

BIM y Construcción Industrializada: Mejorando la calidad, la productividad y reduciendo impactos de la construcción.

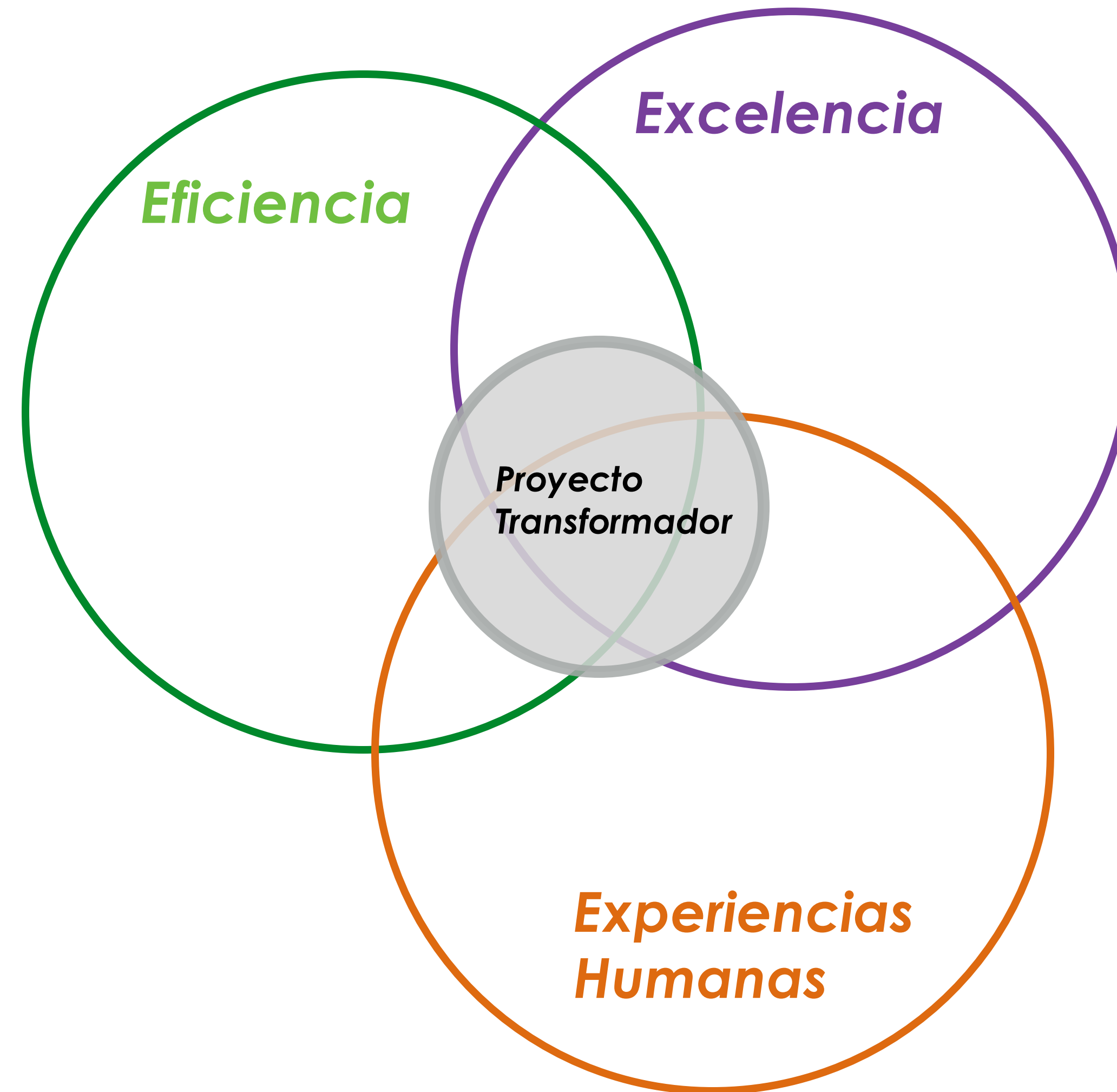
- Criterio de Diseño
- Diseño Computacional y BIM
- Sistemas Prefabricados

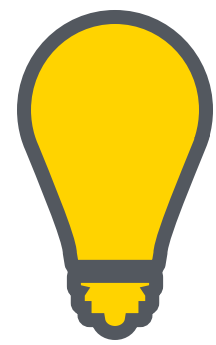
- **Criterio de Diseño**

- Diseño Computacional y BIM

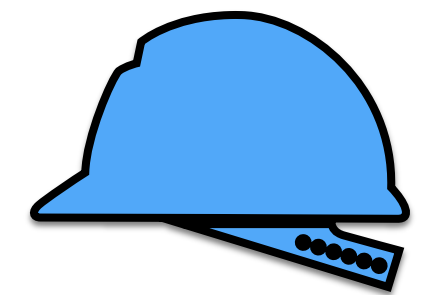
- Sistemas Prefabricados

NBBJ Criterio de Diseño





PROCESO DE DISEÑO



Eficiencia

Excelencia

*Experiencias
Humanas*

Proceso de Diseño:

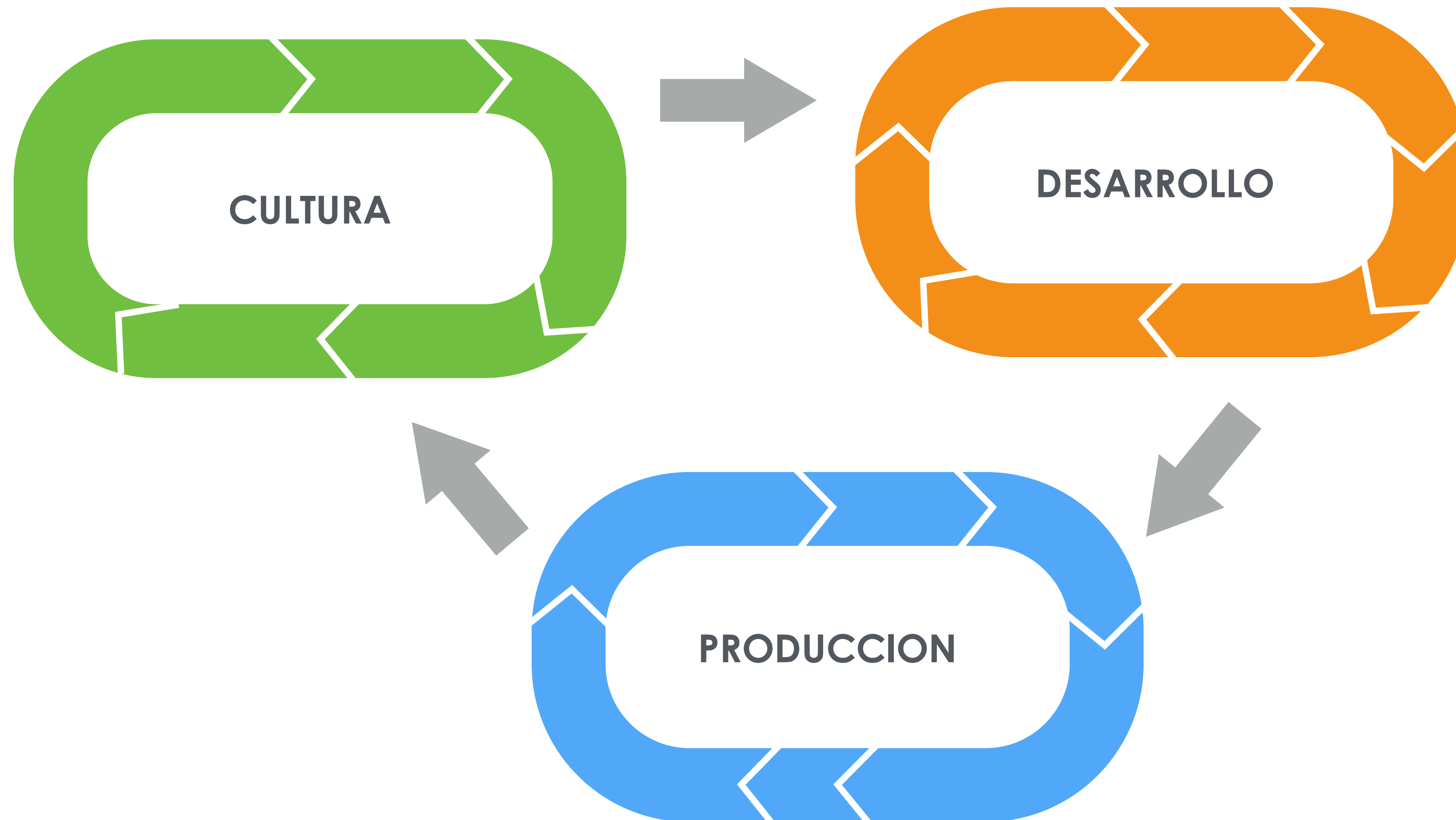
“Es el diseño del Proceso a través de una serie de herramientas”



Busca inspirar y enfocar a los equipos de trabajo.

- + Debe ser simple y entendible
- + Debe fortalecer al equipo
- + Debe ser aceptado por todas las partes, incluyendo el cliente.
- + Debe adaptarse a los cambios requeridos por el cliente
- + Debe ser adoptado por cada individuo del equipo.

Grupo de Herramientas



Herramientas del Proceso de Diseño

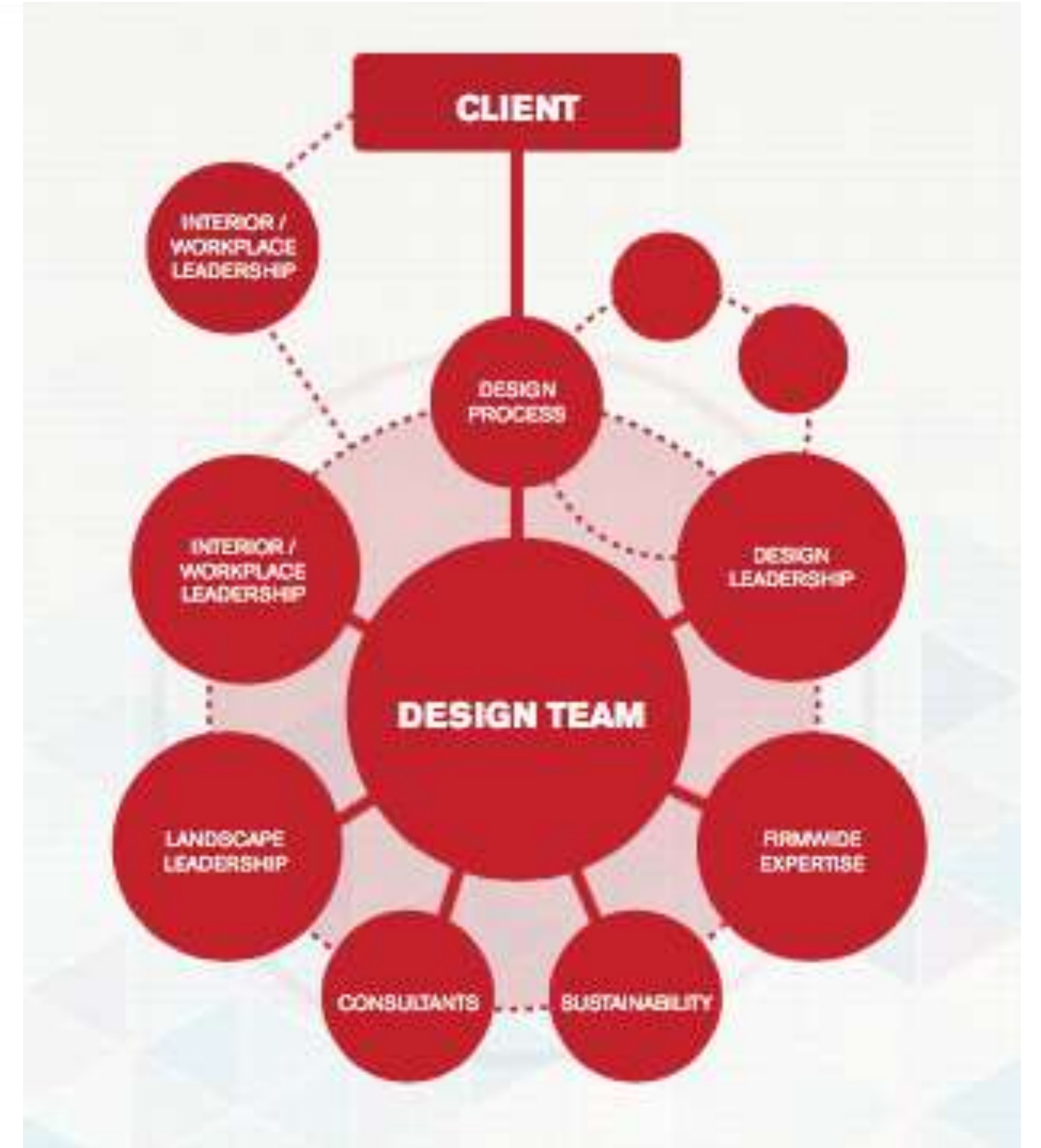
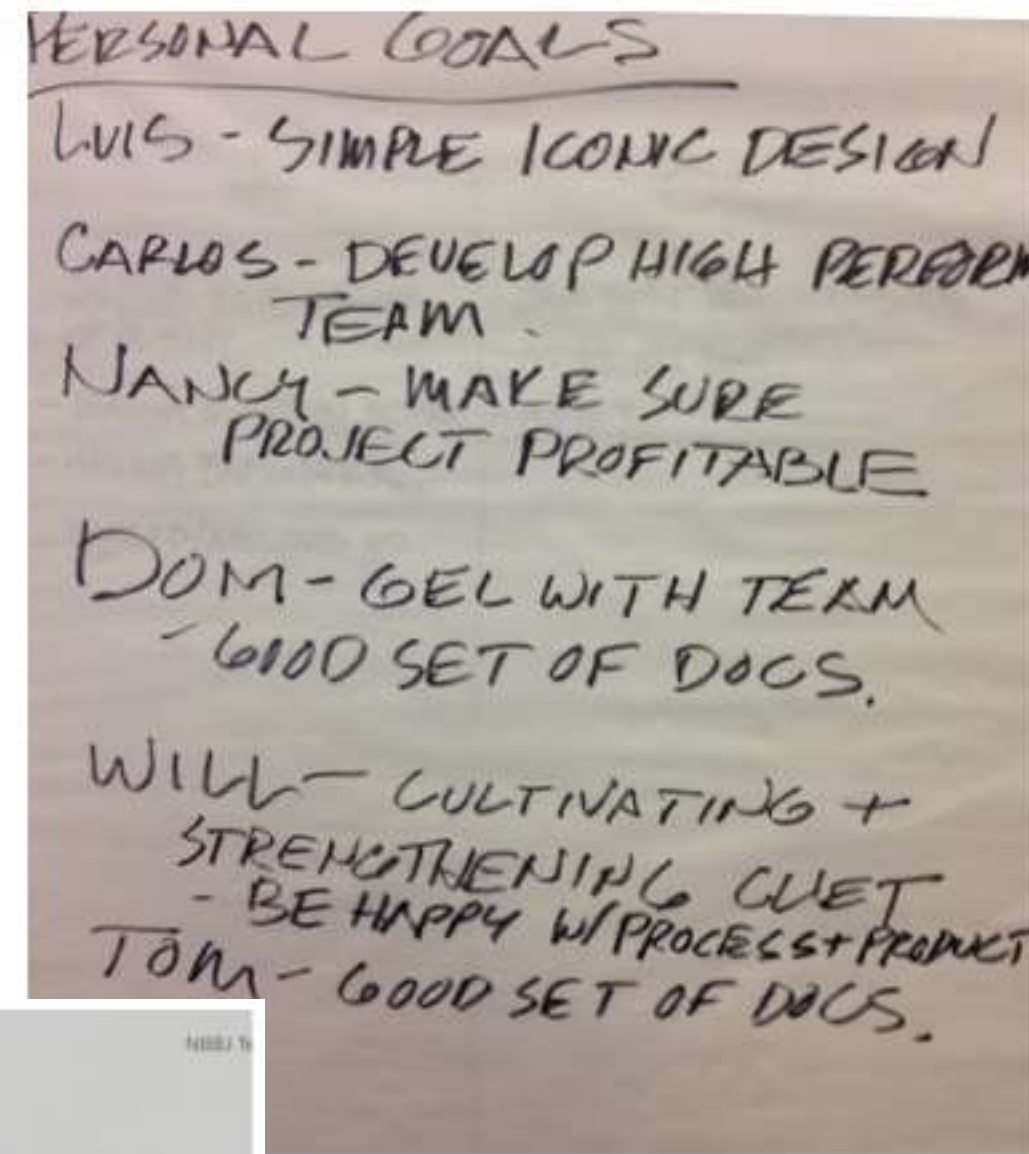


- REVISION DEL PROGRAMA
- AUTOCRITICA
- SE ESTABLECEN METAS PERSONALES
- SE ESTABLECEN LOS ROLES Y RESPONSABILIDADES DEL EQUIPO DE TRABAJO
- SE DEFINE LA ESTRUCTURA DEL EQUIPO



