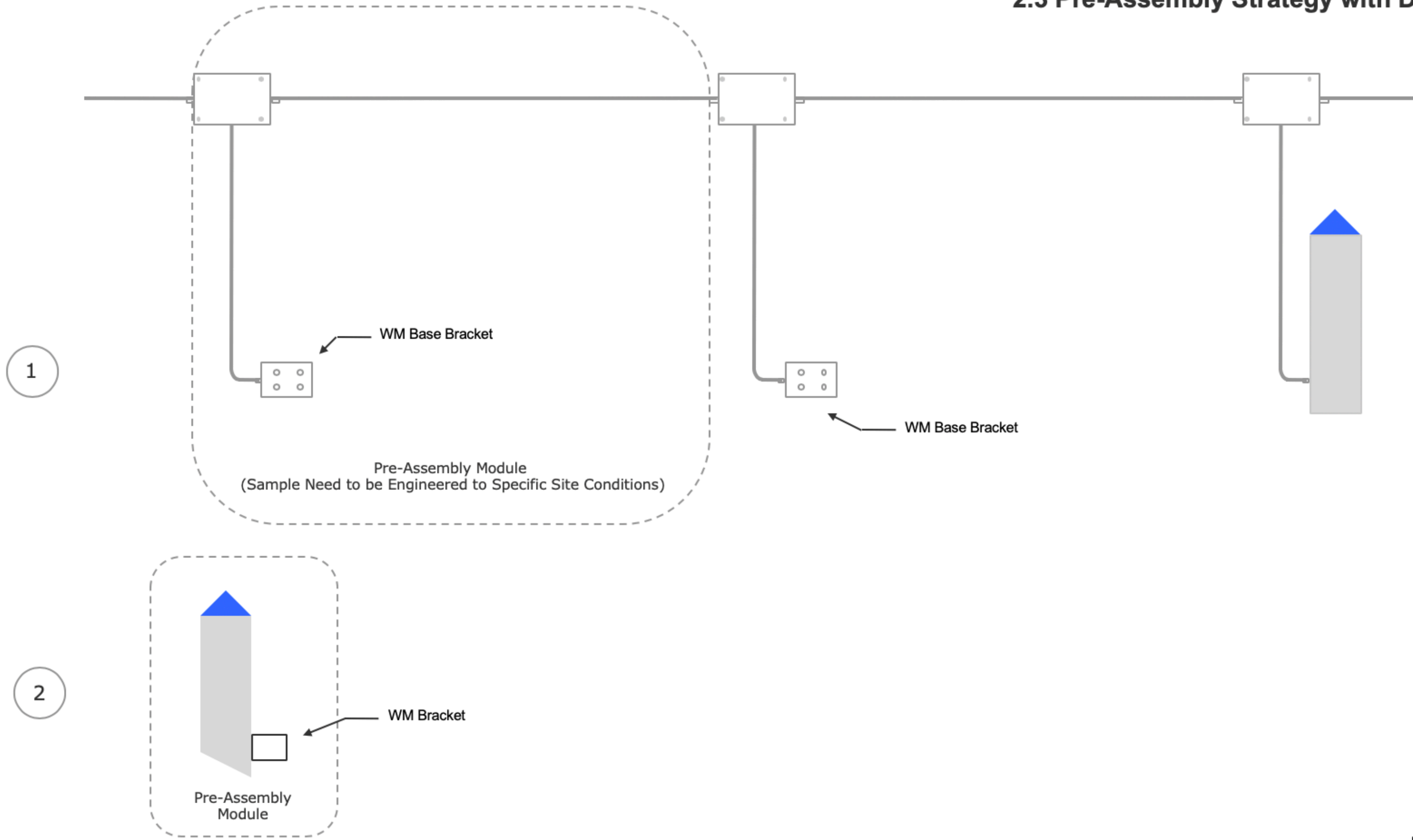


2.2 Pre-Assembly Strategy with Drop – Option A

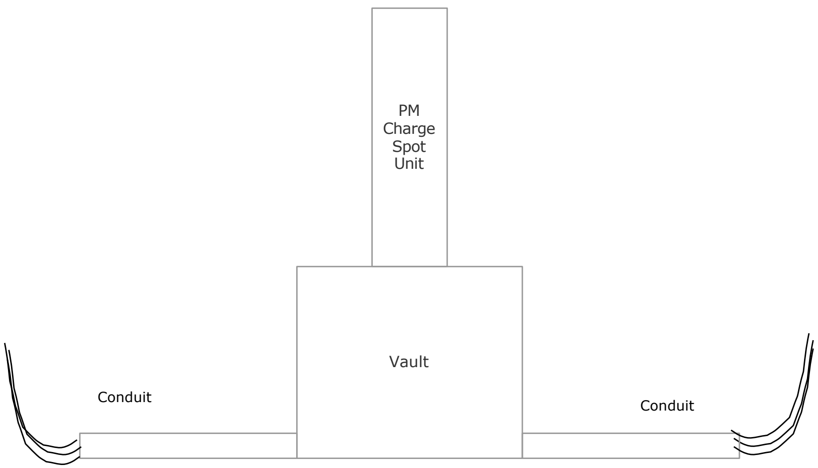


NOTE: Diagrams are not to scale

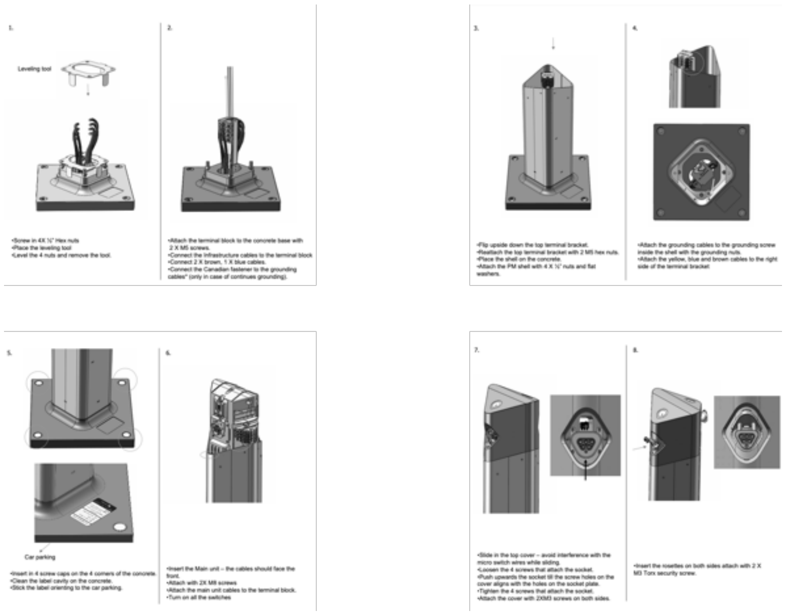
2.3 Pre-Assembly Strategy with Drop – Option B



NOTE: Diagrams are not to scale



Pre-Assembly Strategy (Initial Phase)



Screw HEX Nuts into Base → Place Leveling Tool → Level Nuts & Remove Tool → Attach Terminal Block to Concrete Base → Connect Infrastructure Cables to Block →

Connect Fastener to Grounding Cables → Flip Outside Down the Top Terminal Bracket → Reattach Top Terminal Bracket → Place Shell on Concrete → Attach Shell →

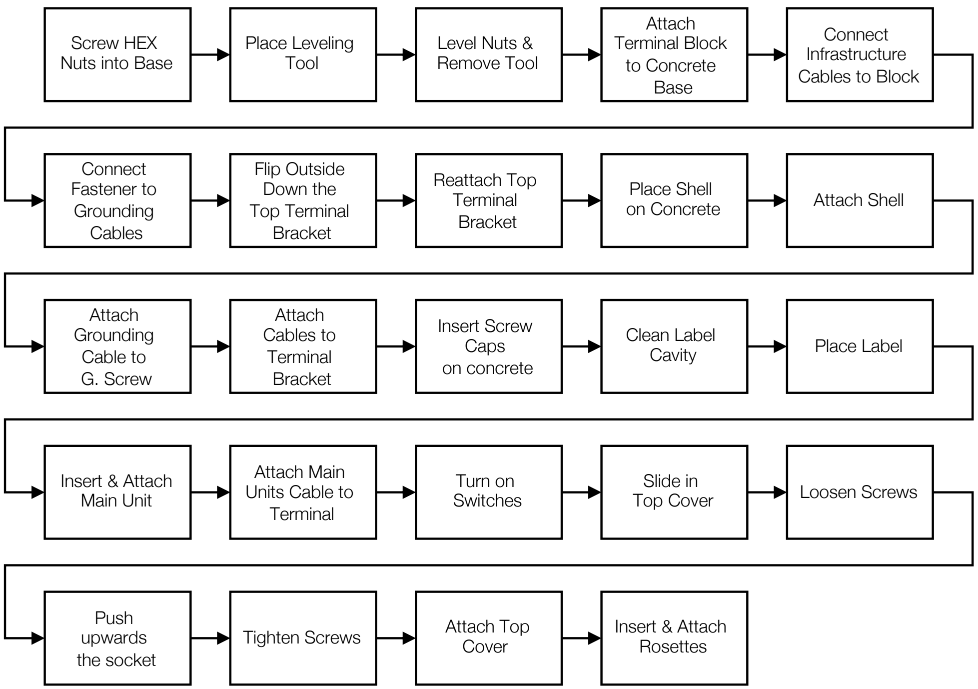
Attach Grounding Cable to G. Screw → Attach Cables to Terminal Bracket → Insert Screw Caps on concrete → Clean Label Cavity → Place Label →

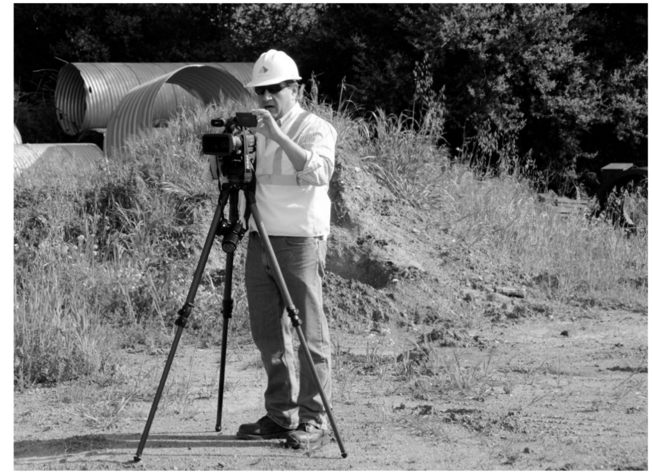
Insert & Attach Main Unit → Attach Main Units Cable to Terminal → Turn on Switches → Slide in Top Cover → Loosen Screws →

Push upwards the socket → Tighten Screws → Attach Top Cover → Insert & Attach Rosettes

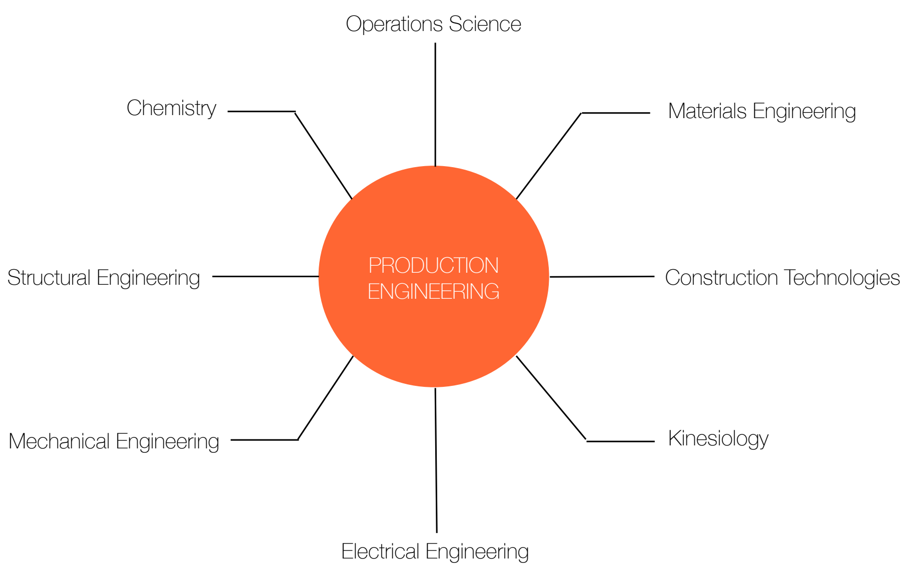

CRI


CRI





PROJECT PRODUCTION INSTITUTE


Operations Science
Chemistry
Materials Engineering
PRODUCTION ENGINEERING
Structural Engineering
Construction Technologies
Mechanical Engineering
Kinesiology
Electrical Engineering