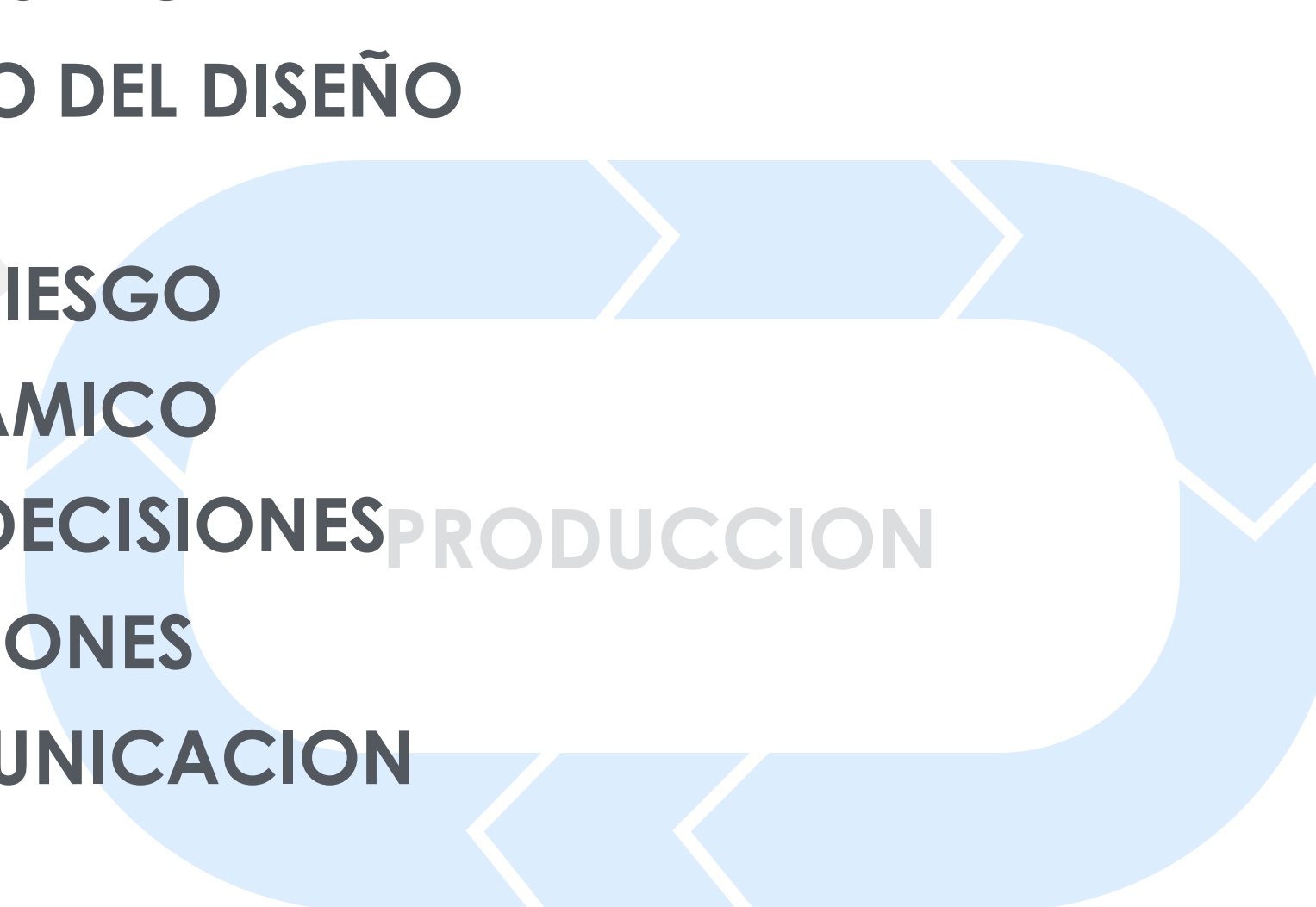
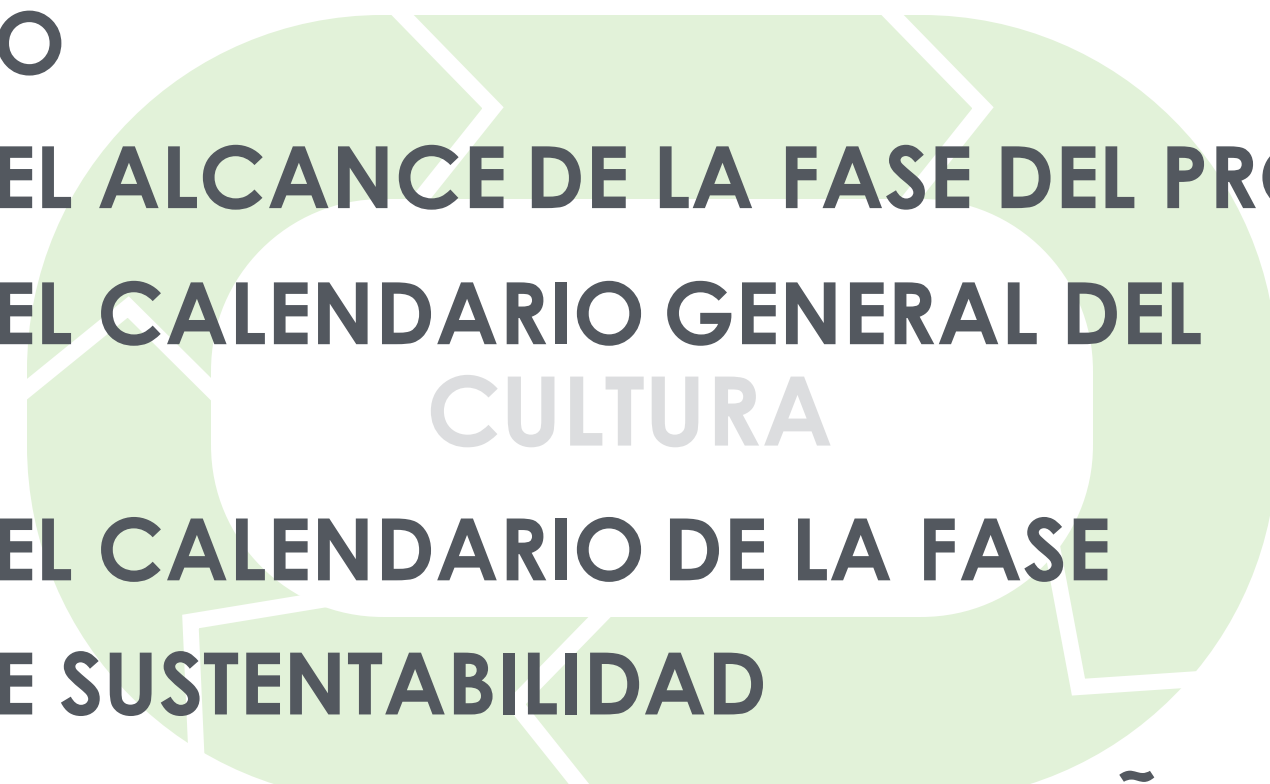
Herramientas del Proceso de Diseño

CULTURA DE TRABAJO



Herramientas del Proceso de Diseño

- REVISION DE CONTRATOS, HONORARIOS Y PRESUPUESTO
- REVISION DEL ALCANCE DE LA FASE DEL PROYECTO
- REVISION DEL CALENDARIO GENERAL DEL PROYECTO
- REVISION DEL CALENDARIO DE LA FASE
- REVISION DE SUSTENTABILIDAD
- REVISION DE LOS PRECEDENTES DE DISEÑO
- REVISION DE LOS FLUJOS DE TRABAJO DEL DISEÑO DIGITAL
- PREPARACION LA EVALUACION DE RIESGO
- DESARROLLO DEL CALENDARIO DINAMICO
- PREPARACION DE LA CASCADA DE DECISIONES
- CREACION DE UNA MATRIZ DE REUNIONES
- CREACION DE UNA MATRIZ DE COMUNICACION



Herramientas del Proceso de Diseño

DESARROLLO

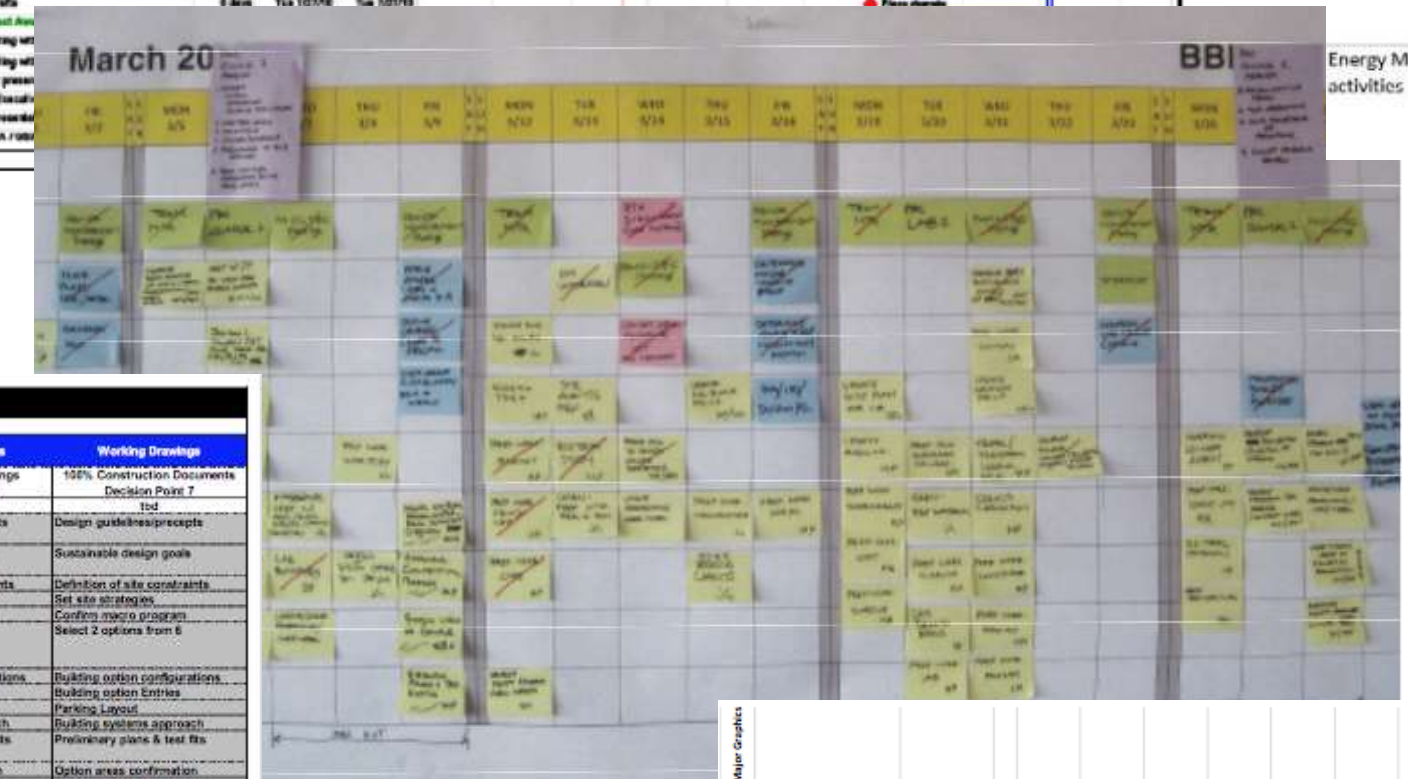
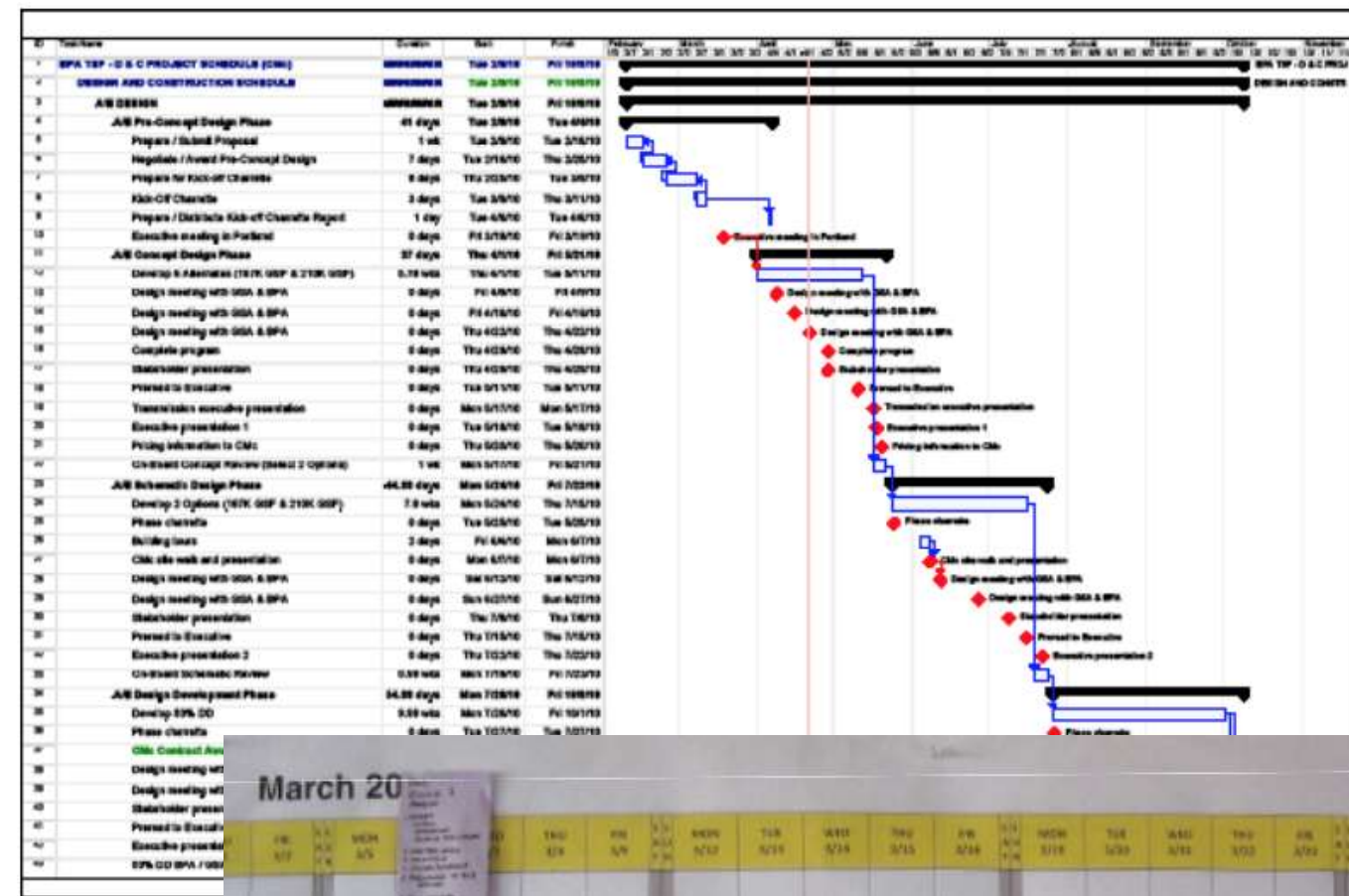
company - discipline	Pre - SD	SD	DD
KPFF civil SPU utility relocation			
KPFF civil	\$57,348	\$213,940	
KPFF structural	\$2,616	\$13,552	
Anup proj management	\$15,000	\$47,560	
Anup - electrical	\$10,920	\$46,152	
Anup - structural	\$9,945	\$134,035	
Anup - mech plumbing	\$52,224	\$175,244	
Anup - acoustics	\$0	\$12,460	
Anup - ICT	\$14,490	\$74,754	
CMS - water features	\$3,330	\$12,280	

nbbj
 CONTRACT FOR LIMITED SCOPE CONSULTING SERVICES
 Dated: April 18, 2006
 Between: NBBJ
 223 Yale Avenue North,
 Seattle WA 98109
 And "Contractor"
 Hammer Design Associates, Inc
 1001 Concourse Drive
 Suite 1006
 Connetquot, PA 15108
 To provide services for
 "Contractor's part of the Project" Foot Facility Design Services
 For the "Project"
 Project location
 And the "Client"
 Bill & Melinda Gates Foundation

	Land	Other Project Construction Costs	2007
Campus	0	70	309
Garage and VLC	0	25	57
Land	30	5	23
Subtotal Project Budget before Contingency	30	100	389
15% Contingency		15	58
Project Budget with Contingency	30	115	447
Owner Occupancy Costs	0	37	0
Project Budget including Owner Occupancy Costs	30	152	447

Task	PHASE 1				PHASE 2			
	Concept	Schematic Design	Schematic Design	Design Development	Design Development	Design Development	Working Drawings	Working Drawings
100% Concept Design Decision Point 1	Who	15-May-10	Who	14-Jun-10	Who	9-Aug-10	Who	10-Sep-10
Design guidelines/acceptance	BS/KU/MW	Design guidelines/acceptance	BS/KU/MW	Design guidelines/acceptance	BS/KU/MW	Design guidelines/acceptance	Design guidelines/acceptance	Design guidelines/acceptance
Sustainable design goals	BS/KU/MW	Sustainable design goals	BS/KU/MW	Sustainable design goals	BS/KU/MW	Sustainable design goals	Sustainable design goals	Sustainable design goals
Definition of site constraints	CF/NC	Definition of site constraints	CF/NC	Definition of site constraints	CF/NC	Definition of site constraints	Definition of site constraints	Definition of site constraints
Set site strategies	CF/NC	Set site strategies	CF/NC	Set site strategies	CF/NC	Set site strategies	Set site strategies	Set site strategies
Confirm master program	BS/KU/MW	Confirm master program	BS/KU/MW	Confirm master program	BS/KU/MW	Confirm master program	Confirm master program	Confirm master program
Select 2 options from 6	BS/KU/MW	Select 2 options from 6	BS/KU/MW	Select 2 options from 6	BS/KU/MW	Select 2 options from 6	Select 2 options from 6	Select 2 options from 6
Building option configurations	BS/KU/MW	Building option configurations	BS/KU/MW	Building option configurations	BS/KU/MW	Building option configurations	Building option configurations	Building option configurations
Building option Entries	BS/KU/MW	Building option Entries	BS/KU/MW	Building option Entries	BS/KU/MW	Building option Entries	Building option Entries	Building option Entries
Parking Layout	BS/KU/MW	Parking Layout	BS/KU/MW	Parking Layout	BS/KU/MW	Parking Layout	Parking Layout	Parking Layout
Building systems approach	BS/KU/MW	Building systems approach	BS/KU/MW	Building systems approach	BS/KU/MW	Building systems approach	Building systems approach	Building systems approach
Preliminary plans & test file	BS/KU/MW	Preliminary plans & test file	BS/KU/MW	Preliminary plans & test file	BS/KU/MW	Preliminary plans & test file	Preliminary plans & test file	Preliminary plans & test file
Option areas confirmation	BS/KU/MW	Option areas confirmation	BS/KU/MW	Option areas confirmation	BS/KU/MW	Option areas confirmation	Option areas confirmation	Option areas confirmation
Structural & planning grids	BS/KU/MW	Structural & planning grids	BS/KU/MW	Structural & planning grids	BS/KU/MW	Structural & planning grids	Structural & planning grids	Structural & planning grids
Micro program	BS/KU/MW	Micro program	BS/KU/MW	Micro program	BS/KU/MW	Micro program	Micro program	Micro program
Preliminary elevations	BS/KU/MW	Preliminary elevations	BS/KU/MW	Preliminary elevations	BS/KU/MW	Preliminary elevations	Preliminary elevations	Preliminary elevations
External Aesthetic	BS/KU/MW	External Aesthetic	BS/KU/MW	External Aesthetic	BS/KU/MW	External Aesthetic	External Aesthetic	External Aesthetic
Landscape aesthetic	BS/KU/MW	Landscape aesthetic	BS/KU/MW	Landscape aesthetic	BS/KU/MW	Landscape aesthetic	Landscape aesthetic	Landscape aesthetic
Interior aesthetic	BS/KU/MW	Interior aesthetic	BS/KU/MW	Interior aesthetic	BS/KU/MW	Interior aesthetic	Interior aesthetic	Interior aesthetic
Principal materials	BS/KU/MW	Principal materials	BS/KU/MW	Principal materials	BS/KU/MW	Principal materials	Principal materials	Principal materials
Budget	BS/KU/MW	Budget	BS/KU/MW	Budget	BS/KU/MW	Budget	Budget	Budget
Principal building systems	BS/KU/MW	Principal building systems	BS/KU/MW	Principal building systems	BS/KU/MW	Principal building systems	Principal building systems	Principal building systems
Typical floor plans	BS/KU/MW	Typical floor plans	BS/KU/MW	Typical floor plans	BS/KU/MW	Typical floor plans	Typical floor plans	Typical floor plans
Select one option from 2	BS/KU/MW	Select one option from 2	BS/KU/MW	Select one option from 2	BS/KU/MW	Select one option from 2	Select one option from 2	Select one option from 2
Common space plans	BS/KU/MW	Common space plans	BS/KU/MW	Common space plans	BS/KU/MW	Common space plans	Common space plans	Common space plans
Major component definitions	BS/KU/MW	Major component definitions	BS/KU/MW	Major component definitions	BS/KU/MW	Major component definitions	Major component definitions	Major component definitions
Final floor plans	BS/KU/MW	Final floor plans	BS/KU/MW	Final floor plans	BS/KU/MW	Final floor plans	Final floor plans	Final floor plans
Elevations	BS/KU/MW	Elevations	BS/KU/MW	Elevations	BS/KU/MW	Elevations	Elevations	Elevations
Outline Specifications	BS/KU/MW	Outline Specifications	BS/KU/MW	Outline Specifications	BS/KU/MW	Outline Specifications	Outline Specifications	Outline Specifications
Principal finishes	BS/KU/MW	Principal finishes	BS/KU/MW	Principal finishes	BS/KU/MW	Principal finishes	Principal finishes	Principal finishes
Minor component definitions	BS/KU/MW	Minor component definitions	BS/KU/MW	Minor component definitions	BS/KU/MW	Minor component definitions	Minor component definitions	Minor component definitions
All finishes with samples	BS/KU/MW	All finishes with samples	BS/KU/MW	All finishes with samples	BS/KU/MW	All finishes with samples	All finishes with samples	All finishes with samples
All colors	BS/KU/MW	All colors	BS/KU/MW	All colors	BS/KU/MW	All colors	All colors	All colors
Full details & specifications	BS/KU/MW	Full details & specifications	BS/KU/MW	Full details & specifications	BS/KU/MW	Full details & specifications	Full details & specifications	Full details & specifications

Present for decision
 Present current progress
 Start considering now
 To be considered later
 Already signed off



Meeting Name	Frequency	Tom S.	Michael N.	Alex K.	Matt P.	Kathy M.	Jose G.	Sarah M.	Seah L.	Nigel J.	Rob	St. Design	Zor	Usha	David H.	Joan S.	Jim	Debi
Process Design	By Phase																	
Facilities (W&C)	Weekly																	
Process/Project Mgt./OAC	Weekly																	
St. Manage. (PH)	Weekly																	
Decision/OAC	Weekly																	
Project Team Meeting (Monday)	Weekly																	
Consultant Mtg.	Every 2 Weeks																	
Core Team Mtg.	Every 2 Weeks																	
User Mtg. Research	Every 2 Weeks																	
User Mtg. Clinical	As Needed																	
Infrastructure Users Mtg.	Every 2 Weeks																	
Building Support	As Needed																	
Steering Committee Execs	Monthly																	
User Mtg. Verification	Monthly																	
User Mtg. Public/Conference	Monthly																	
Public Mtg. RTM, BAA, City	Monthly																	
Design Team Meetings	Weekly																	
Infrastructure Systems Mtg. Structure	Every 2 Weeks																	
Design Meetings with the Client	Every 3 Weeks																	
Primary																		
Secondary																		

Phases & Activities	Proposal/ Contract	Programming/ Predisign	Concept Design	Schematic Design	Design Development	Construction Documents	Construction/ Occupancy	Performance Tracking
Major team tasks	SCOPE: Provide high quality Design Energy Modeling in Base Contract. Align Client budget for investment opportunities.	DISCOVER: Identify resource threat, environmental influences, project based parameters that influence energy use. Learn local energy sources and carbon profile/behaviors. Identify your project's typical energy/revenue use profile and target areas of opportunity.	IDENTIFY: All potential resource use opportunities. Use energy modeling to build team consensus and influence decisions. Research potential grants or incentives and make initial contact. Build Cost/Benefit analysis tools that uses Project success criteria.	VALIDATE: Energy approach and strategies from Concept Design report. Use energy modeling to inform design development. Integrate utility into team and work to ensure best investment to support ROI deliverables.	DECIDE: Agree on energy systems and envelope to achieve performance goals. Integrate utility into team and work to ensure best investment to support ROI deliverables.	DOCUMENT: Initial design portions. Issue configuration of systems, electrical, etc. into construction documents.	CONSTRUCT: Construct and Commission for efficient operations. Ensure operations are trained.	MEET: Meeting assignment opportunity to confirm seasonal performance matches expectations.
AIA 2030 Commitment Activities	INCLUDE Energy Use Intensity (EUI) reporting and support in base contract base expectations and hourly build-up.	ESTABLISH EUI Benchmark Using EnergyStar Together based on Site and Program Report on Sustainability Knowledgebase.	REPORT your project's EUI Target using EnergyStar Together based on Site and Program Report on Sustainability Knowledgebase.	REPORT your project's final EUI Energy Use Intensity. Consider approaches to return to incision carbon trajectory.	REPORT your project's final EUI Energy Use Intensity. Consider approaches to return to incision carbon trajectory.	REPORT your project's final EUI Energy Use Intensity.	REPORT your project's final EUI Energy Use Intensity.	TRACK energy performance and issue EnergyStar portfolio manager.
Responsible team member	Project Manager/EC	Project Manager	Project Core Team and Energy Modeler	Project Core Team, Energy Modeler, Mechanical Engineer	Project Core Team, Energy Modeler, Mechanical Engineer	Project Core Team, Energy Modeler, Mechanical Engineer	Project Core Team, Energy Modeler, Mechanical Engineer	Project Core Team, Energy Modeler, Mechanical Engineer
Key Decisions	Design Approach and Preliminary Communication plan	Establish Project success criteria with client leadership to assess proposed solutions.	Review potential end-point certification systems with client and establish direction. Note that EUI is not measured, but a good tool for Quality Assurance for construction.	Decide on a clear set of certified energy reduction strategies and compact capital costs. EUI, use other project metrics. Plan studies to reach system decision.	Review Design Team's proposed system and confirm that the approach meets proposed EUI, carbon footprint and other project metrics.	Selection of Contractor capable of delivering proposed systems.	Prepared sub-contractor selection. Issue RFQ to appropriate subcontractors.	Be Decisions

Visualization
 Rapid Prototyping
 Model Atelier
 Environmental Analysis
 Design Computation
 BIM Execution

Herramientas del Proceso de Diseño



Herramientas del Proceso de Diseño

PRODUCCION

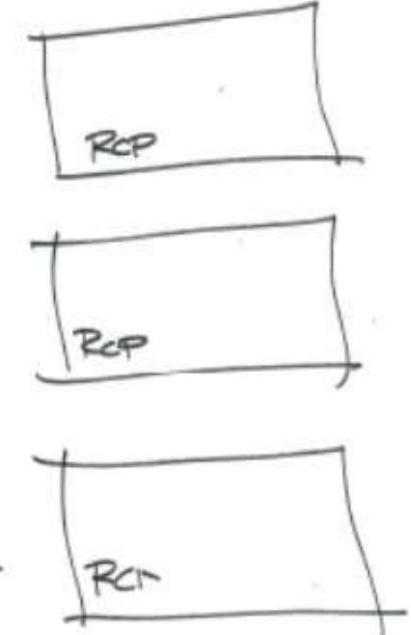
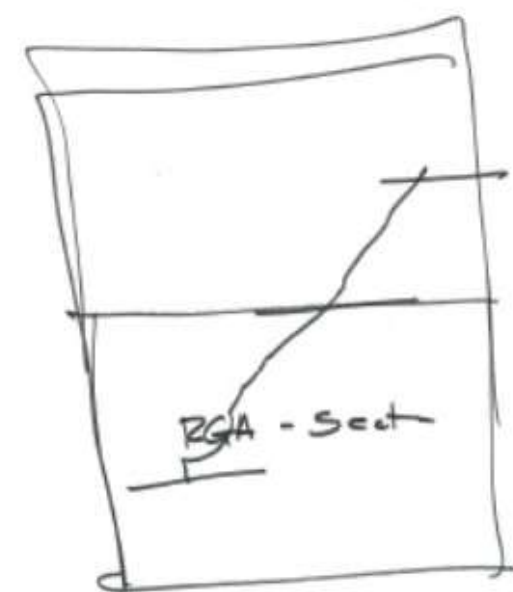
Date: 08.10.06 - revA
500 5th Avenue North
QA / QC Procedures

The following is a description of QA /QC procedures which are in place for the Campus Project. The timing of these activities is indicated on the attached schedule. The Seattle Center 5th Avenue North Garage is completed and applicable procedures are now complete:

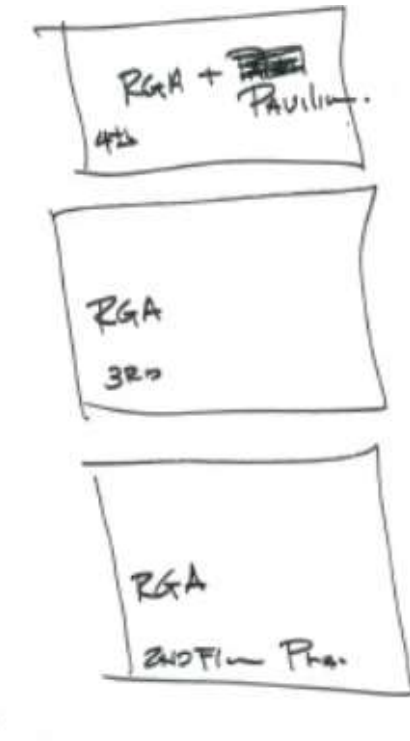
1. Peer Review
 - a. Group Critiques and Redlines: Ongoing peer reviews throughout production of our documents take two forms: group critiques by non-team members, and "redlining" by team members of the work of other team members. The redlines are then discussed and changes are made as appropriate.
 - b. Cross Disciplinary Design Co-ordination meetings: NBBJ also engages in cross disciplinary reviews on an ongoing basis. We have a standing time set aside each week for workshops, and we hold additional meetings as needed, to work through coordination issues. Workshops are carefully scheduled to insure that appropriate representatives from



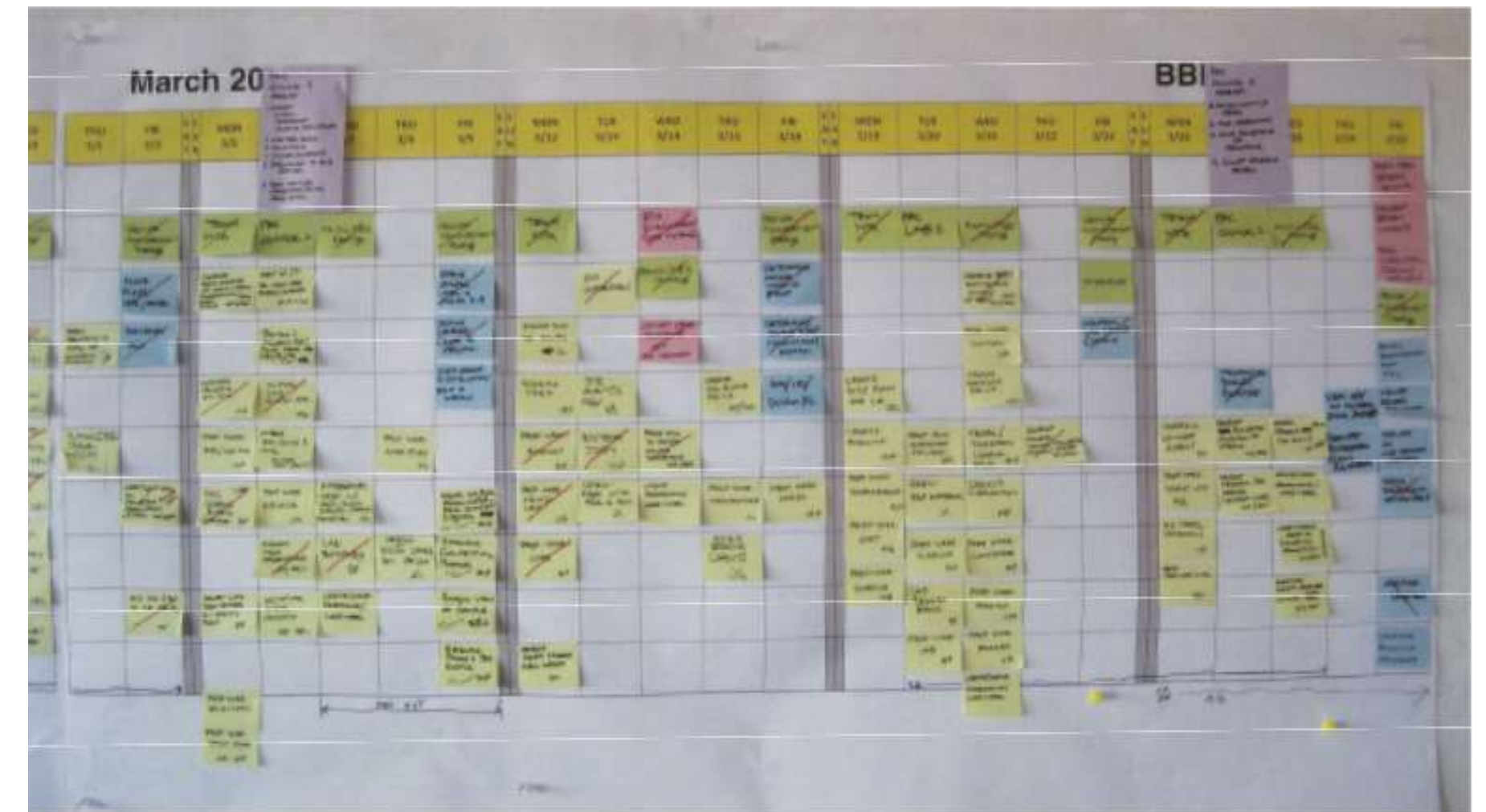
BRIDGE/Root GARAGE Access.



Elevat.

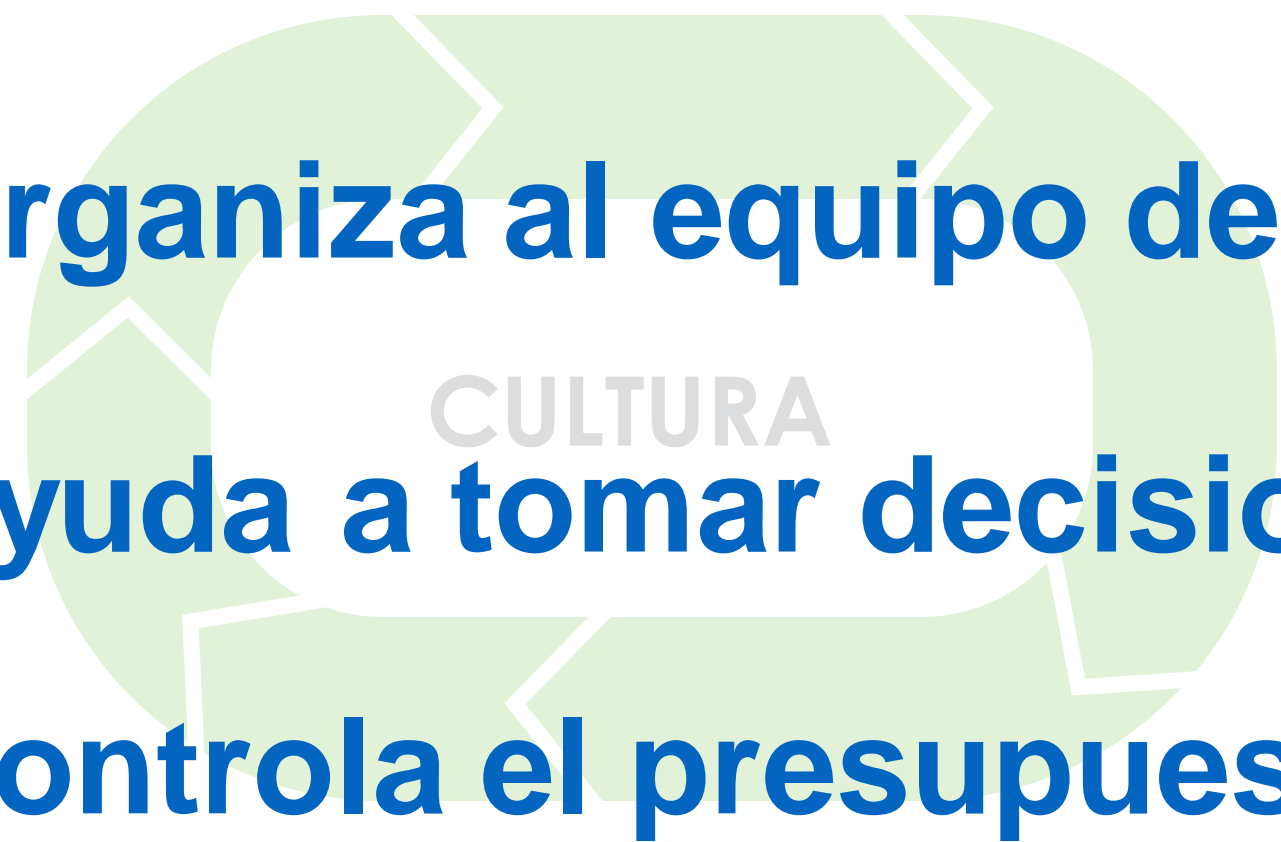


Boor Plan A500 ZL



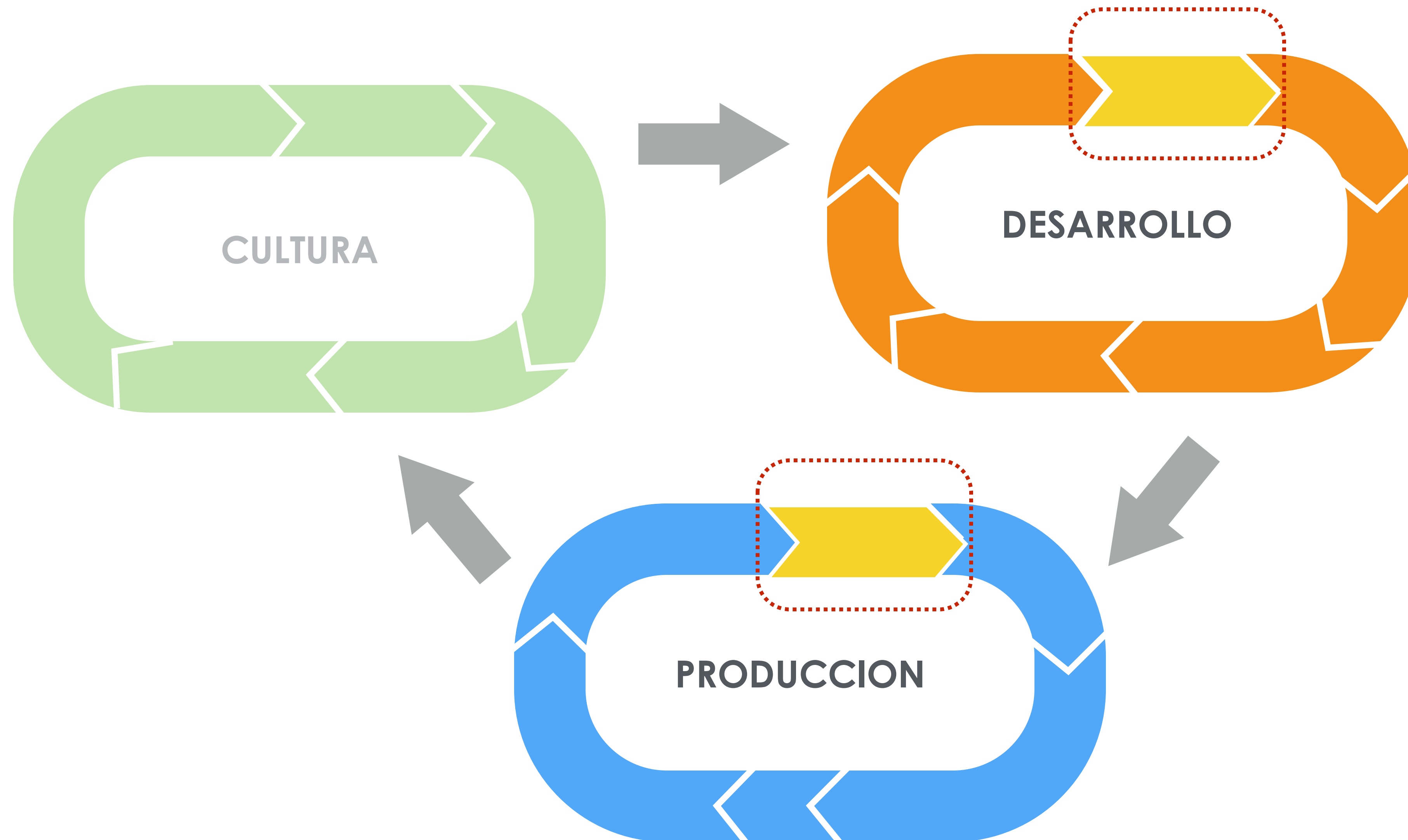
Proceso de Diseño

- **Organiza al equipo de diseño, al cliente y el proyecto**
- **Ayuda a tomar decisiones**
- **Controla el presupuesto**
- **Mejora la comunicación entre todas las partes involucradas en el proyecto.**