BP WCD HSE Analysis.mov
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Site Visit

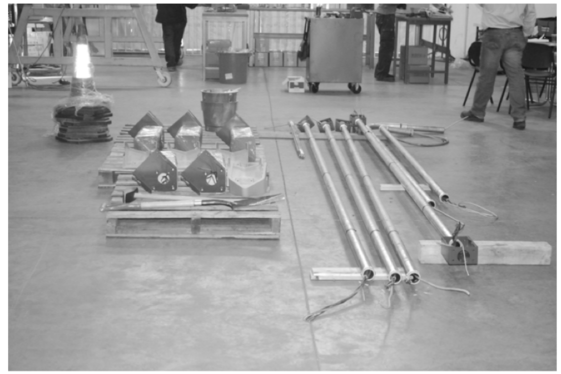
Field Studies & Product Analysis (v1)

Process Design Optimization & Product Analysis (V1 bracket)

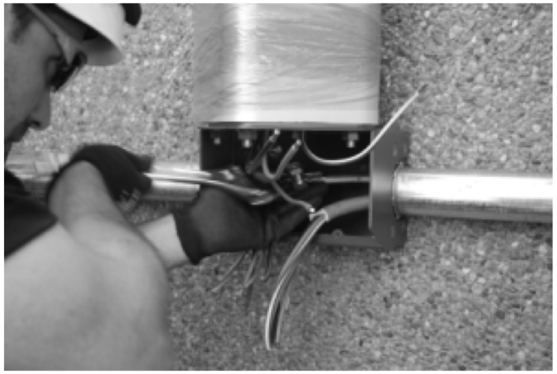
First Run Study / Proof of Concept - Israel

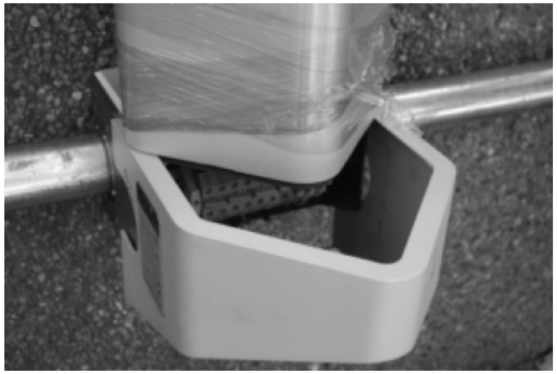
Process Design Optimization & Product DfX Optimization (v2)

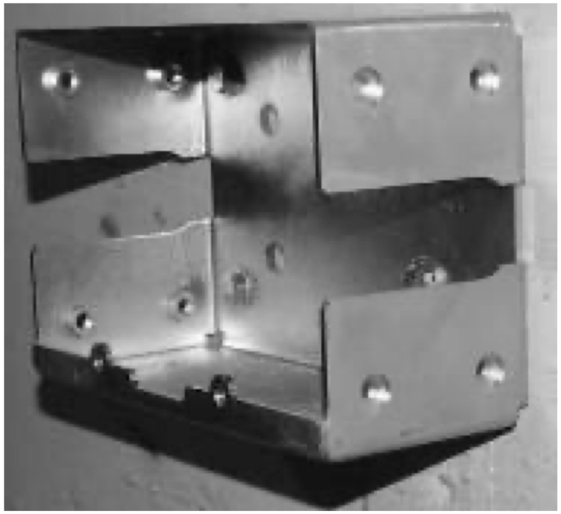
First Run Study / Proof of Concept LDSC - Denmark

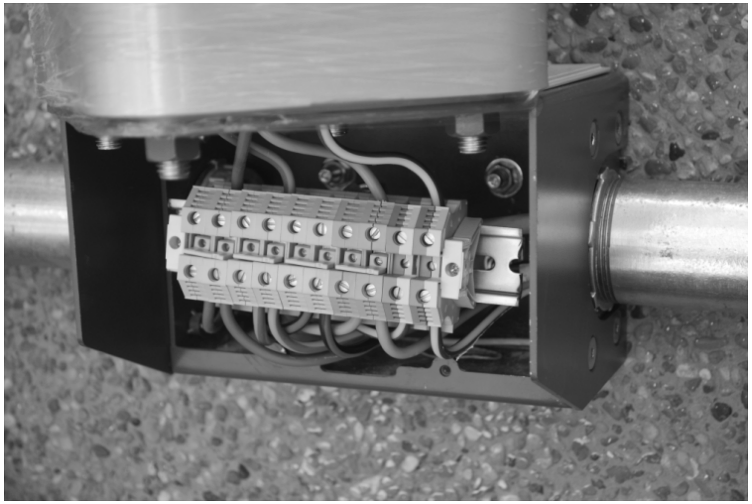


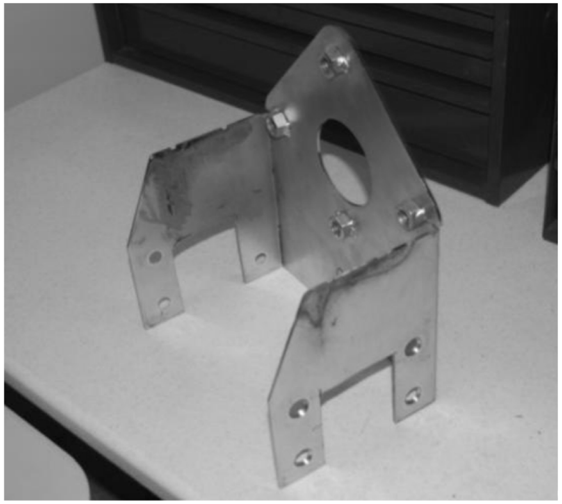

STILL
R 60-25
קידמה

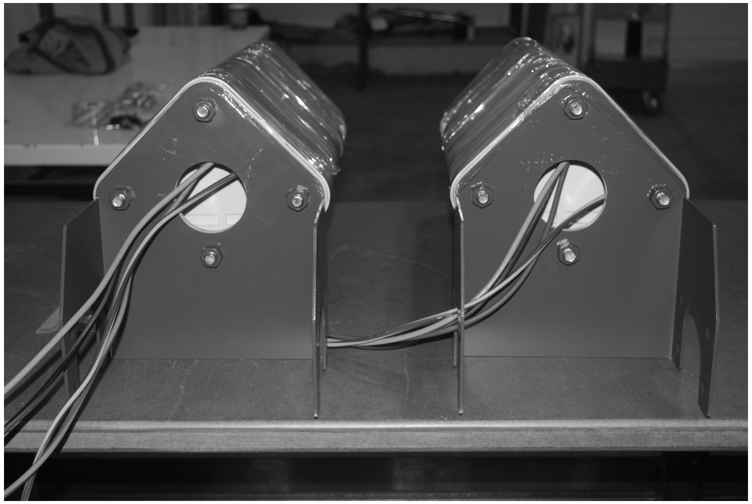






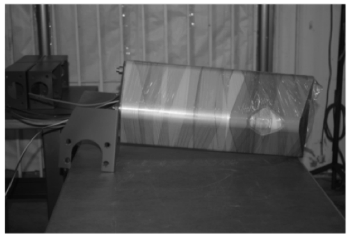






Room for Improvement

Availability of proper PPE (goggles were provided to Mr. Sprinkler technician)



Opportunity to define a better protection solution for modules to avoid physical damage

Provide a working platform for assembly of modules (ergonomics and safety)

Train technicians on proper use of tools and postures

Need to define a better solution for the use of terminals inside junction boxes (use of wire connectors may be easier and faster)

When installed, plastic cover pushes terminal inside junction box

Better refuse disposal – use of carts

Opportunity to train local technicians on proper loading and off-loading signals (demonstrated here)

Define standard packaging procedures and materials

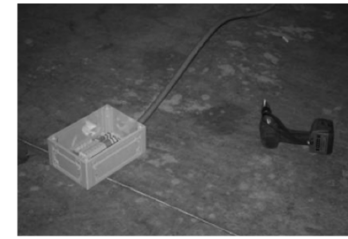
Select quality materials

Use of Carts for Transportation of Tools and Small Materials

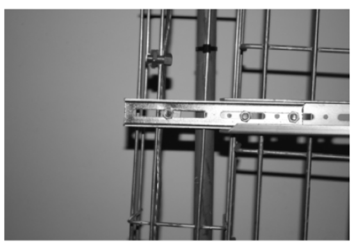
Use of Proper Tool Belts for better access to tools and small materials

Use of Proper Garbage Containers

Garbage cart can be placed underneath working area

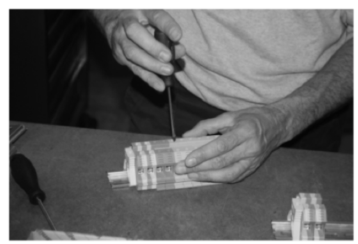


Carts can provide a working platform if especially designed



Are three bolts required when attaching support extensions?

Charge Spot Bracket Lateral Screws Damaged during Installation



Opportunity to use better / faster tools for assembly of terminals

Time spent doing detailed engineering on Site involving technicians

Better solution definition for conduits (white conduit was painted blue at the request of the property manager) – how does it affect the company brand?

Room for Improvement

Site Visit

Field Studies & Product Analysis (v1)

Process Design Optimization & Product Analysis (V1 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

First Run Study / Proof of Concept LDSC - Denmark

Site Engineering Survey through Laser Scanning

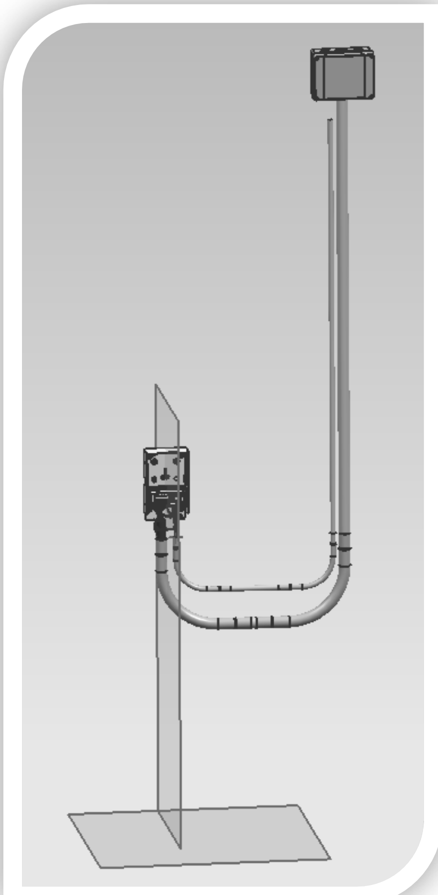
Detailed Engineering through PLM

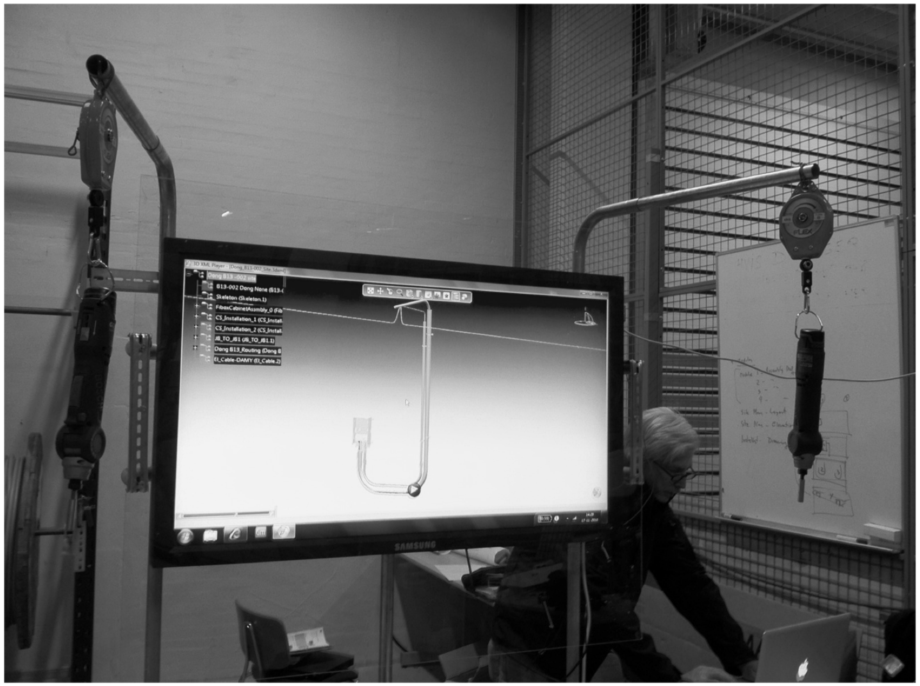
Fabrication at LDSC

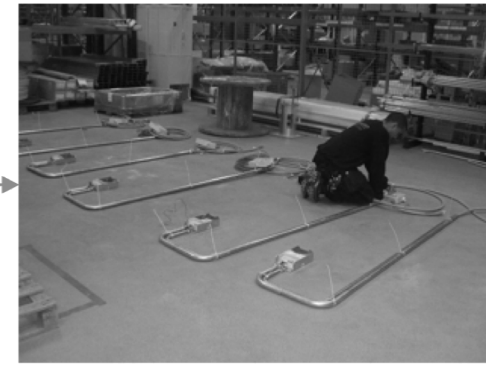
Module Assembly at LDSC

Kitting at LDSC

Site Installation of Modules & Individual Infrastructure Components







Assemble WM Bracket Unit

Assemble “J” Drop Configuration

Assemble Switchboard Modules

Assemble Circuit Modules (e.g., Trays, Conductors, etc.)

Defining LDSC Layout

Implementing Work Stations

Implementing Enabling Systems & Tools

(LCD screen for Viewing PLM Packages)

Educating Team in Project Specifics

Getting Ready for Shop Floor Operations

Training on Infrastructure Details

Offload Kits from Truck & Place in Designated Area

Layout

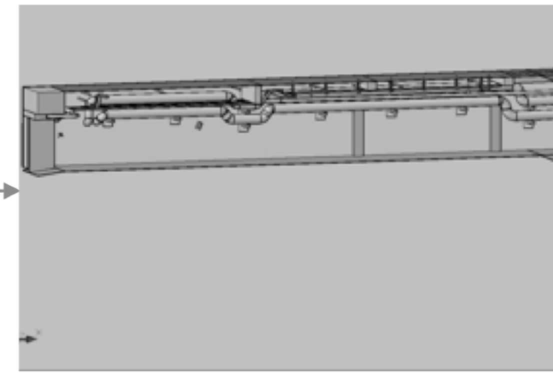
Install ‘J’ Drop Modules

Install Switchboard Module

Install Circuit Modules

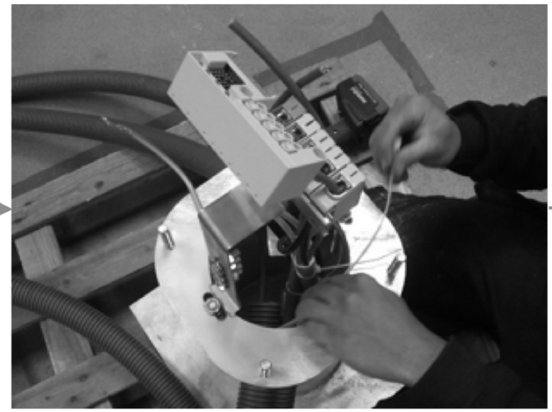
Scan Site

Register Point Clouds



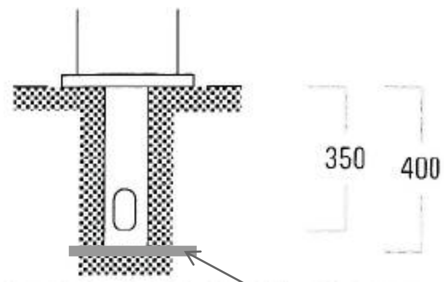
Develop 3D Model of Existing Site Conditions

Assemble Base, Leveling Bracket & Terminal Block



Connect Fast Connector to Base Assembly

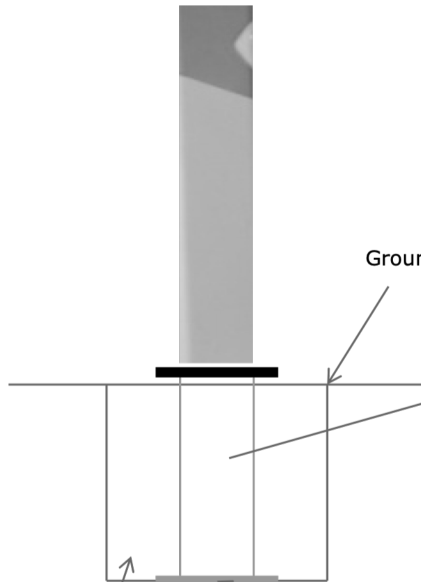
Assemble Circuit Modules



Metal Plate
Welded to
Planted Root
Component

Consider: The pipe is 13cm in diameter.
the top is 16cm in diameter. The bottom
plate 30 x 30cm. Height - 40 cm.

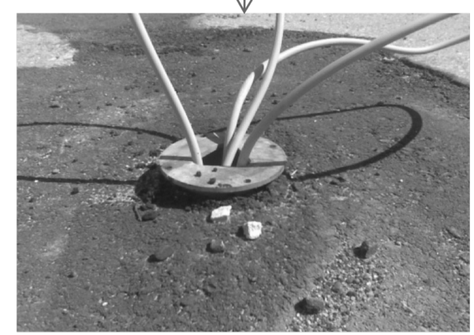
Ground Level

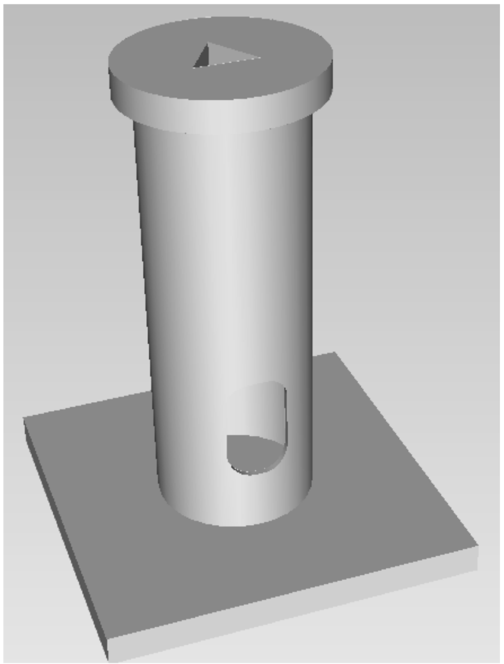


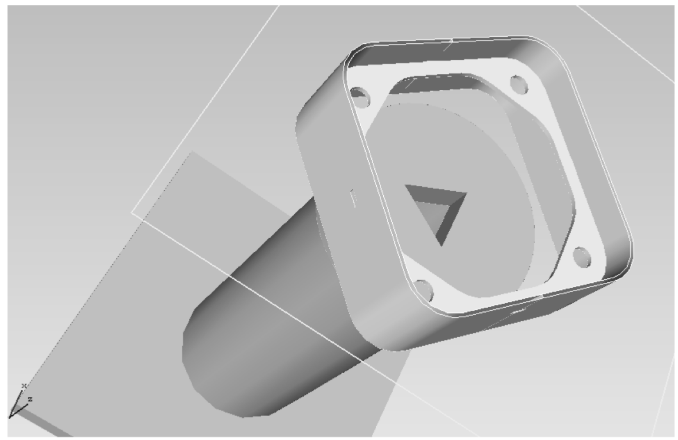
Trench

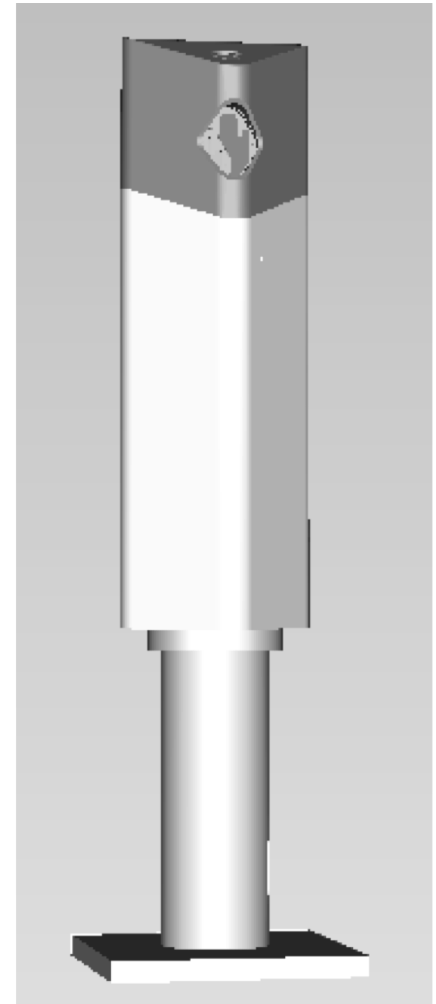
Metal Plate
Welded to
Planted Root
Component