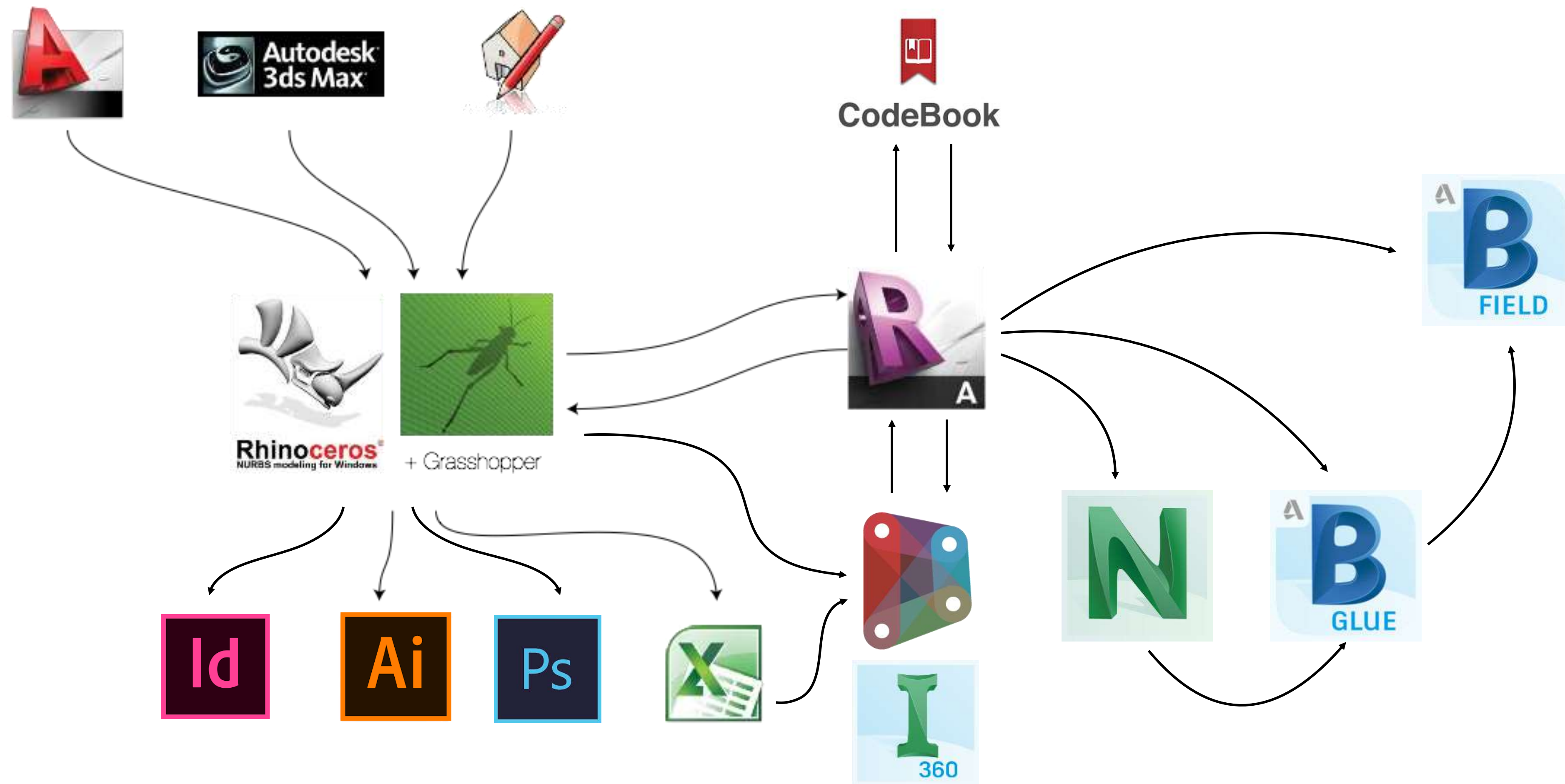


- Criterio de Diseño
- **Diseño Computacional y BIM**
- Sistemas Prefabricados

Diseño Computacional y BIM



Sistema de Integración Computacional



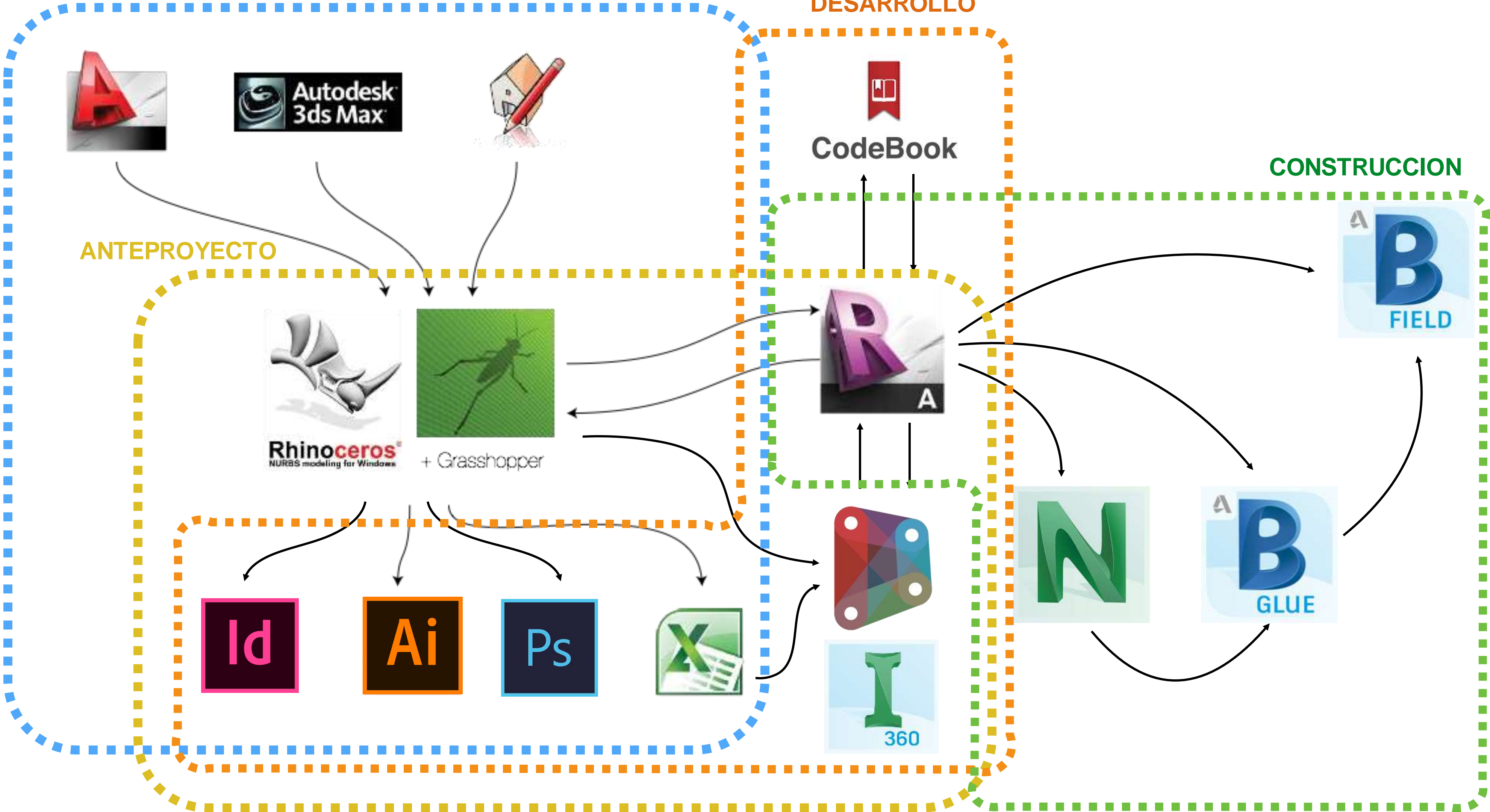
Sistema de Integración Computacional

PLAN MAESTRO, PROGRAMACION Y CONCEPTO

DESARROLLO

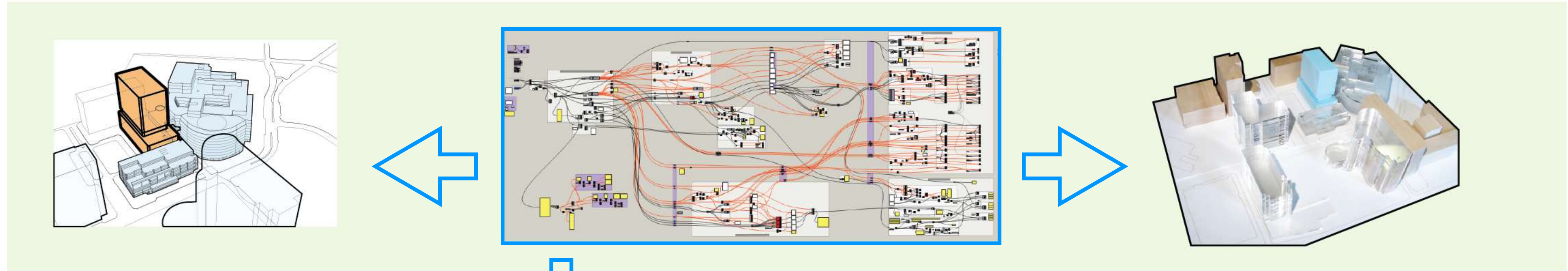
CONSTRUCCION

ANTEPROYECTO



Diseño Computacional - Etapa Plan Maestro

Representación



Visualization y
Análisis de Datos

PROGRAM DISPLACEMENTS

PROGRAM	SW	SW	SW	SW	SW
AMBULATORY	2,160 SF	2,160 SF	2,160 SF	2,160 SF	2,160 SF
EMERGENCY DEPARTMENT	8,000 SF	8,000 SF	8,000 SF	8,000 SF	8,000 SF
GENERAL PHYSICIANS	4,200 SF	4,200 SF	4,200 SF	4,200 SF	4,200 SF
LAB	2,400 SF	2,400 SF	2,400 SF	2,400 SF	2,400 SF
OUTPATIENT SURGERY	3,600 SF	3,600 SF	3,600 SF	3,600 SF	3,600 SF
PHARMACY	1,200 SF	1,200 SF	1,200 SF	1,200 SF	1,200 SF
RADIOLOGY	2,400 SF	2,400 SF	2,400 SF	2,400 SF	2,400 SF
RECEPTION	1,200 SF	1,200 SF	1,200 SF	1,200 SF	1,200 SF
STAFF OFFICES	2,400 SF	2,400 SF	2,400 SF	2,400 SF	2,400 SF
TRAINING CENTER	1,200 SF	1,200 SF	1,200 SF	1,200 SF	1,200 SF
WALKWAY	2,400 SF	2,400 SF	2,400 SF	2,400 SF	2,400 SF
TOTALS	34,000 SF	34,000 SF	34,000 SF	34,000 SF	34,000 SF

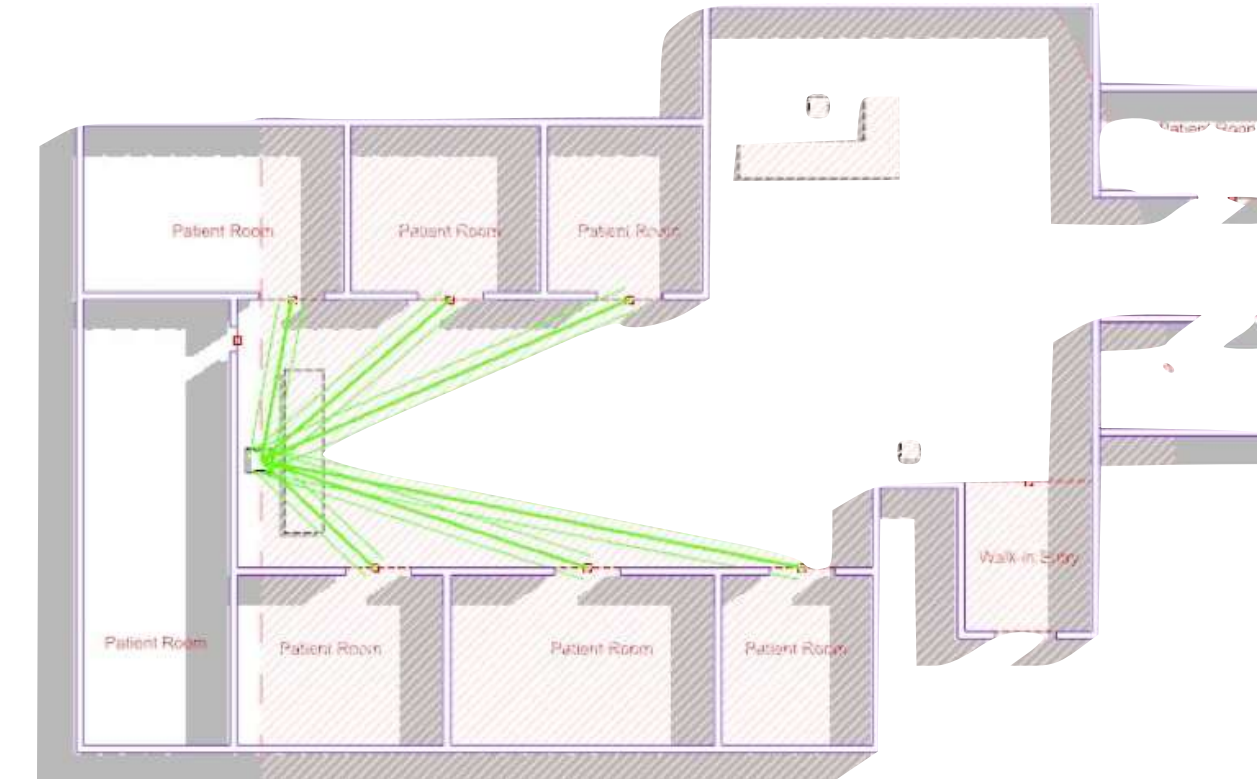
BED COUNT AND DISTRIBUTION

WFL	NEW/RENEW	ALL	STAYS	ADULT	CHILD	ICU	ICU/PICU	ICU/NICU	ICU/ICU	ICU/ICU	ICU/ICU	ICU/ICU	ICU/ICU	ICU/ICU
L1														
L2														
L3														
L4														
L5														
L6														
L7														
L8														
L9														
L10														
L11														
L12														
NEW	200	200												
TOTALS	200	200												

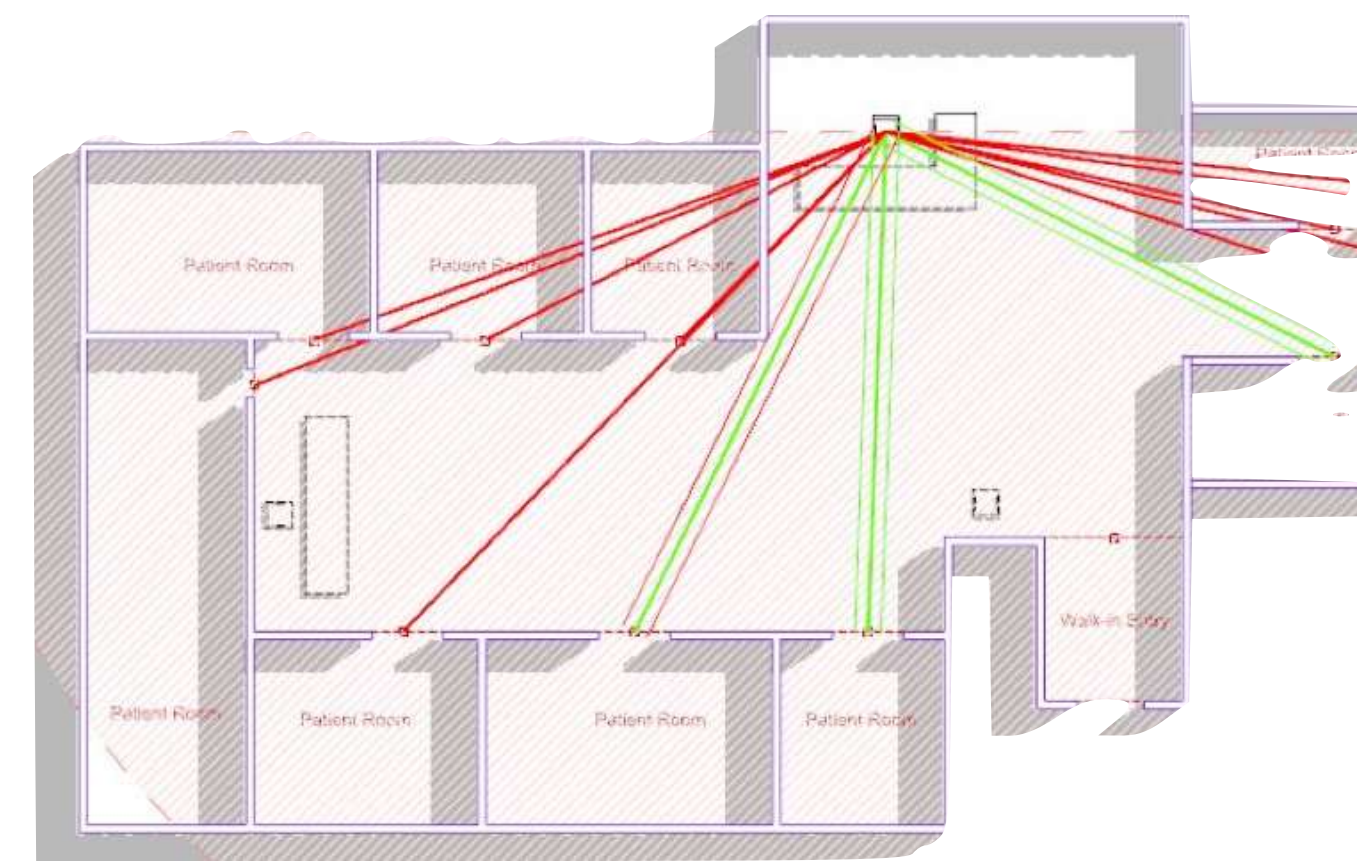
ROOM OCCUPANCY TYPES

Room	SW
Plaza	SW
Garage	SW
Site	SW

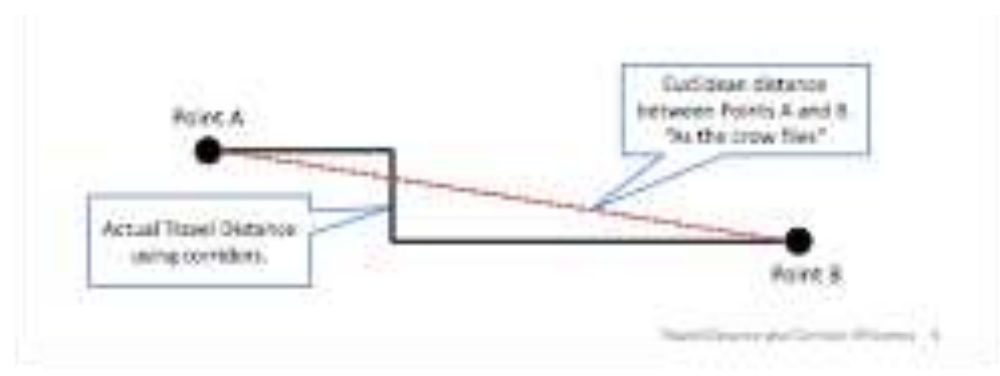
Diseño Computacional - Etapa Plan Maestro



Estación Clínica con 100% de visibilidad a las habitaciones de los pacientes

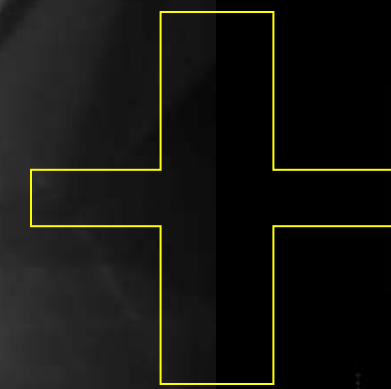


Estación Clínica con 30% de visibilidad a las habitaciones de los pacientes

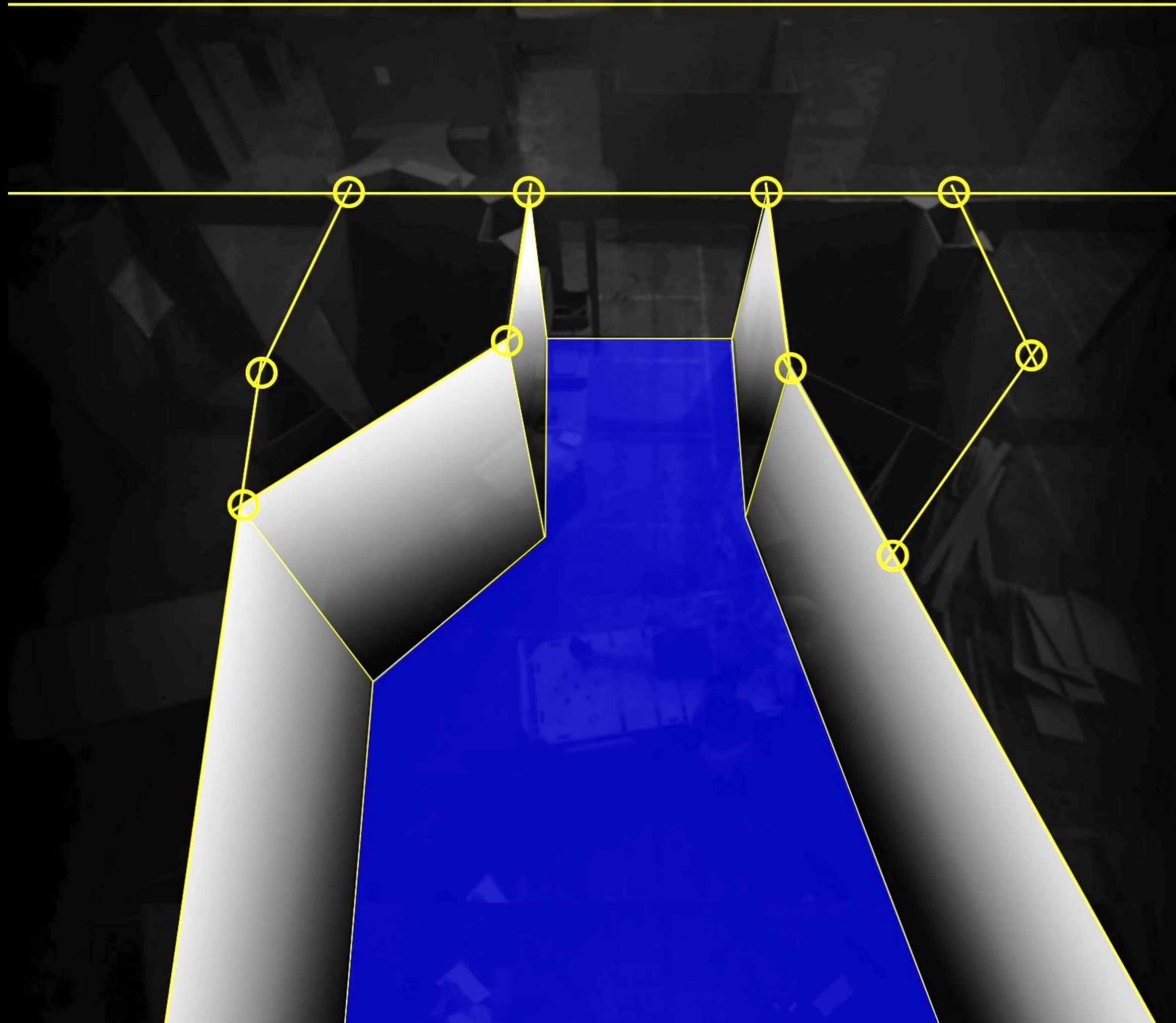


Prototipo Rápido Digital Aumentado - Etapa de Diseño





GEOMETRY PARAMETERS



Bed

Bed Width

Bed Length

Clearances

Foot of Bed

Side of Bed

Toilet Room

Length

Depth

Major Planning

Planning Module

Bay Depth

Inboard Outboard

Same-handed Mirrored

Corridor Width

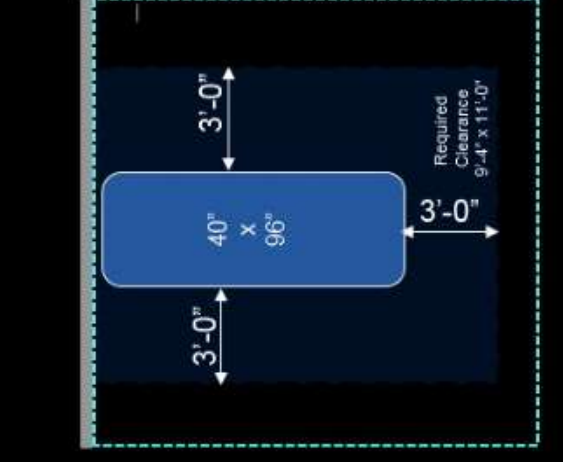
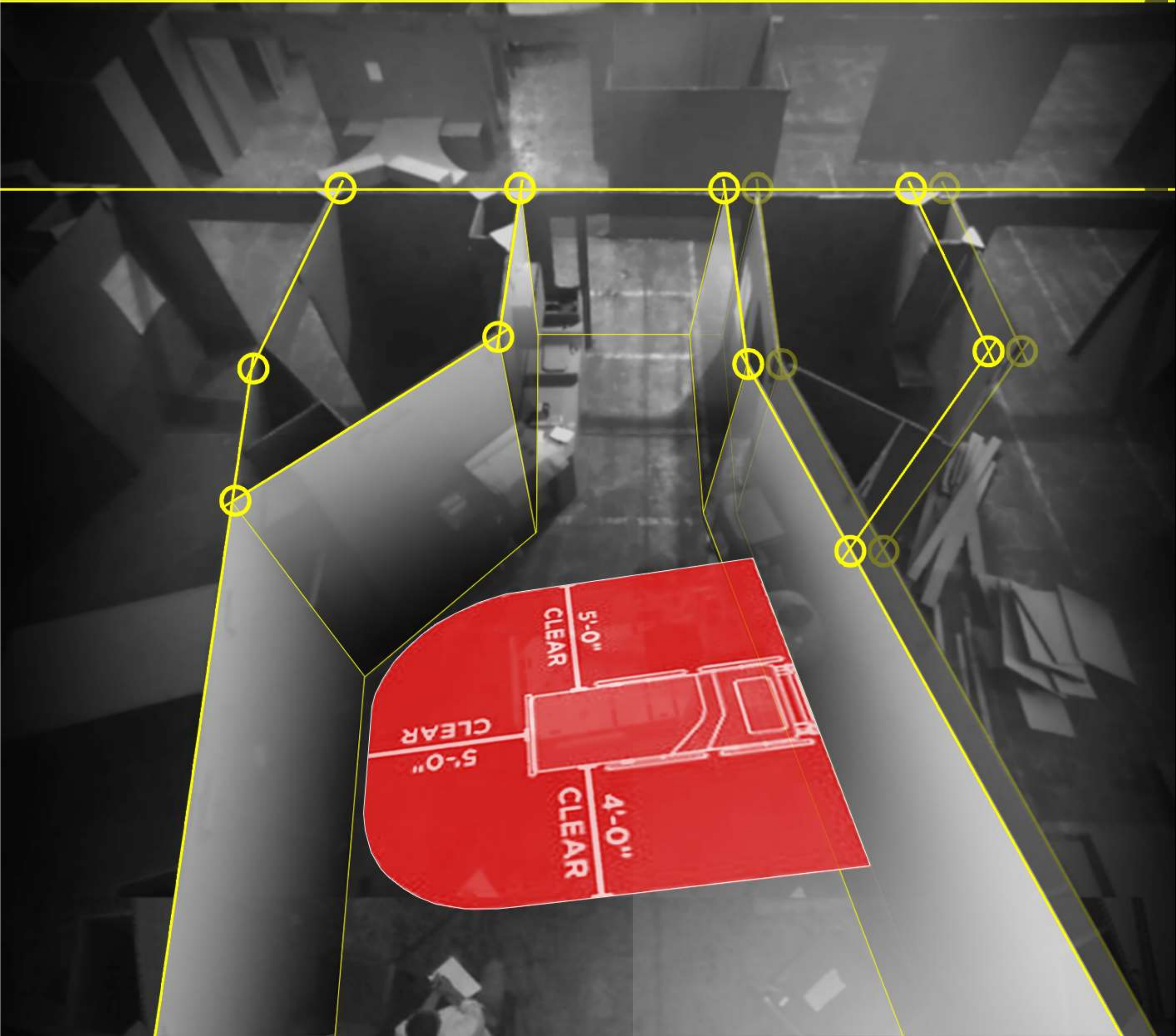
Corridor Shift

Patient Room Geometry

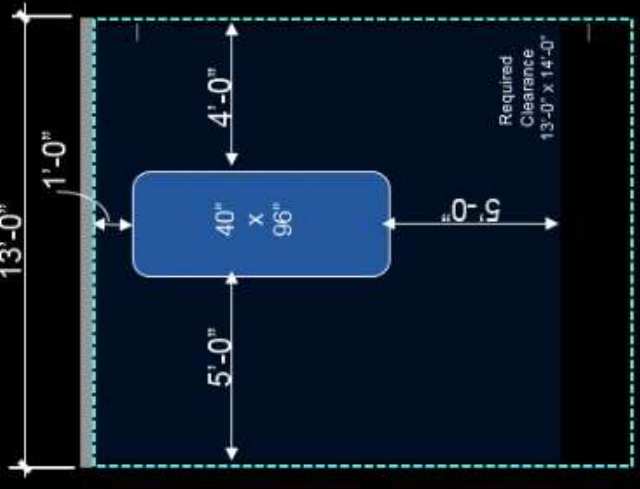
Restroom Rotation

METRICS

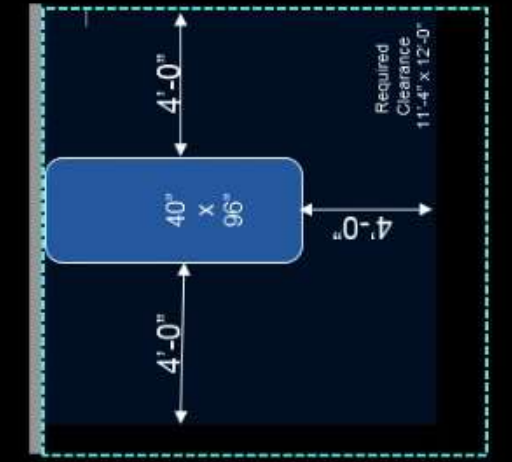
Patient Room Area:	327sf
Toilet Room Area:	87sf



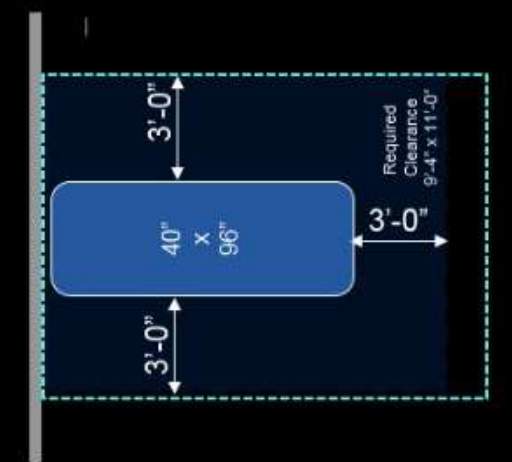
Postpartum
 Required CFA 150 sf
 EGI Section 2.2-2.11.2



Critical Care
 Required CFA 200 sf
 EGI Section 2.2-2.6



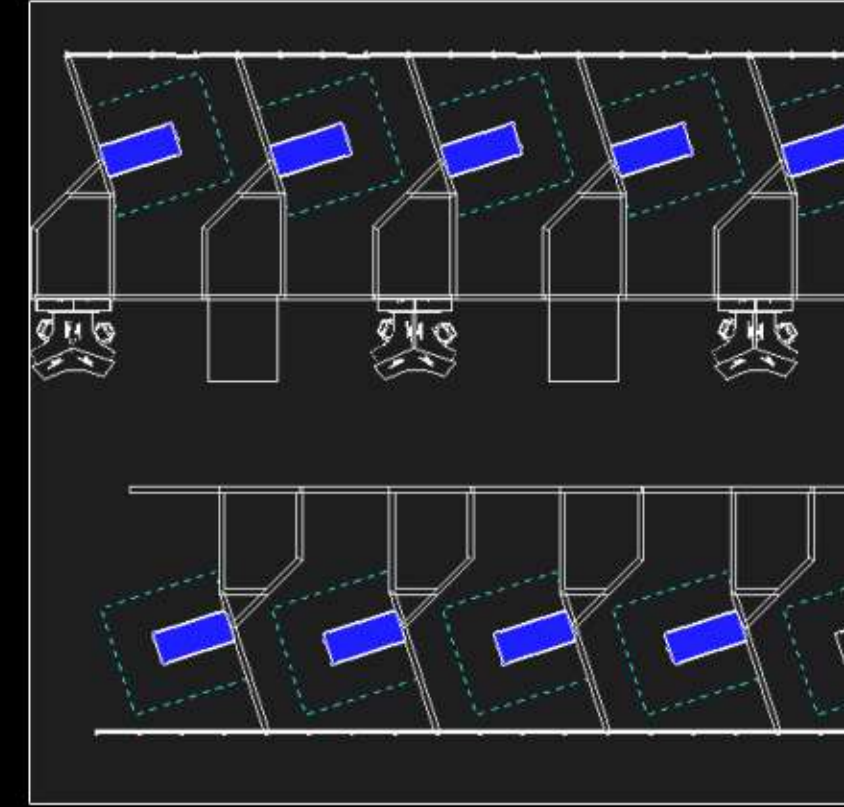
Intermediate Care
 Required CFA 150 sf
 EGI Section 2.2-2.5



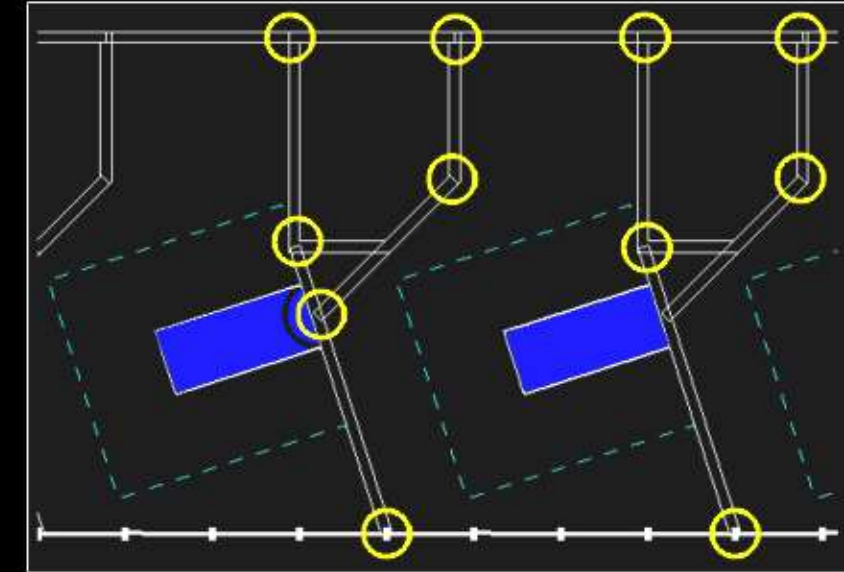
Acute Care
 Required CFA 120 sf
 EGI Section 2.2-2.2