Planted Root
Component over
metal plate





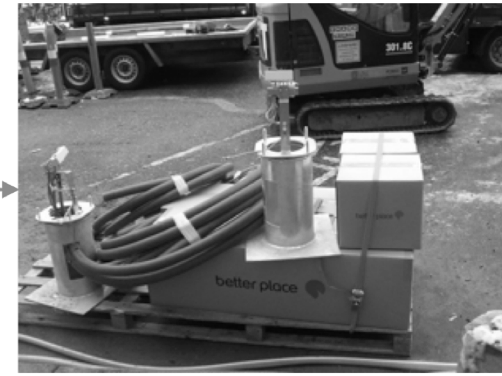




Kitting at LDSC

LDSC Dispatch & Load Truck

Barricade & Excavate Site



Offload Kits and Place into Designated Area on Site

Install Switchboard

Install Circuit Modules

Install PM Unit

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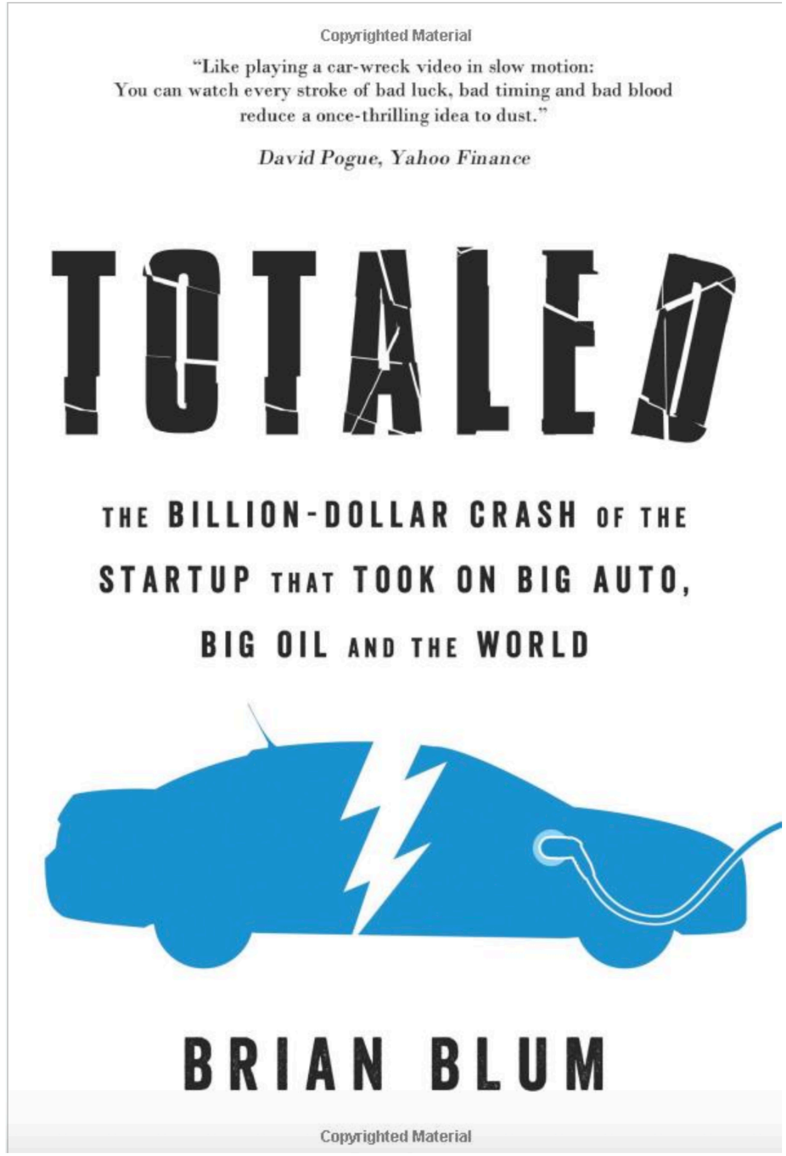
Layout WM Unit (locate position of 4 anchors) → Drill Holes (4 anchors) → Place Fasteners (4 anchors) → Place Nuts on Fasteners (4 nuts) → Place Leveling Plate on the nuts → Adjust Nuts to Level the Plate → Remove Leveling Tool → Position Bracket Box against leveled nuts → Install securing nuts (4 nuts) →

Run Raceway & Cables from JB to WM Bracket → Strip & Connect Cables (power & com) to FT → Attach FT Water Cover & FT to Bracket (2 screws) → Test Com & Set Dip Switches → Position WM CSU (tabs inserted into bracket) → Secure WM CSU (4 screws) → Test Power

Remove Front Cover of WM CSU (6 captive screws) → Remove SIM Card Cover (4 screws) →

Install SIM Card → Replace SIM Card Cover (4 screws) → Replace Front WM CSU Cover (6 captive screws)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"Like playing a car-wreck video in slow motion:
You can watch every stroke of bad luck, bad timing and bad blood
reduce a once-thrilling idea to dust."
David Pogue, Yahoo Finance
TOTALED
THE BILLION-DOLLAR CRASH OF THE
STARTUP THAT TOOK ON BIG AUTO,
BIG OIL AND THE WORLD
BRIAN BLUM
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Wrap Up

Computer Aided Production Engineering

04 December 2019

BACK UP SLIDES

Concurrent Digital Engineering for Capital Projects

Todd R. Zabelle, Alex G. Kunz, Ben Amaba PhD P.E. and James E. Craig P.E. / DOWNLOAD ARTICLE

Abstract

Ongoing analysis of efficiency in construction compared to other industries indicates construction continues to fall further behind. There are several reasons for this, but one that is most prevalent is the difference in approach to design and engineering between advanced industries such as aerospace, automotive, etc. and the construction industry.

Over the past several decades, advanced industries have used different processes, methods and tools to design and engineer their products. With the advent of ever-increasing computer power and network speed, artificial intelligence (AI), machine learning (ML), robotic process automation (RPA) and enormous data complexes fed by sensors, new and more effective ways to design and engineer will emerge, no doubt reshaping design and engineering as we know it today.

In this paper, the Project Production Institute (PPI) proposes an alternative approach for design and engineering of capital assets. PPI proposes Concurrent Digital Engineering as the framework forward.

Keywords: *Operations Science; Concurrent Digital Engineering; Artificial Intelligence; Machine Learning; Automation*

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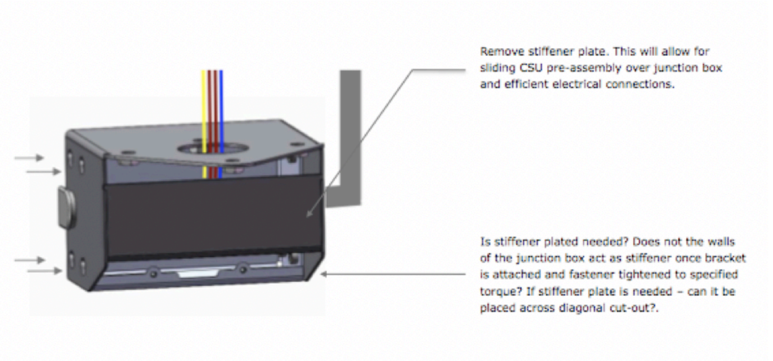
Findings

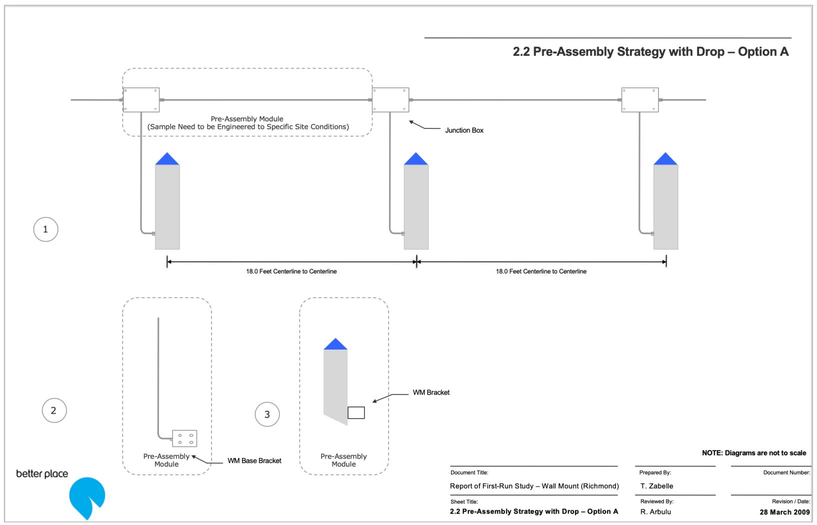
Initial conclusions are that the pre-assembly strategy offers Better Place significant health & safety, quality, time and cost benefit for installation of charge spot assemblies for wall mount installations.

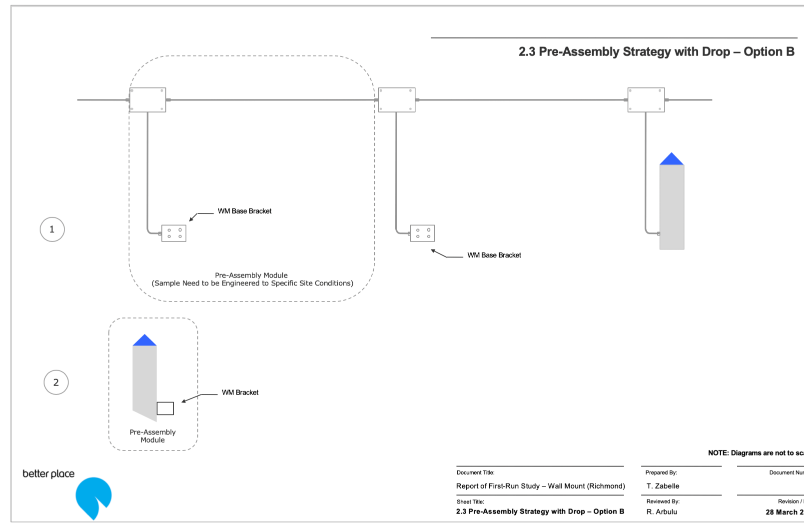
Opportunities for Further Optimization

1. The benefits of a pre-assembly strategy requires that various investments be made including a robust process of site evaluation, survey, engineering, deployment of a logistics center, and specialized equipment for the transport of pre-assembled modules.
2. Local code requirements will need to be identified and modifications agreed prior to commencing work in a specific market (e.g. type of conduit required)
3. The current charge spot unit requires some modification to the current design. Specifically the wall mount concept (base bracket), the wiring and the packaging will need to be rationalized.
4. Cable tray appears to be lower cost but this needs further analysis. The total installed and life cycle cost of conduit may be less than that of mesh tray.
5. A standard catalog should be set-up to allow engineers to pull and place components in a PDM system enabling automated BOM generation.



Observations to the WM Base Bracket Design


2.2 Pre-Assembly Strategy with Drop – Option A
Pre-Assembly Module
(Sample Need to be Engineered to Specific Site Conditions)
Junction Box
1
18.0 Feet Centerline to Centerline
18.0 Feet Centerline to Centerline
2
3
WM Bracket
Pre-Assembly Module
WM Base Bracket
Pre-Assembly Module
better place
NOTE: Diagrams are not to scale
Document Title:
Report of First-Run Study – Wall Mount (Richmond)
Prepared By:
T. Zabelle
Document Number:
Sheet Title:
2.2 Pre-Assembly Strategy with Drop – Option A
Reviewed By:
R. Arbulu
Revision / Date:
28 March 2009


2.3 Pre-Assembly Strategy with Drop – Option B
WM Base Bracket
1
WM Base Bracket
Pre-Assembly Module
(Sample Need to be Engineered to Specific Site Conditions)
2
WM Bracket
Pre-Assembly Module
better place
NOTE: Diagrams are not to scale
Document Title:
Report of First-Run Study – Wall Mount (Richmond)
Prepared By:
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Document Number:
Sheet Title:
2.3 Pre-Assembly Strategy with Drop – Option B
Reviewed By:
R. Arbulu
Revision / Date:
28 March 2009



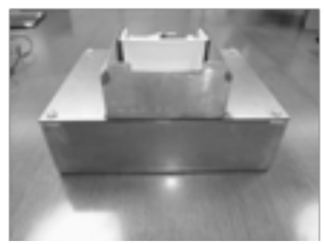
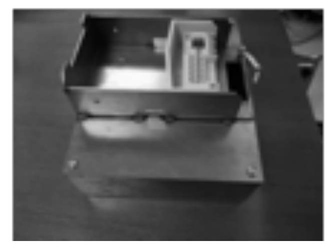