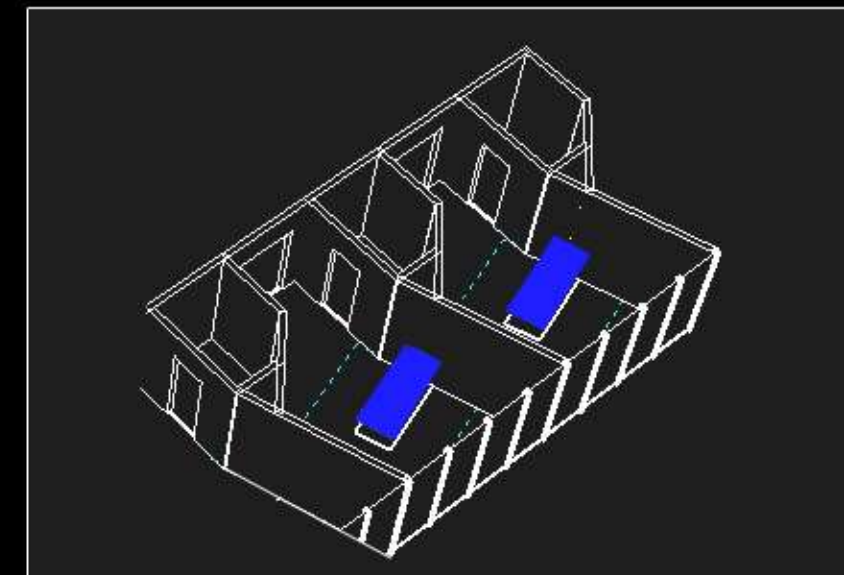
WING ARRAY PLAN

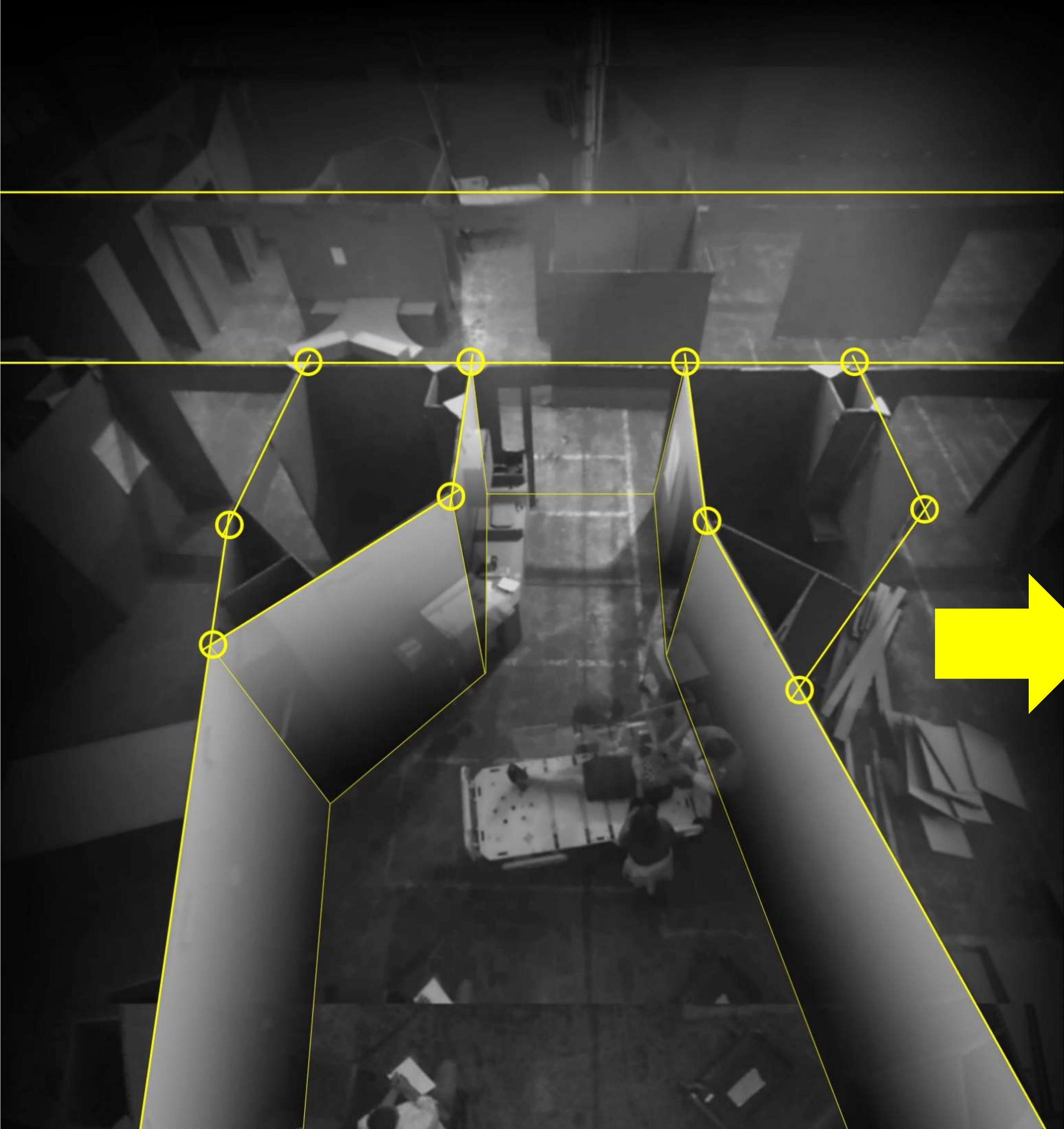


ROOM PLAN

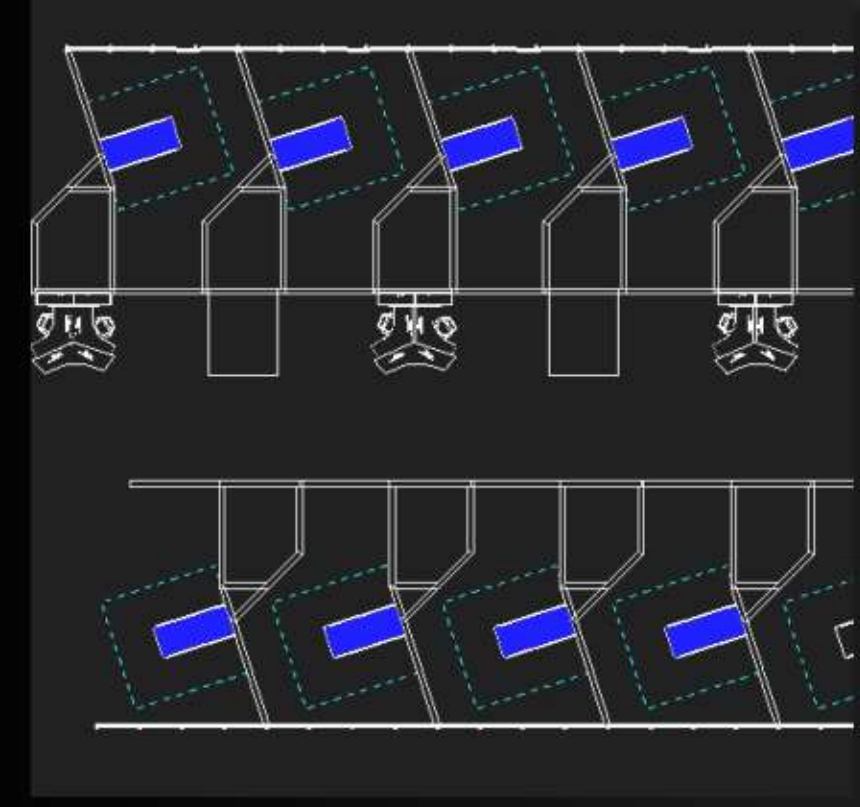


ROOM MODEL

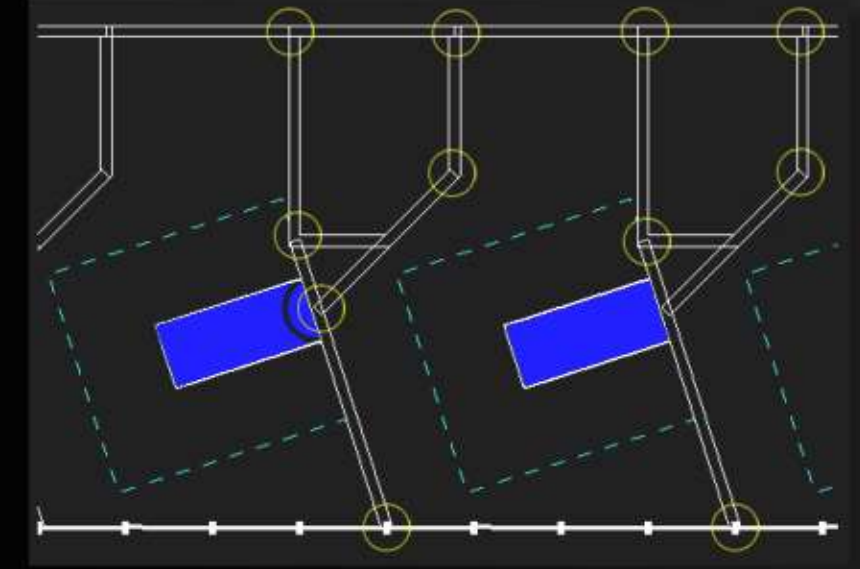




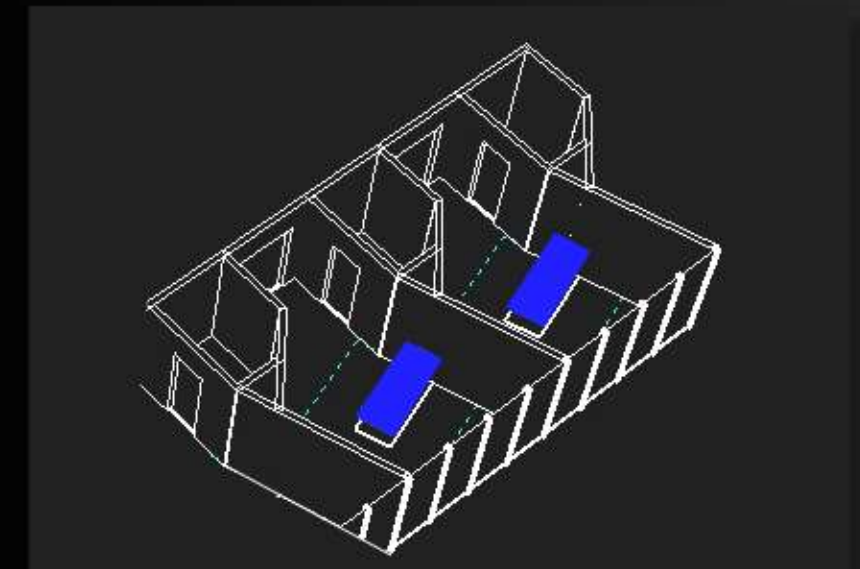
WING ARRAY PLAN



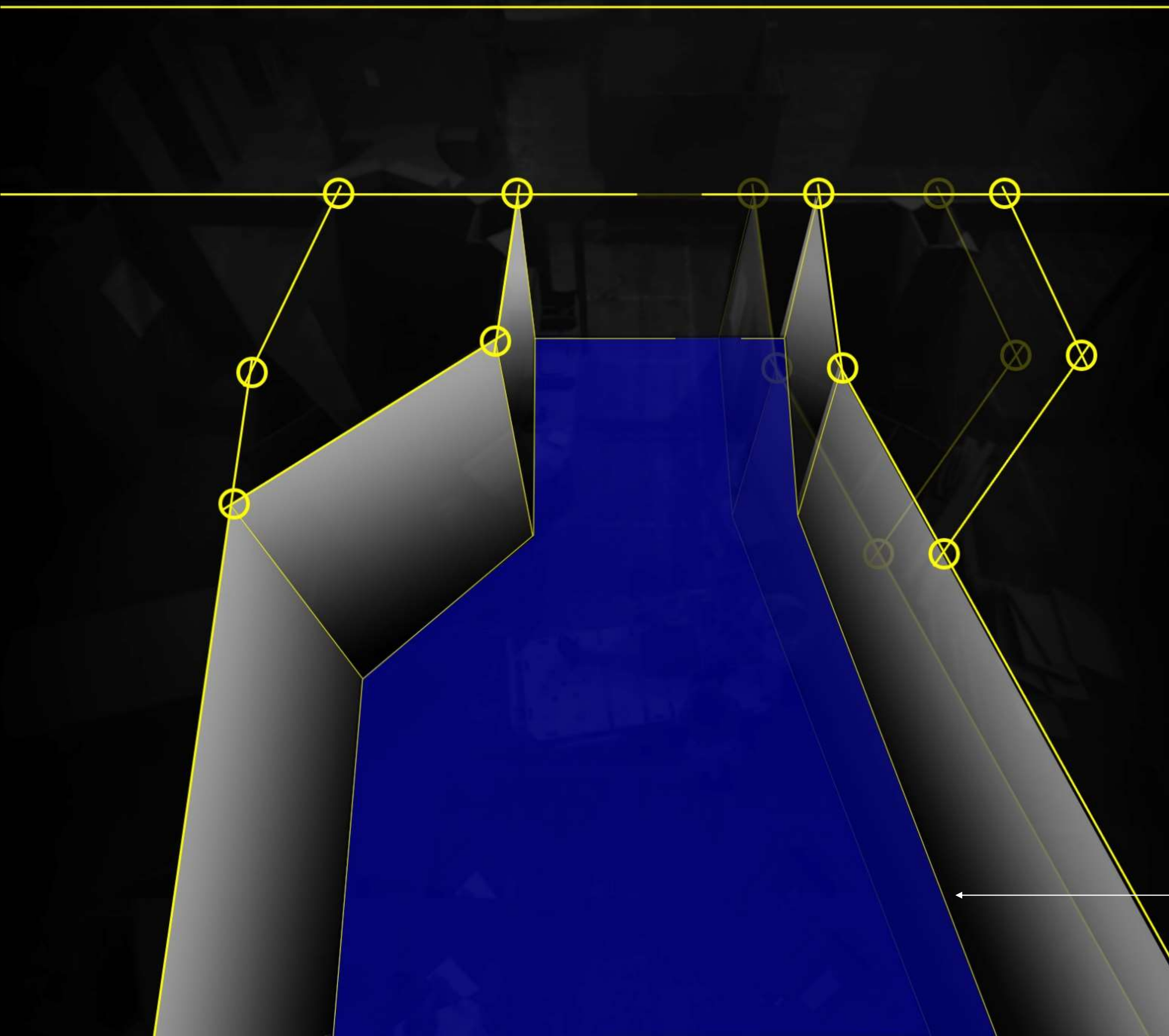
ROOM PLAN



ROOM MODEL



GEOMETRY PARAMETERS



Bed

Bed Width

Bed Length

Clearances

Foot of Bed

Side of Bed

Toilet Room

Length

Depth

Major Planning

Planning Module

Bay Depth

Inboard Outboard

Same-handed Mirrored

Corridor Width

Corridor Shift

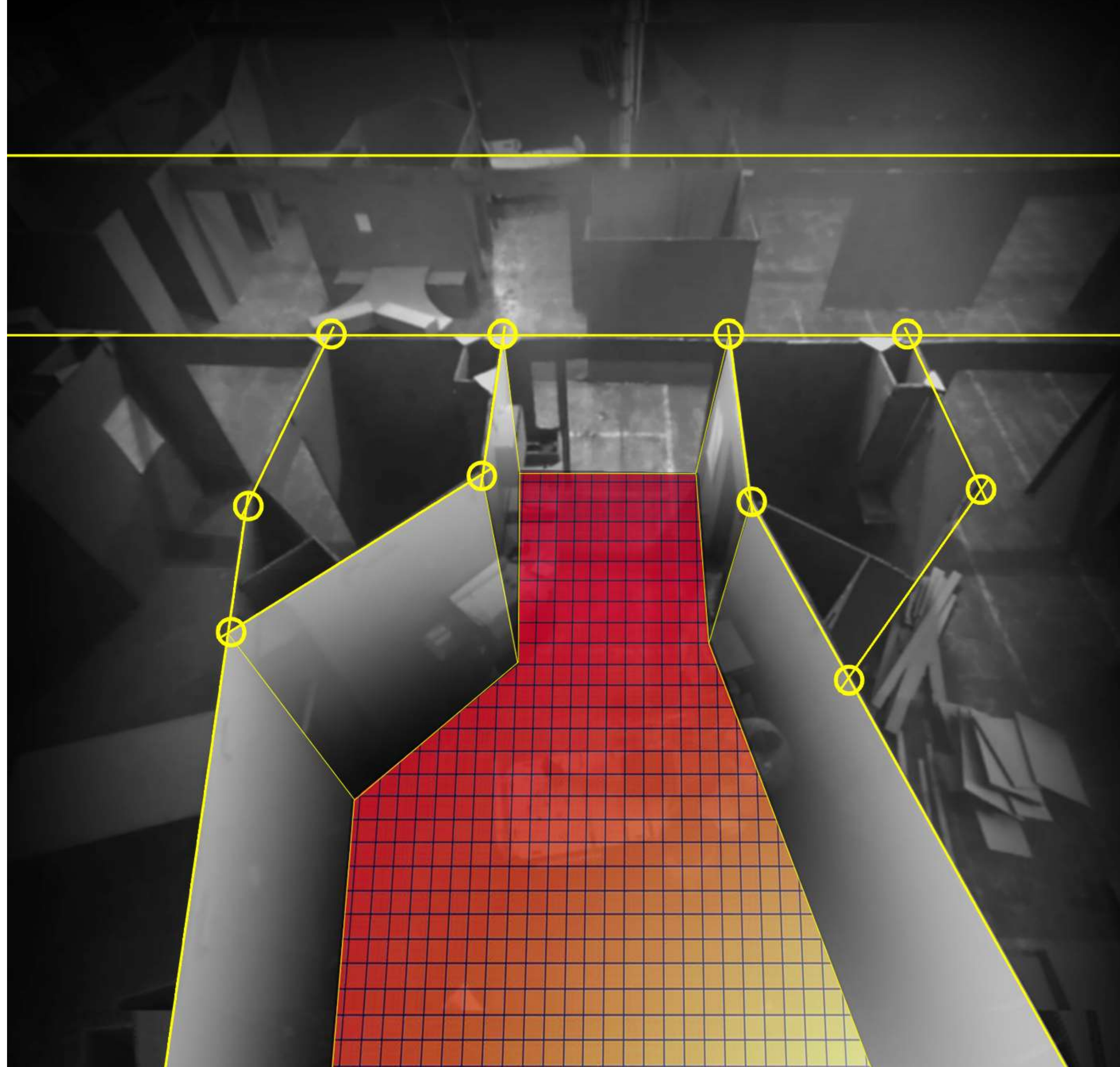
Patient Room Geometry

Restroom Rotation

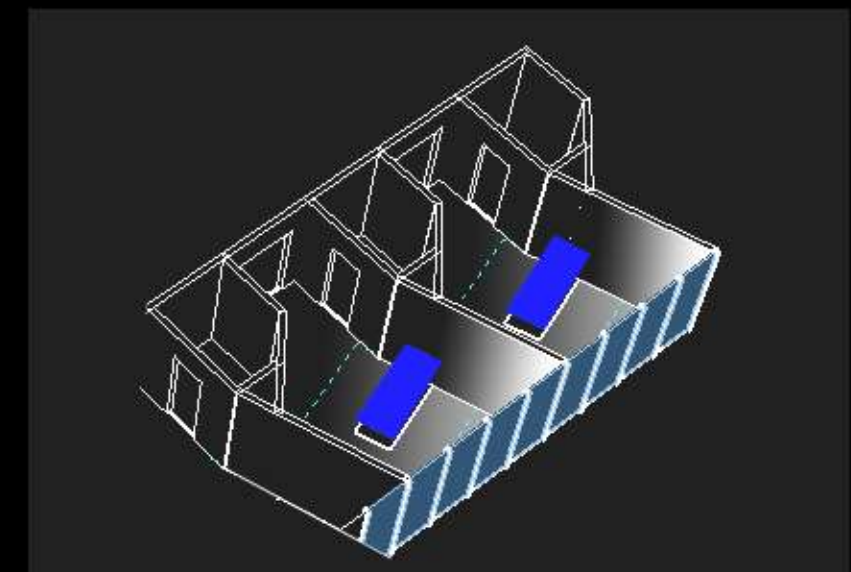
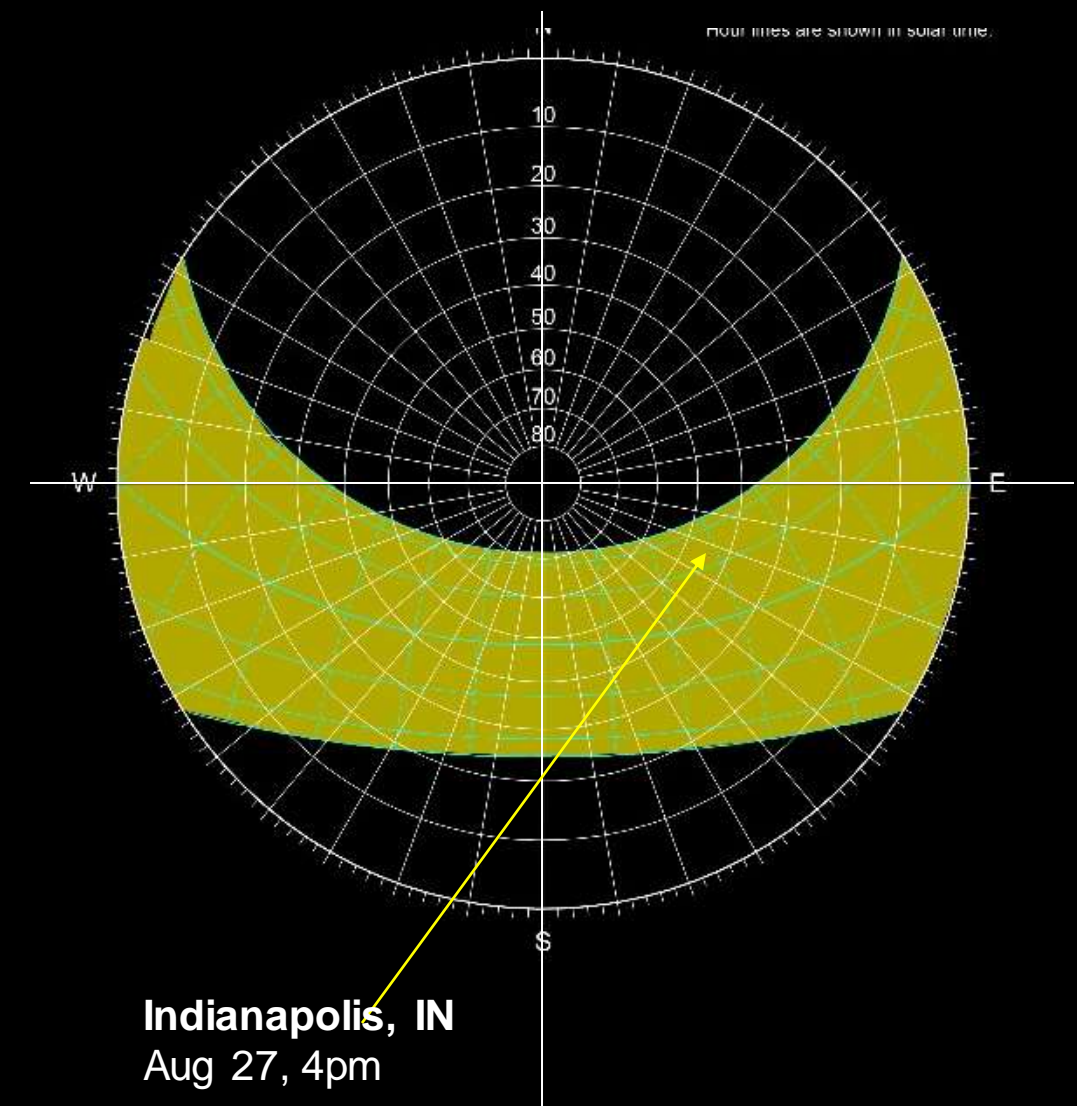
METRICS

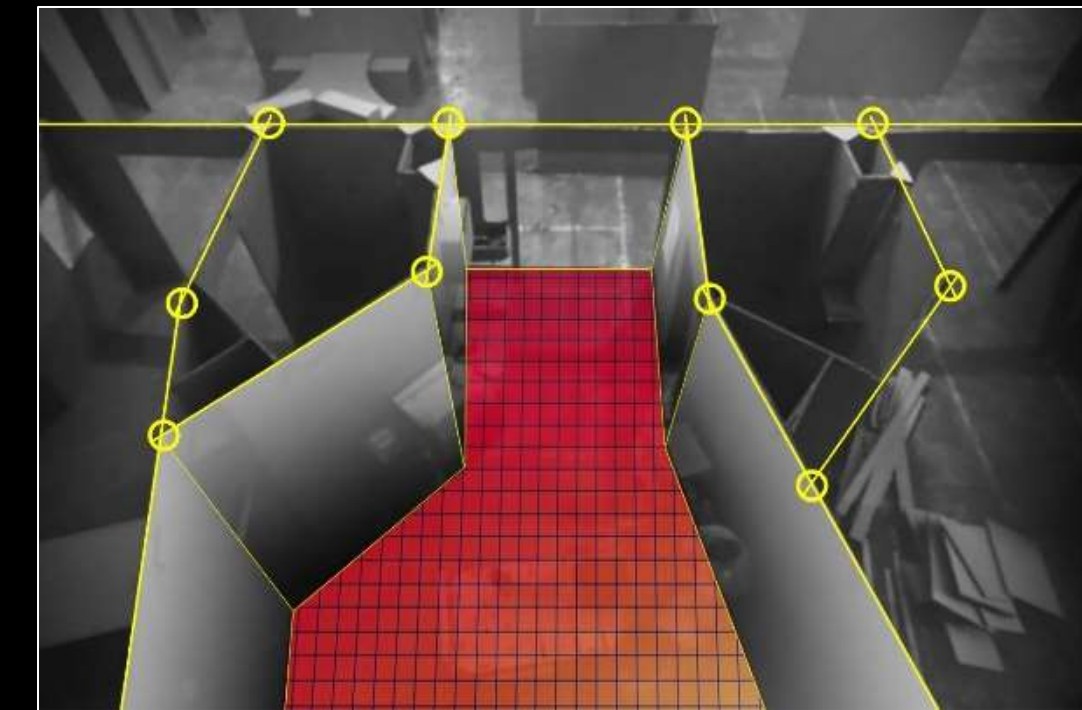
Patient Room Area: 327sf
Toilet Room Area: 87sf

Wall Shift Delta: 45sf
Delta x 280 rooms: 12,600sf
Delta x \$300/sf \$3,780,000



STEREOGRAPHIC SUNPATH DIAGRAM





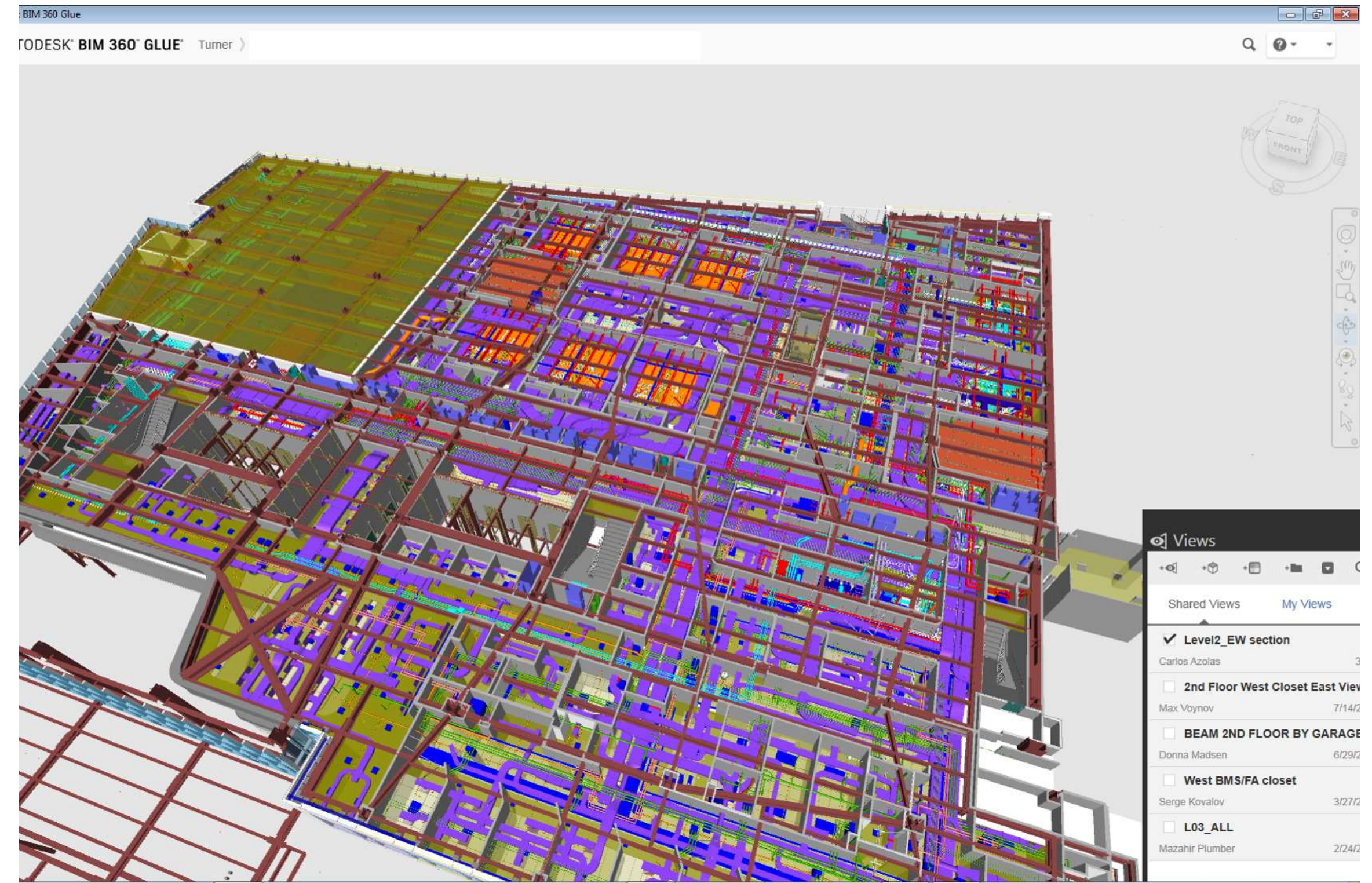
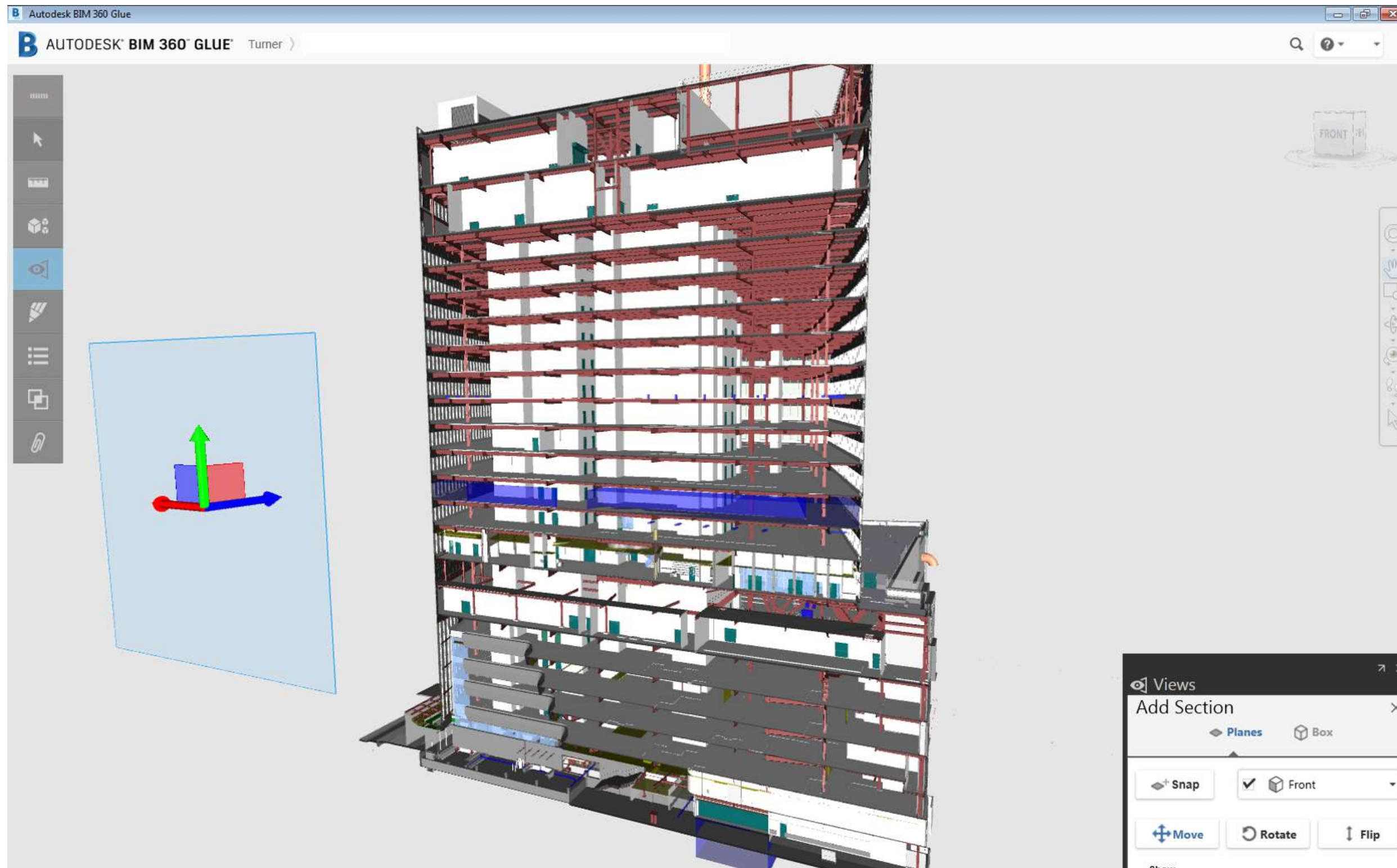
- + Area tracking
- + Cost tracking
- + Code & clearance compliance
- + Energy performance
- + Daylight and views
- + Revit Integration

H. ANALOGAS

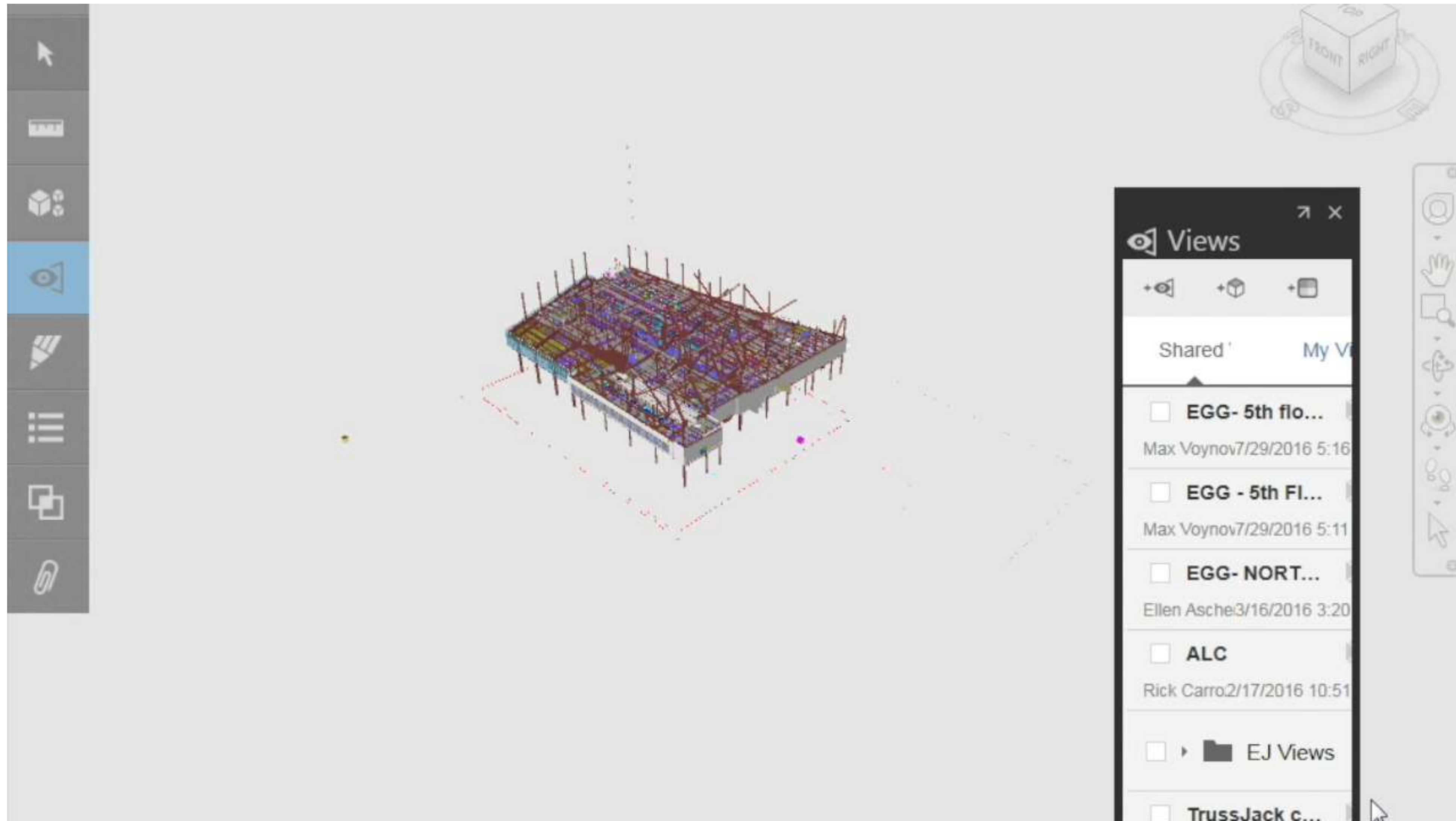
H. DIGITALES

VALOR PARA EL CLIENTE

BIM - Etapa de Construcción



BIM - Etapa de Construcción



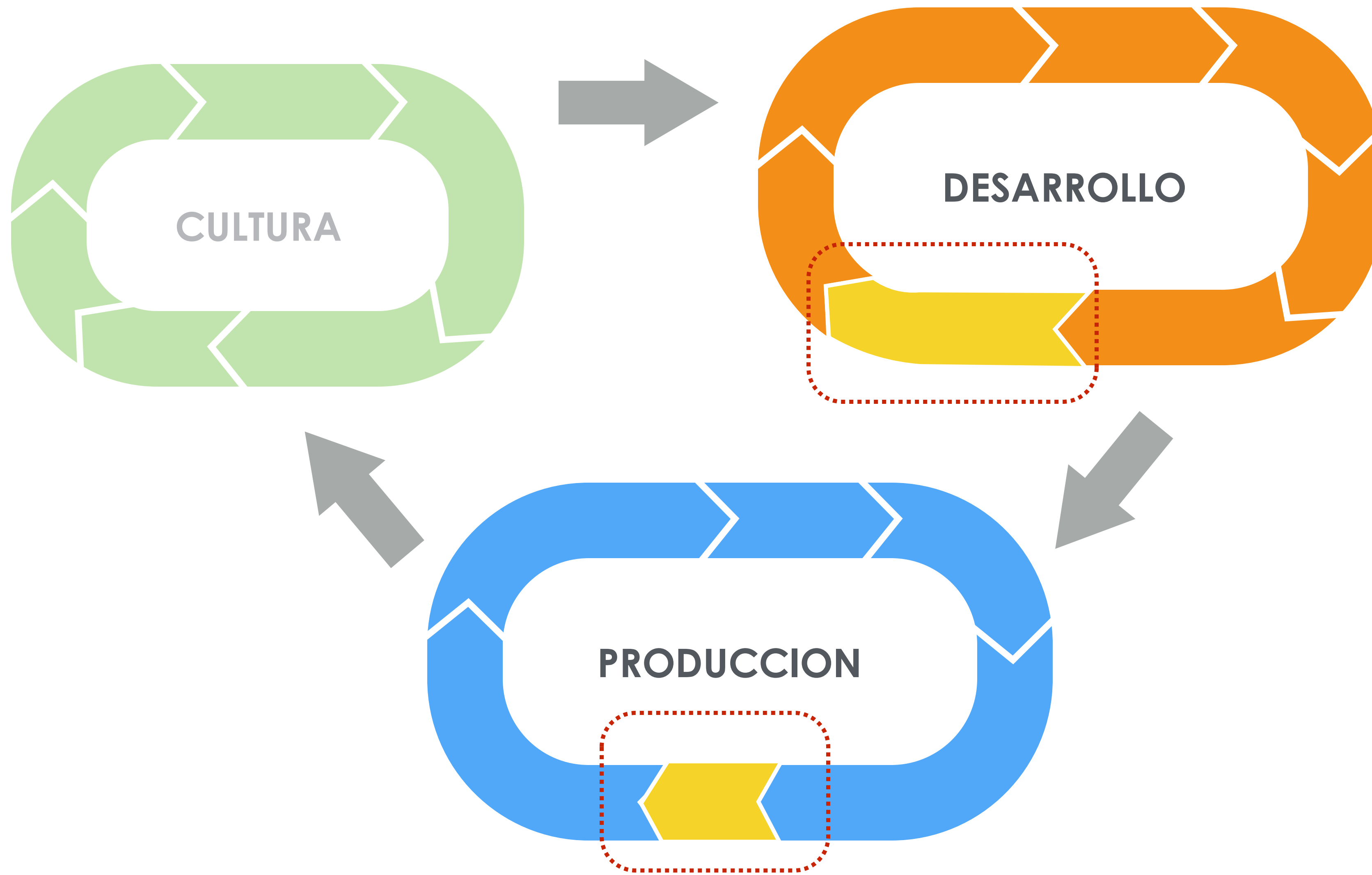
Diseño Computacional y BIM

- **Eficiencia y Creatividad: Evaluación de diferentes opciones simultáneamente y en tiempo real**
- **Minimiza Errores de Coordinación**
- **Controla el presupuesto**
- **Puede Incorporar bases de datos existentes y decisiones tomadas durante el proyecto**