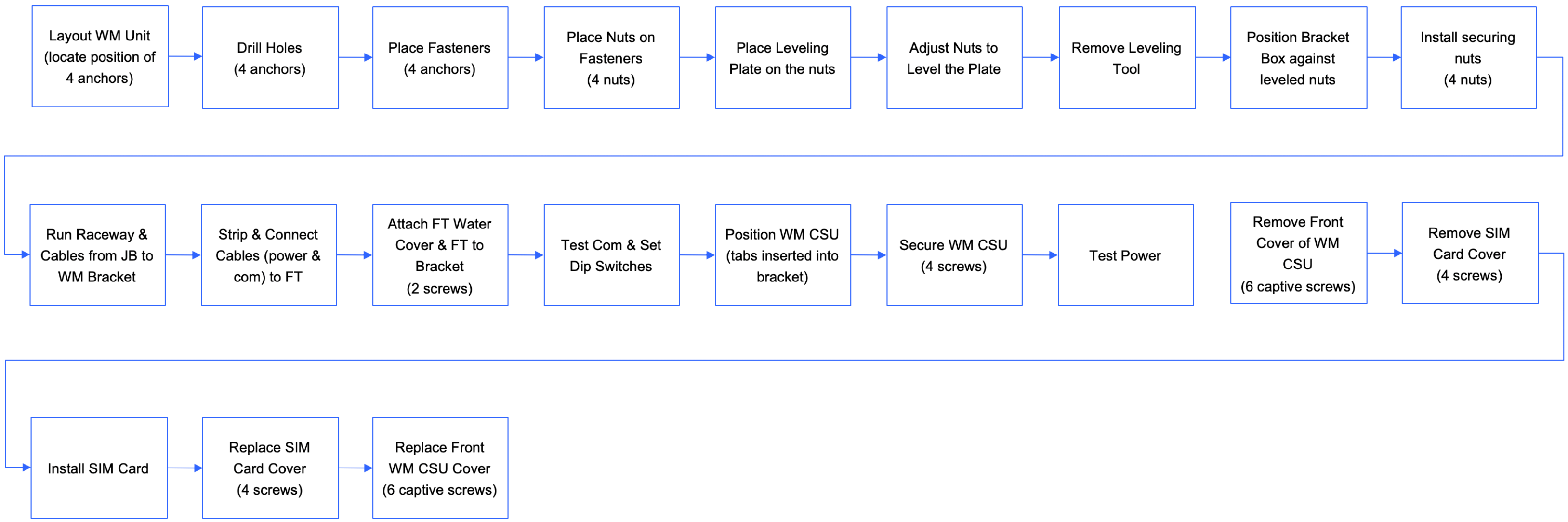






Wall Mount Floating Charge Spot Unit V1 – Installation Process Map



Note:

This process map reflects installation steps that the GID team identified based on the current WM CSU V1 design. This is not an optimized process.

better place

Document Title:	Document Number:
Global Infrastructure Deployment Team	
Sheet Title:	Revision / Date:
Wall Mount Floating CSU V1 – Installation Process Map	**27 January 2010**

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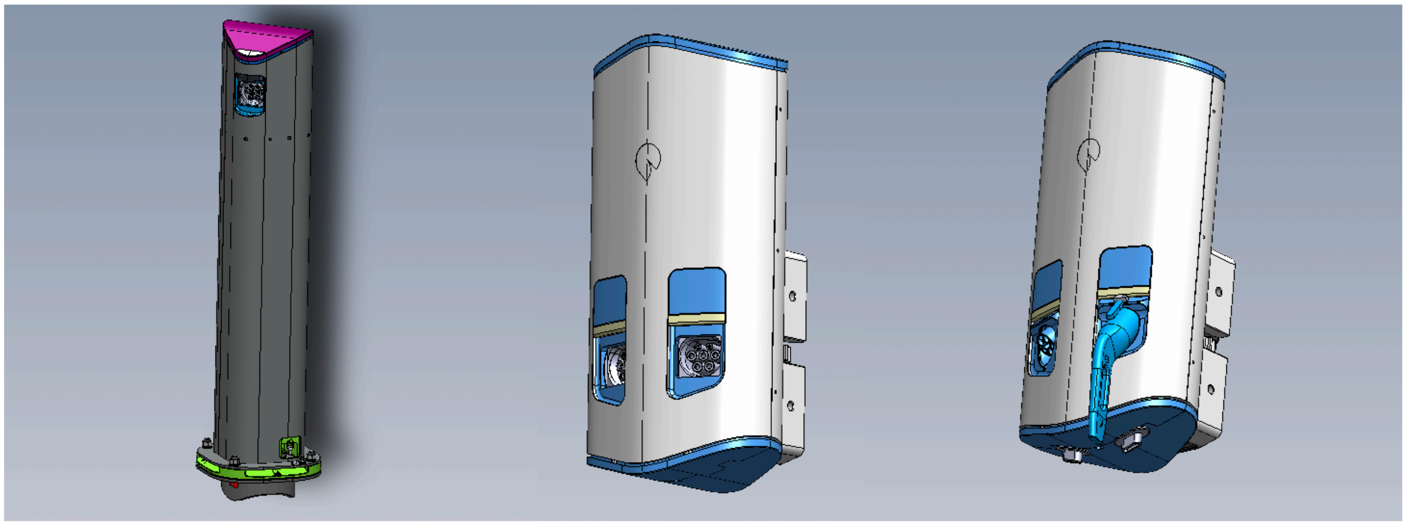
Charge Spot Unit V1 – Installation Process Analysis



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Document Title:
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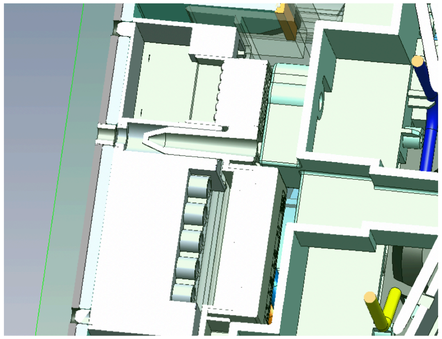
Document Number:

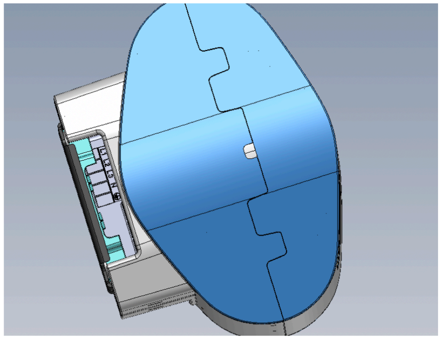
Sheet Title:
CSU - Installation Process Analysis

Revision / Date:
27 January 2010

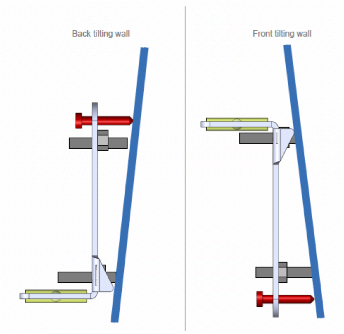
Wall Mount Floating Charge Spot Unit V1 – Questions



Do we need to secure the FT water cover and the FT to the bracket before placing the bracket on the wall? – it seems the nuts needs to be placed from the back of the bracket rather than the FT just screw from the front



Per our understanding of the proposed standard, all EVSEs (CSUs) must be suitable for outdoor installation. Does this slot in the bottom of the WM CSU where the cable enters the bracket provide adequate protection of the conductors and other electrical components from the elements (driven rain, splashed water, snow from build up melting, snow removal equipment, irrigation, etc.)?



What holds the nuts in place?

Other Questions:

How are the CSUs going to be packaged?

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Document Title:	Document Number:
Global Infrastructure Deployment Team	
Sheet Title:	Revision / Date:
Wall Mount Floating CSU V1 – Design Review	**27 January 2010**

FLEET SEWER POSESSION

Remove crash deck

Install temporary steel supports

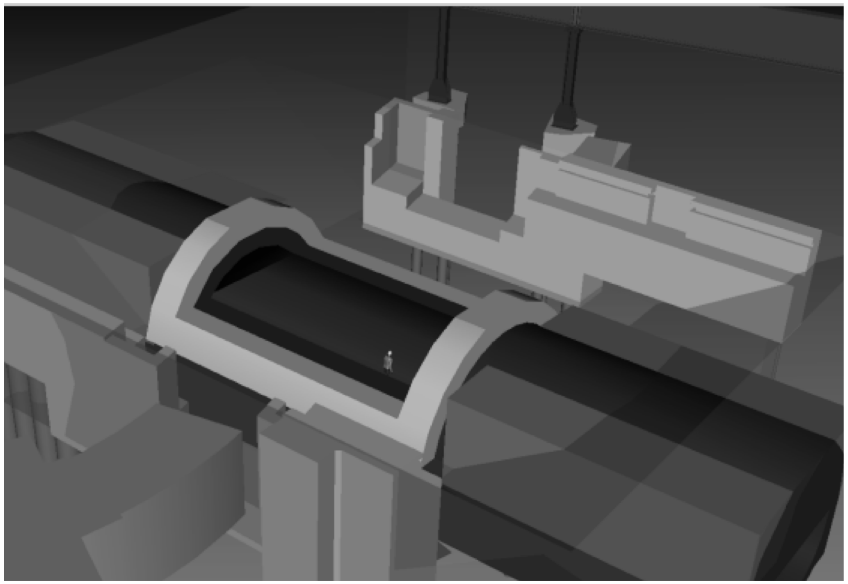
Install 7 sections of Orthotropic deck

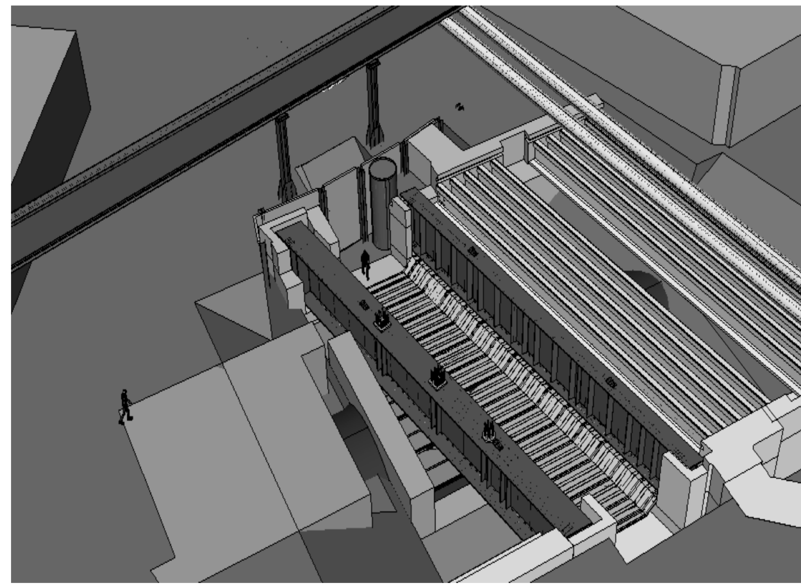
Earth and Bond Orthotropic Deck

Install 2 Plate Girders (65 & 105 Ton)

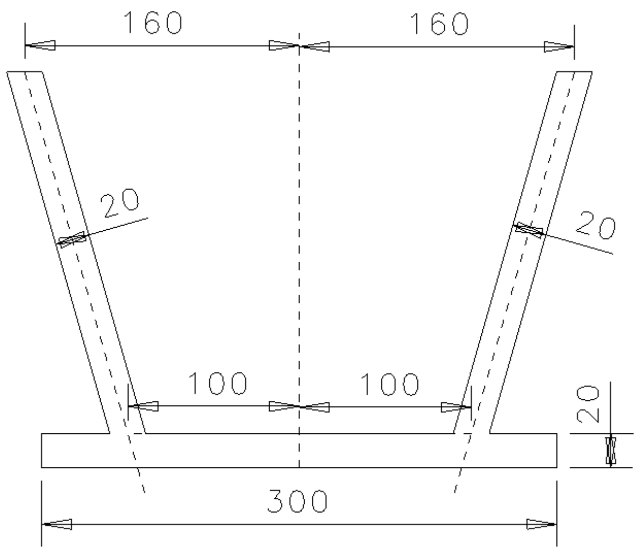
Install 5 M-Beams (30 Ton each)