- Criterio de Diseño
- Diseño Computacional y BIM
- **Sistemas Prefabricados**

Sistemas Prefabricados



Prefabricación en Hospitales



2010

**Miami Valley Hospital
Dayton, OH**

Sistemas Prefabricados:

- 1. Panel de gases y baño - Habitaciones
- 2. Estructura para Sistema Mecánicos en piso de habitaciones
- 3. Sistema Muro Cortina.



2015

**Riverside Hospital
Columbus, OH**

Sistemas Prefabricados:

- 1. Panel de gases y baño - Habitaciones
- 2. Estructura para Sistema Mecánicos en piso de habitaciones
- 3. Sistema Muro Cortina.
- 4. OR Estructura para Sistema Mecánicos en corredores
- 5. Baños individuales
- 6. Piezas de Pre/Post operación
- 7. Componentes para sala de exámenes
- 8. Caja de Válvulas de Gases zonal
- 9. Cobertizo de entrada



2016

**Mount Carmel Hospital
Cincinnati, OH**

Sistemas Prefabricados:

- 1. Panel de gases y baño - Habitaciones
- 2. Estructura para Sistema Mecánicos en piso de habitaciones
- 3. Sistema Muro Cortina.
- 4. OR Estructura para Sistema Mecánicos en corredores
- 5. Baños individuales
- 6. Piezas de Pre/Post operación
- 7. Componentes para sala de la sala de exámenes
- 8. Caja de Válvulas de Gases zonal
- 9. Cobertizo de entrada



2018

**Universidad de Washington
Seattle, WA
Phase II - 2018**

Sistemas Prefabricados:

- 1. Panel de gases - Habitaciones
- 2. Estructura para Sistema Mecánicos en piso de habitaciones

300%

AUMENTO DE LA PRODUCTIVIDAD

0

LESIONES

35%

FABRICACION FUERA DE TERRENO

U\$1.3

MILLONES SE AHORRARON

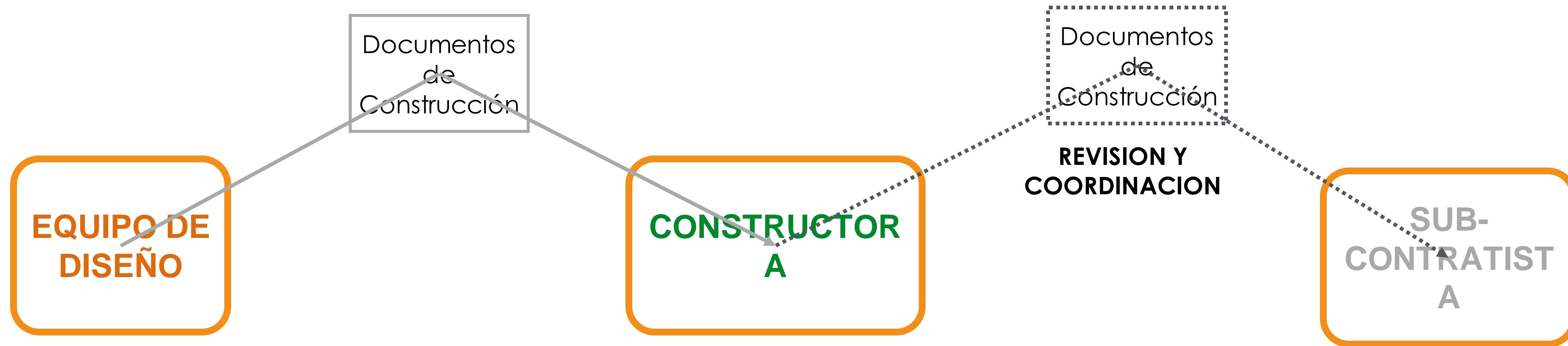
2%

AHORRO DEL COSTO TOTAL

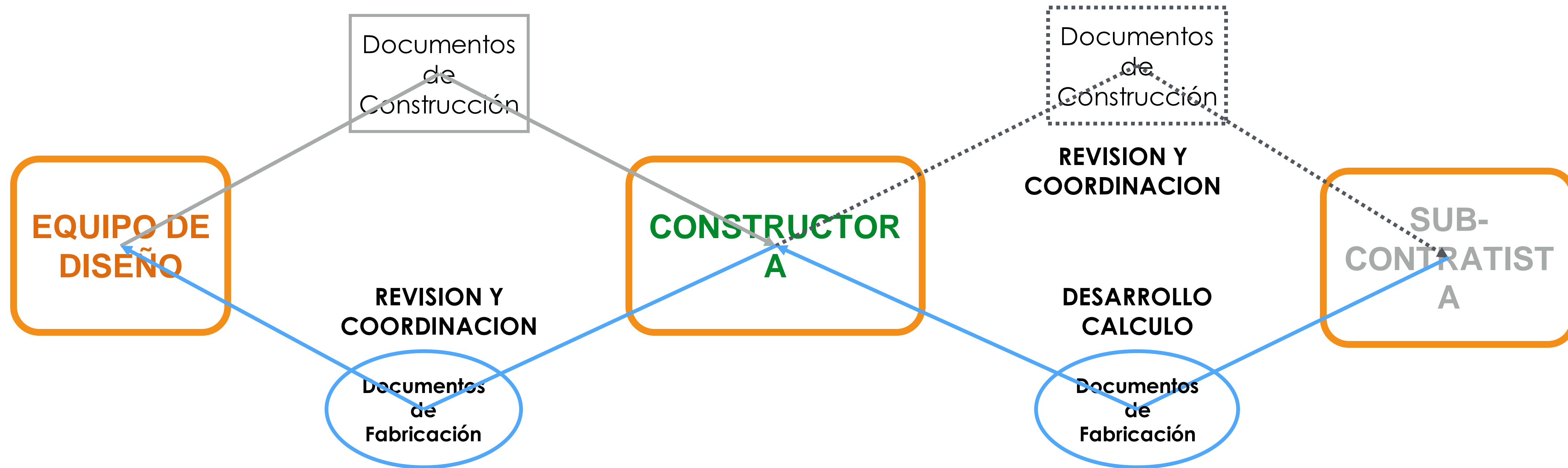
14%

MAS EFICIENTE QUE LA CONSTRUCCION TRADICIONAL

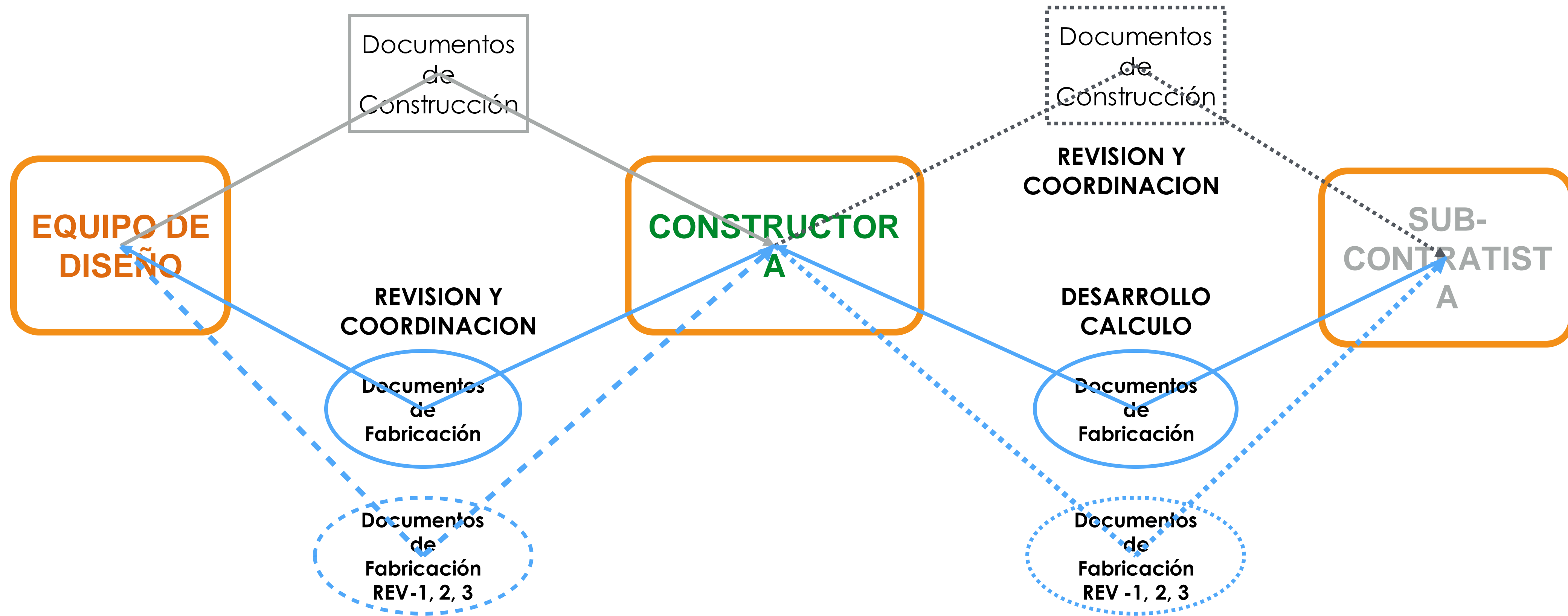
Proceso Constructivo



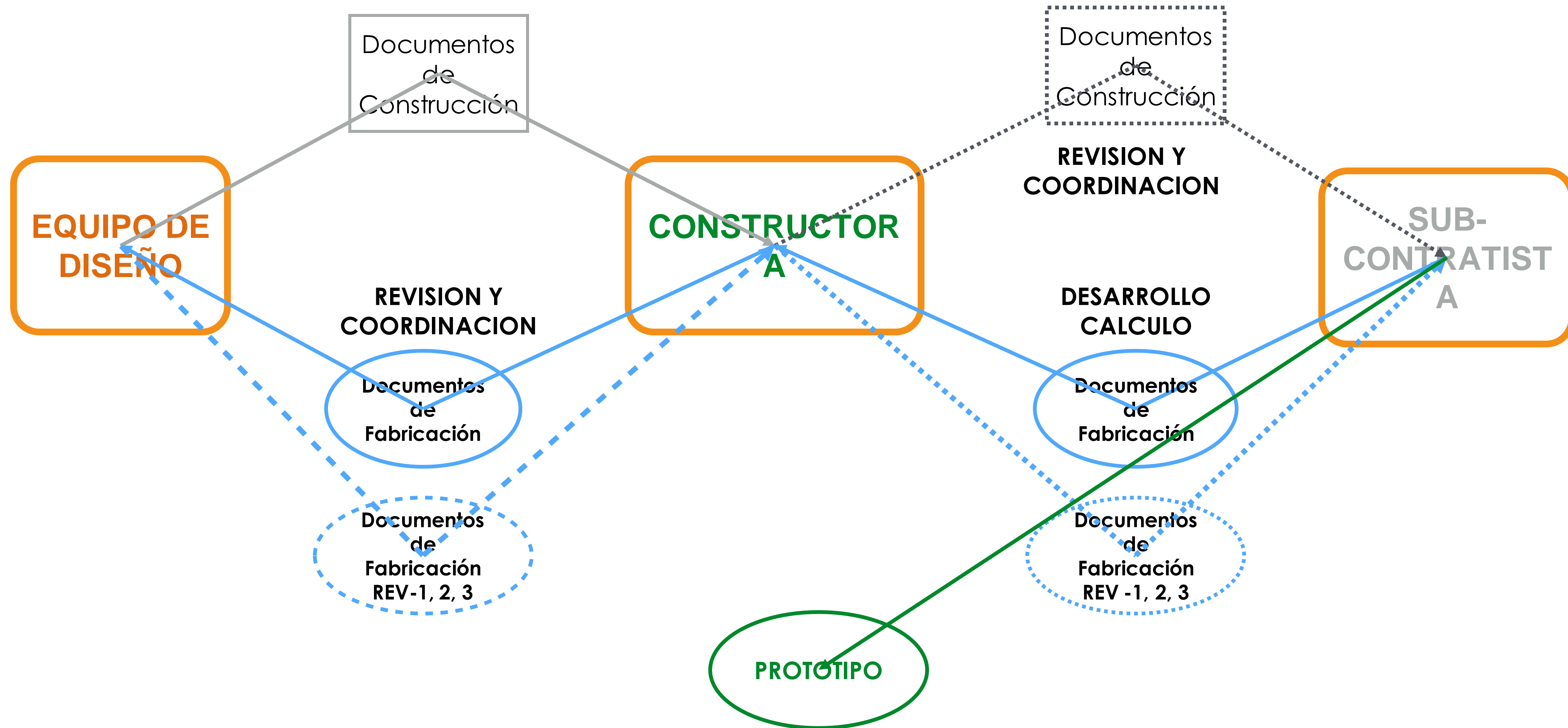
Proceso Constructivo



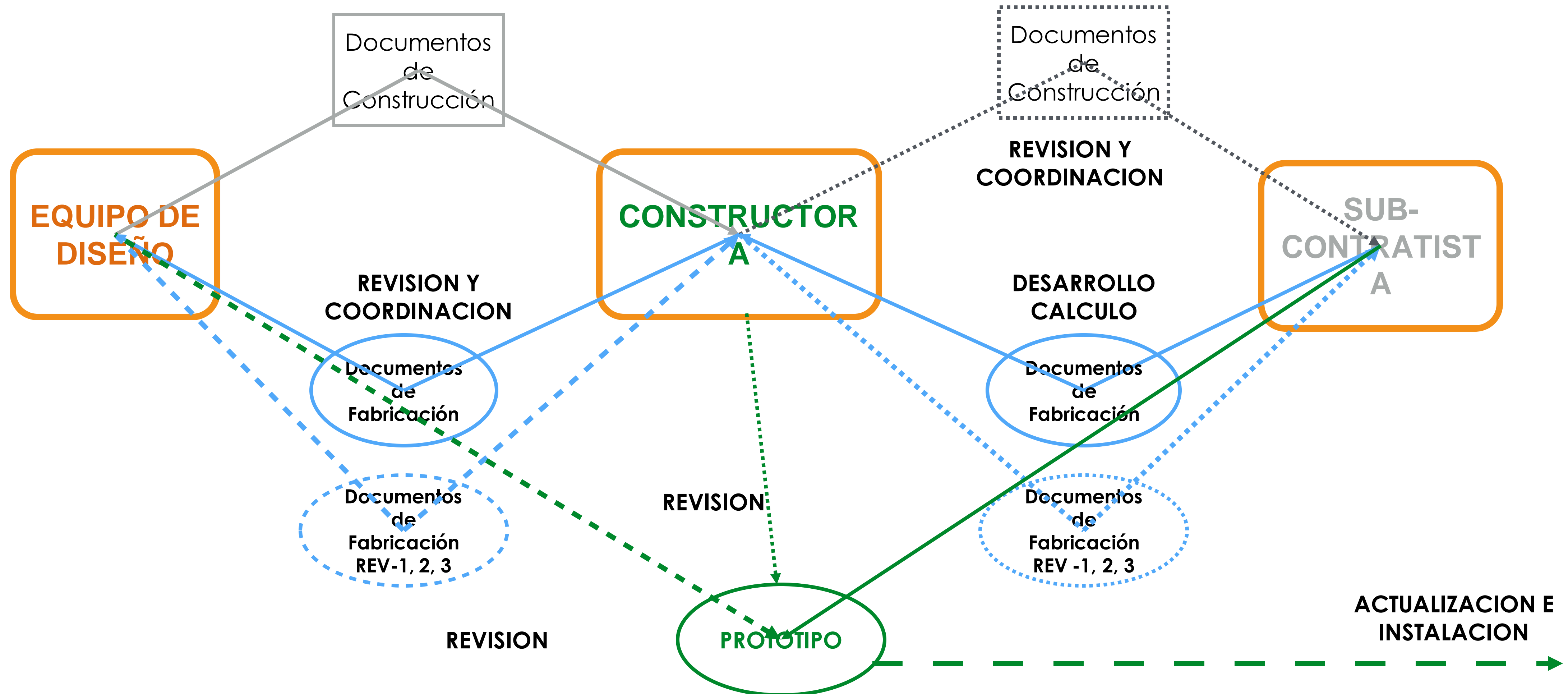
Proceso Constructivo



Proceso Constructivo



Proceso Constructivo



Sistemas Prefabricados

- **Disminuye tiempos de construcción.**
- **Minimiza posibles lesiones en obra.**
- **Disminuye errores de instalación y construcción.**
- **Mejora el Control de Calidad y Presupuesto.**