51 Hours to Execute Work

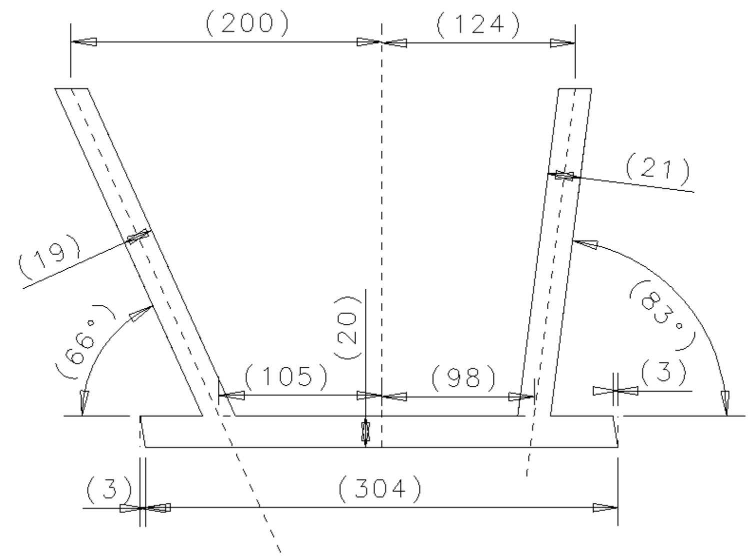




Build Digital Prototype



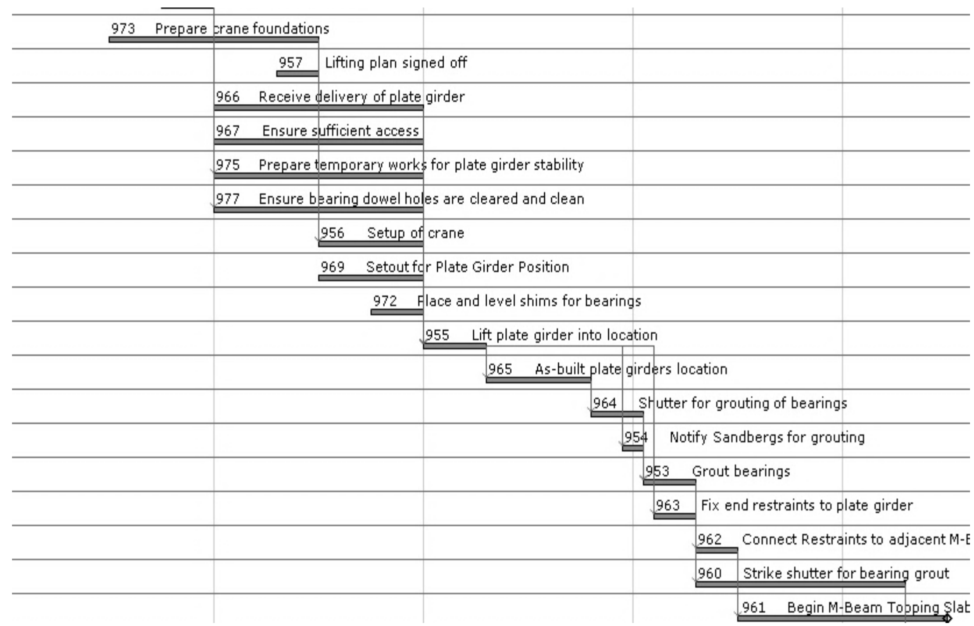
2D Drawings



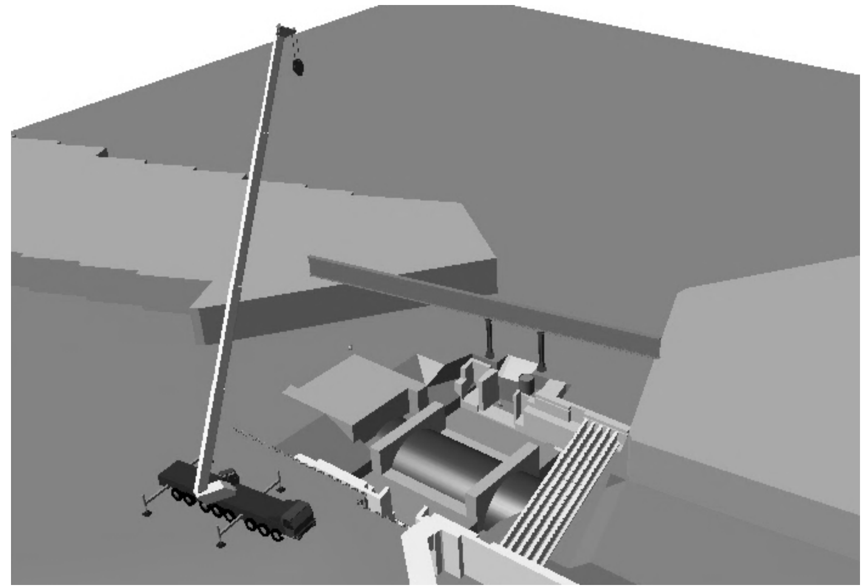
Digital Prototype

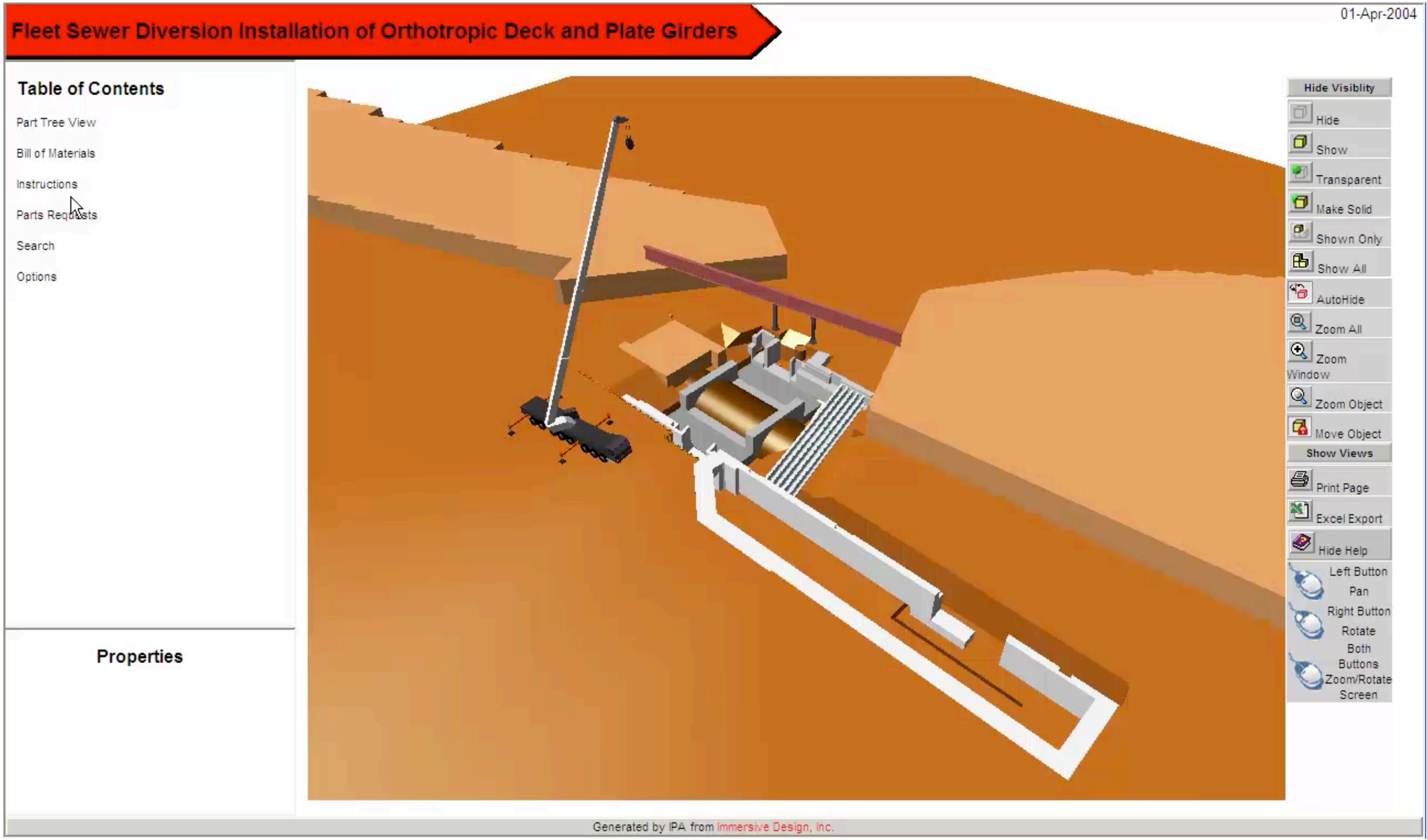

IBM
INSTALL GIRDER TEMP STRUCTURE
INSTALL GIRDERS
JACK UP DECK
REMOVE TEMP PROPS
JACK DOWN DECK


INSTALL GIRDER TEMP STRUCTURE
INSTALL GIRDERS
JACK UP DECK
REMOVE TEMP PROPS
JACK DOWN DECK

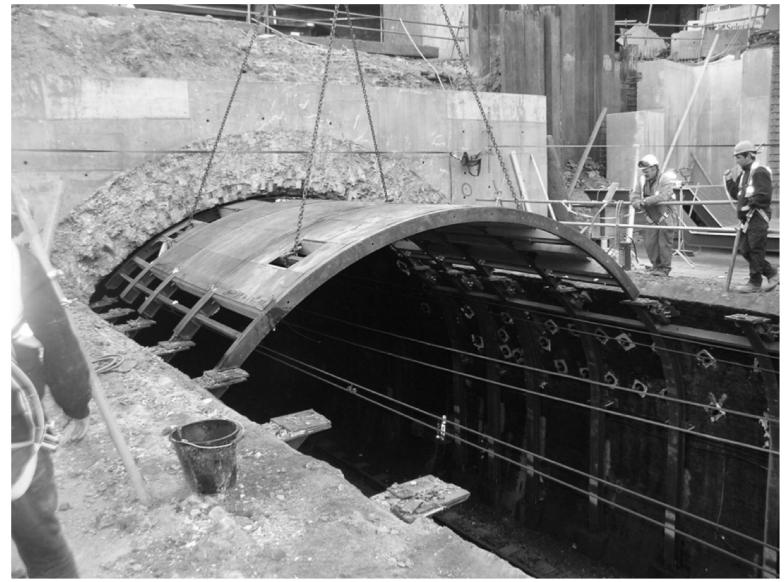

973 Prepare crane foundations
957 Lifting plan signed off
966 Receive delivery of plate girder
967 Ensure sufficient access
975 Prepare temporary works for plate girder stability
977 Ensure bearing dowel holes are cleared and clean
956 Setup of crane
969 Setout for Plate Girder Position
972 Place and level shims for bearings
955 Lift plate girder into location
965 As-built plate girders location
964 Shutter for grouting of bearings
954 Notify Sandbergs for grouting
953 Grout bearings
963 Fix end restraints to plate girder
962 Connect Restraints to adjacent M-E
960 Strike shutter for bearing grout
961 Begin M-Beam Topping Slab


INSTALL GIRDER TEMP STRUCTURE
INSTALL GIRDERS
JACK UP DECK
REMOVE TEMP PROPS
JACK DOWN DECK



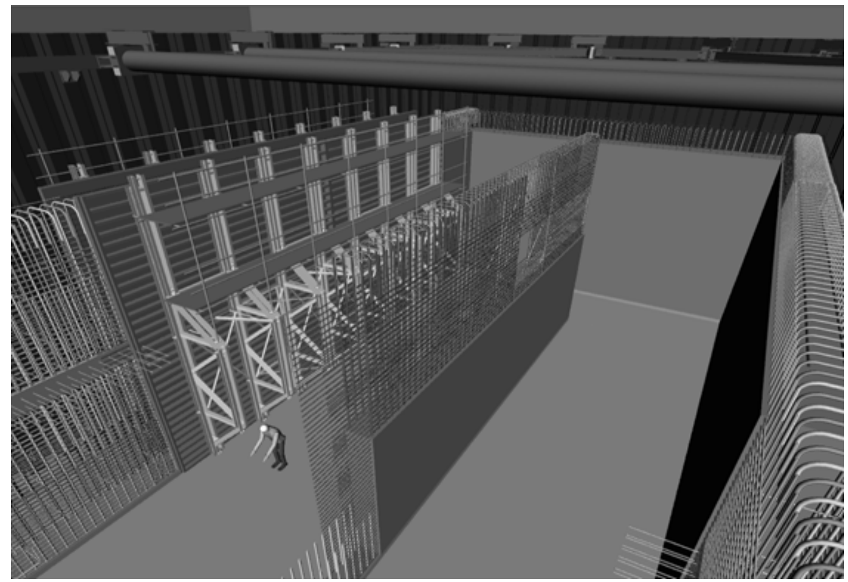


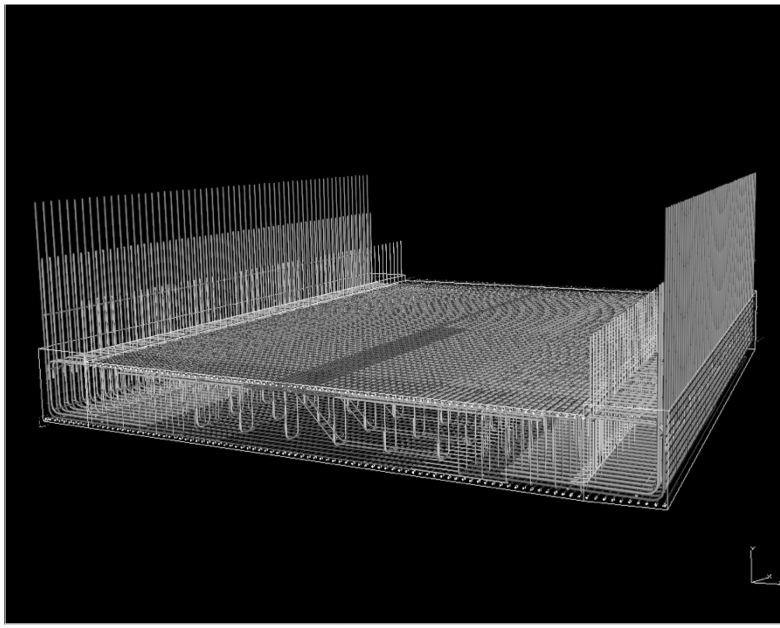
4D Visualization: Product + Production Process

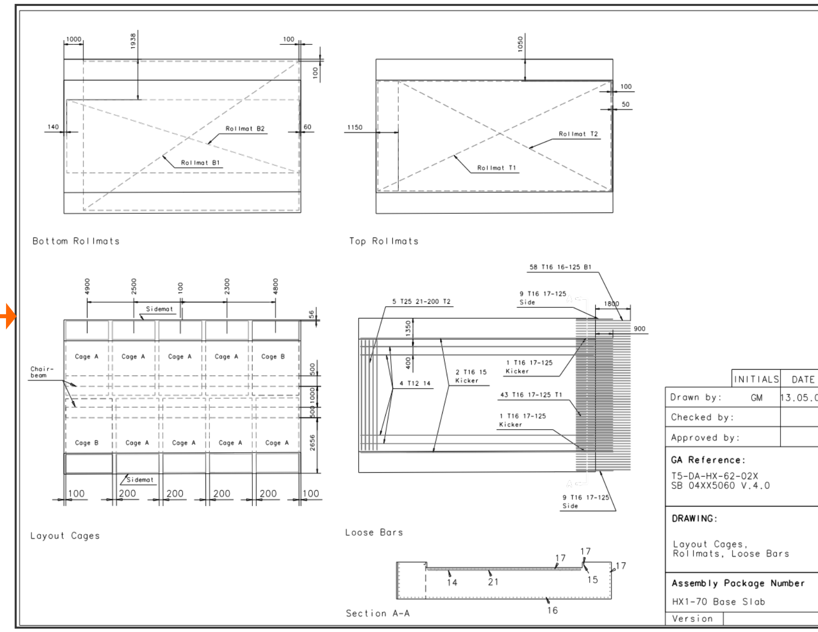


Completed 14 hours faster

TRAIN UNDERGROUND TUNNEL







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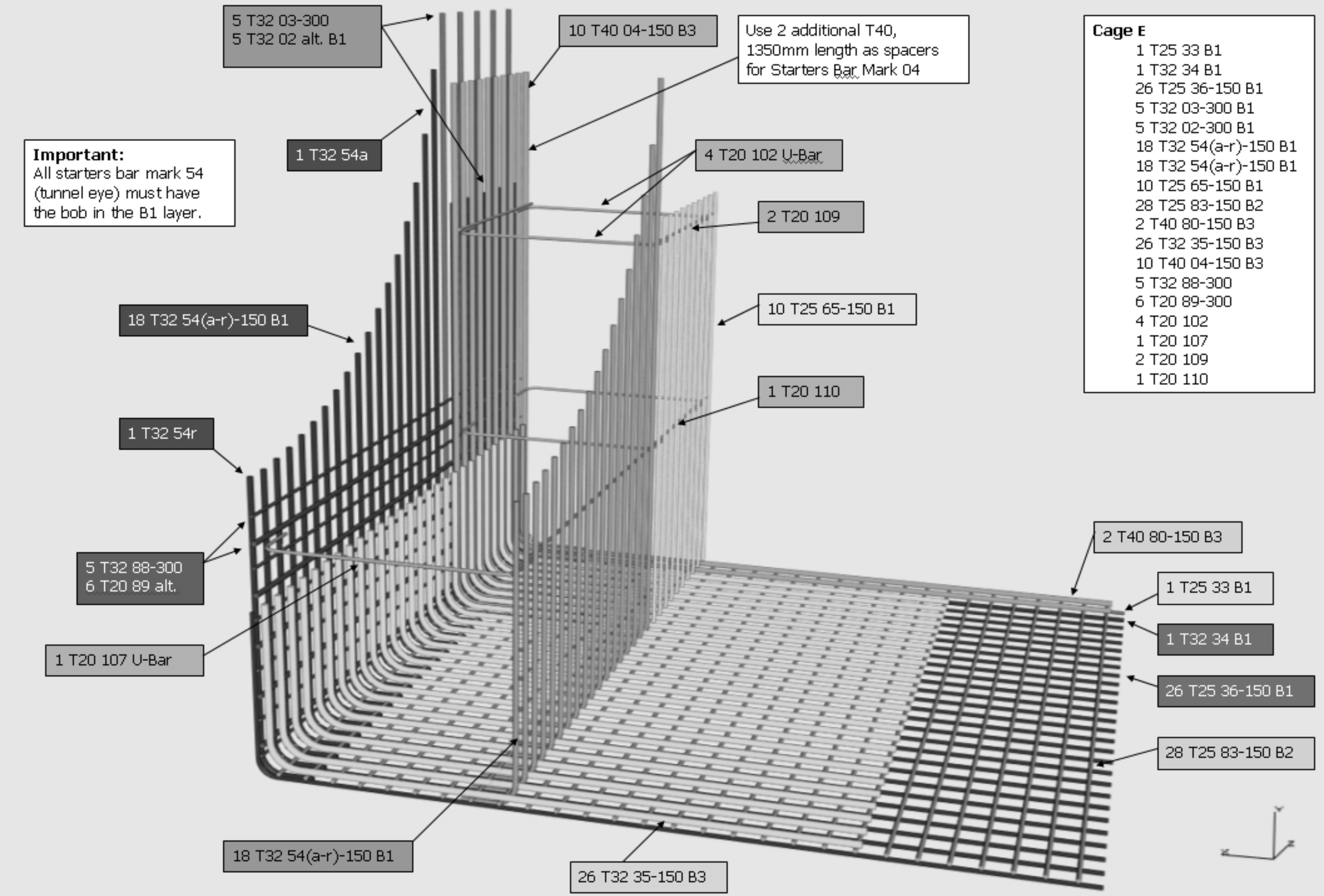
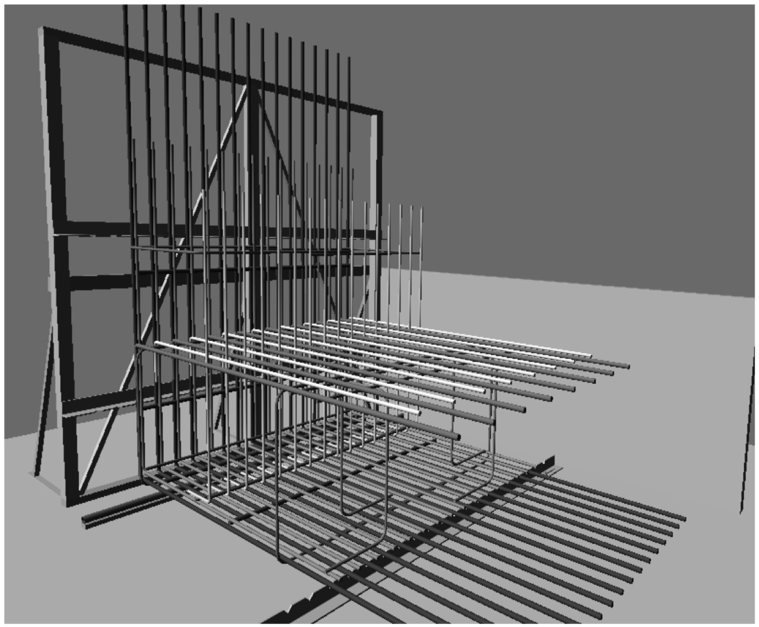
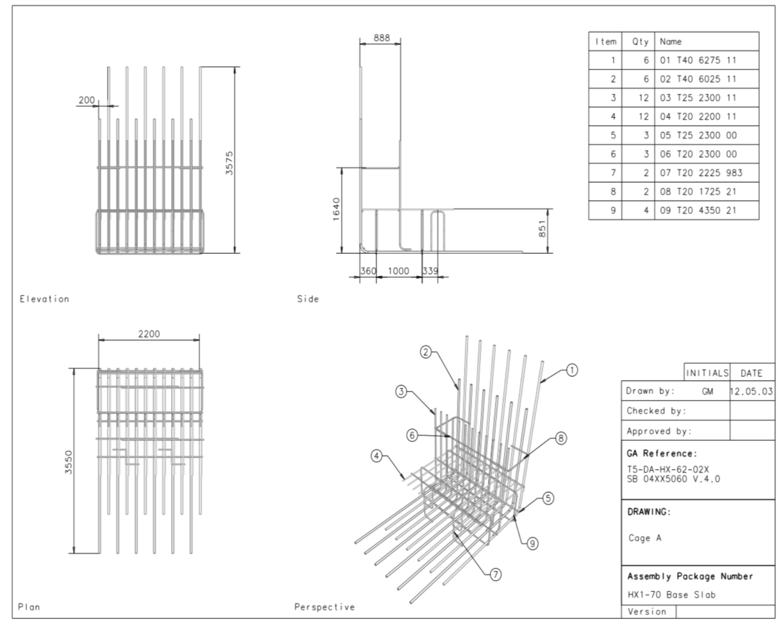
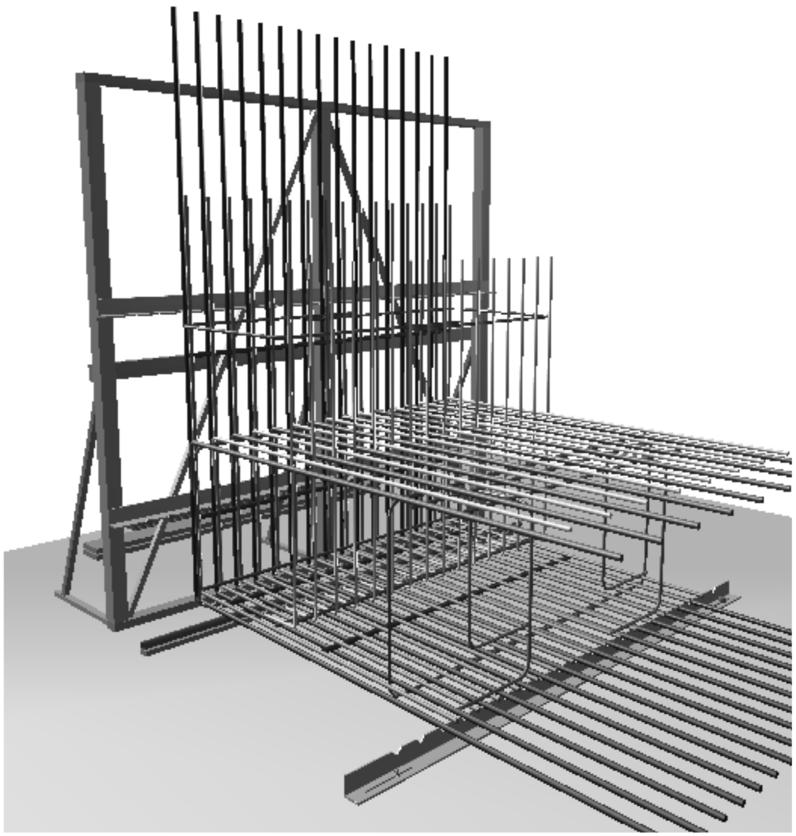

5 T32 03-300
5 T32 02 alt. B1
10 T40 04-150 B3
Use 2 additional T40, 1350mm length as spacers for Starters Bar Mark 04
Cage E
1 T25 33 B1
1 T32 34 B1
26 T25 36-150 B1
5 T32 03-300 B1
5 T32 02-300 B1
18 T32 54(a-r)-150 B1
18 T32 54(a-r)-150 B1
10 T25 65-150 B1
28 T25 83-150 B2
2 T40 80-150 B3
26 T32 35-150 B3
10 T40 04-150 B3
5 T32 88-300
6 T20 89-300
4 T20 102
1 T20 107
2 T20 109
1 T20 110
Important:
All starters bar mark 54 (tunnel eye) must have the bob in the B1 layer.
1 T32 54a
4 T20 102 U-Bar
2 T20 109
18 T32 54(a-r)-150 B1
10 T25 65-150 B1
1 T20 110
1 T32 54r
2 T40 80-150 B3
5 T32 88-300
6 T20 89 alt.
1 T25 33 B1
1 T32 34 B1
1 T20 107 U-Bar
26 T25 36-150 B1
28 T25 83-150 B2
18 T32 54(a-r)-150 B1
26 T32 35-150 B3

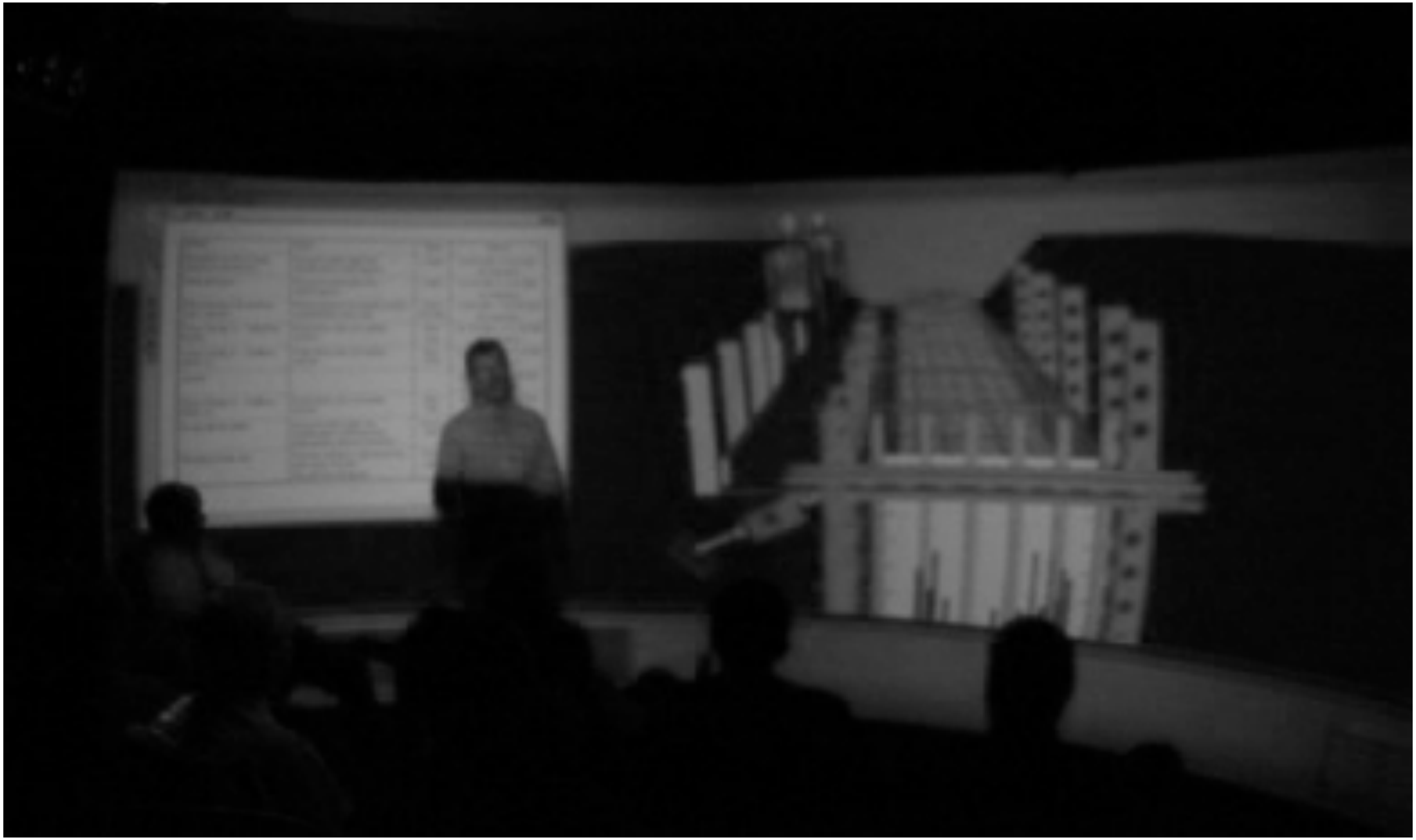




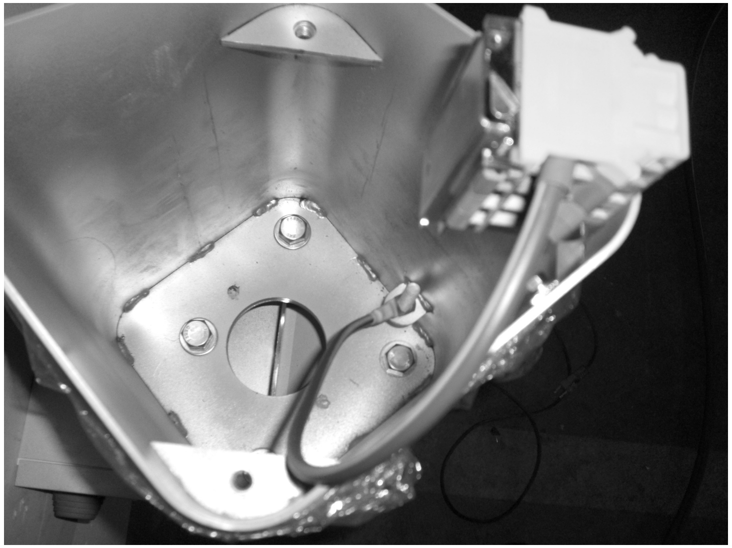
Item	Qty	Name
1	6	01 T40 6275 11
2	6	02 T40 6025 11
3	12	03 T25 2300 11
4	12	04 T20 2200 11
5	3	05 T25 2300 00
6	3	06 T20 2300 00
7	2	07 T20 2225 983
8	2	08 T20 1725 21
9	4	09 T20 4350 21

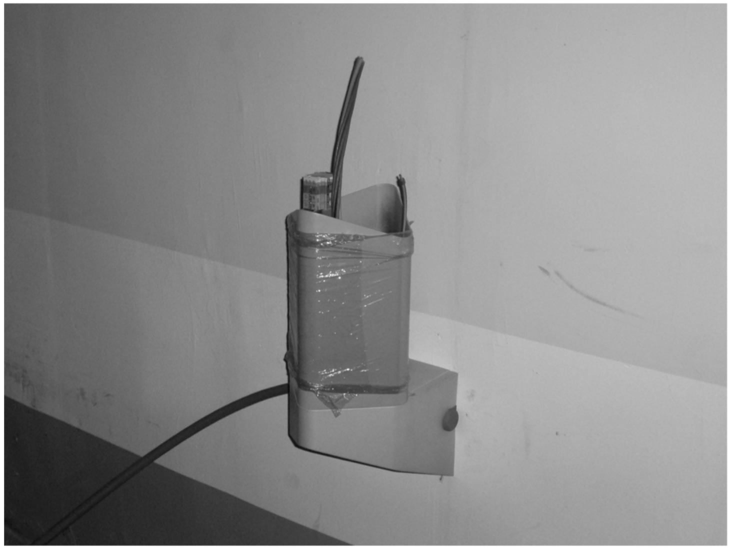
200
3575
Elevation
888
1640
851
360
1000
339
Side
2200
3550
Plan
Perspective
INITIALS
DATE
Drawn by: GM 12.05.03
Checked by:
Approved by:
GA Reference:
T5-DA-HX-62-02X
SB 04XX5060 V.4.0
DRAWING:
Cage A
Assembly Package Number
HX1-70 Base Slab
Version

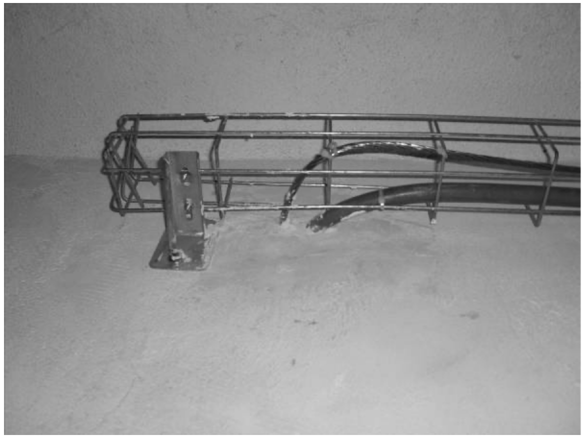


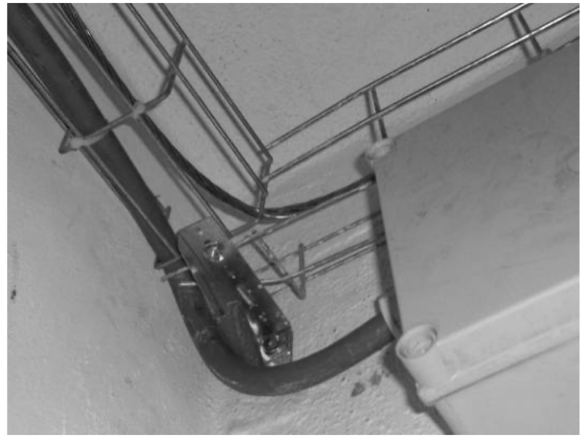


CAPE using Immerse Virtual Reality







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