AUTODESK UNIVERSITY

# A Digital Revolution in Resilient Housing – Build Change & Autodesk

**Allie Young & Andrés Robles**

BIM Technologies – Build Change

# About us

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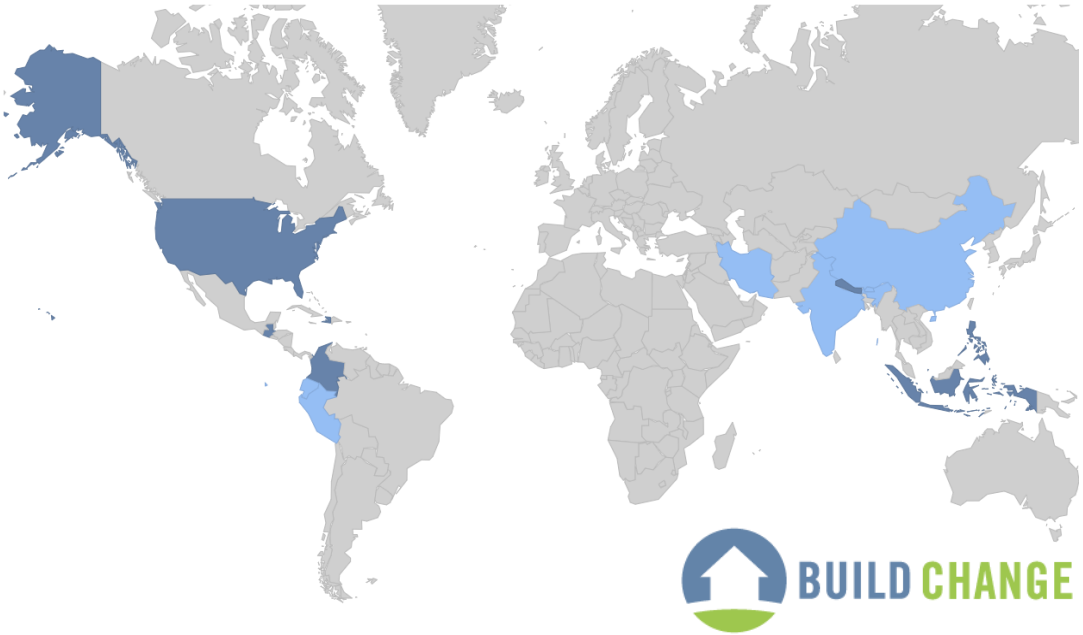
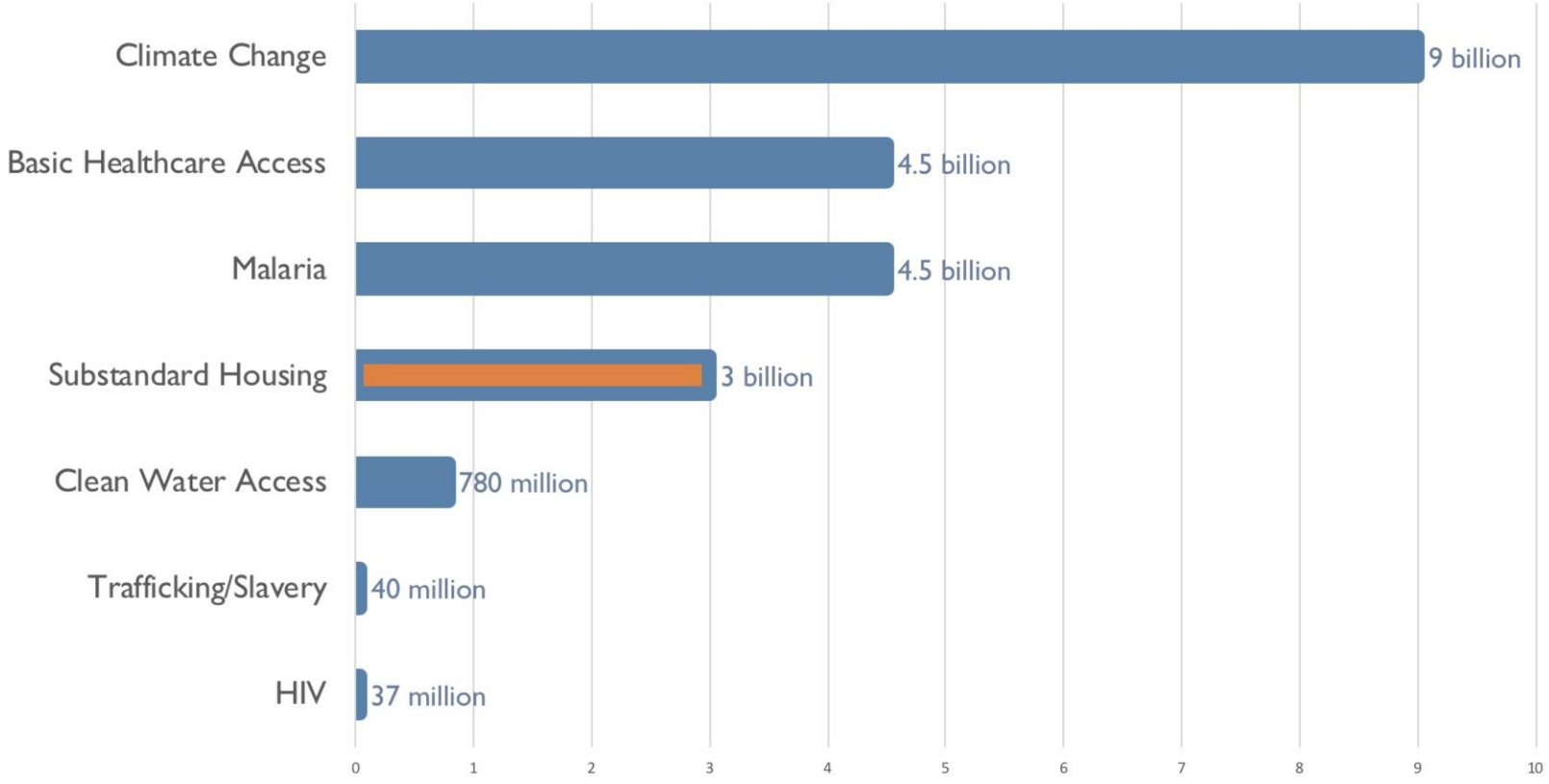
# About Build Change

- Founded in 2004 by Dr. Elizabeth Hausler
- Mission: to save lives in earthquakes and other natural disasters
- Currently in about 6 countries



# Global Challenges by Affected Population (2030)



# Main approaches to disaster resilient design

## New construction

- Designing and constructing new, earthquake-resilient housing

## Retrofits of existing housing

- Structurally reinforcing existing houses by adding new structural elements

# Post-disaster vs. prevention

Nepal – post 2015 earthquake

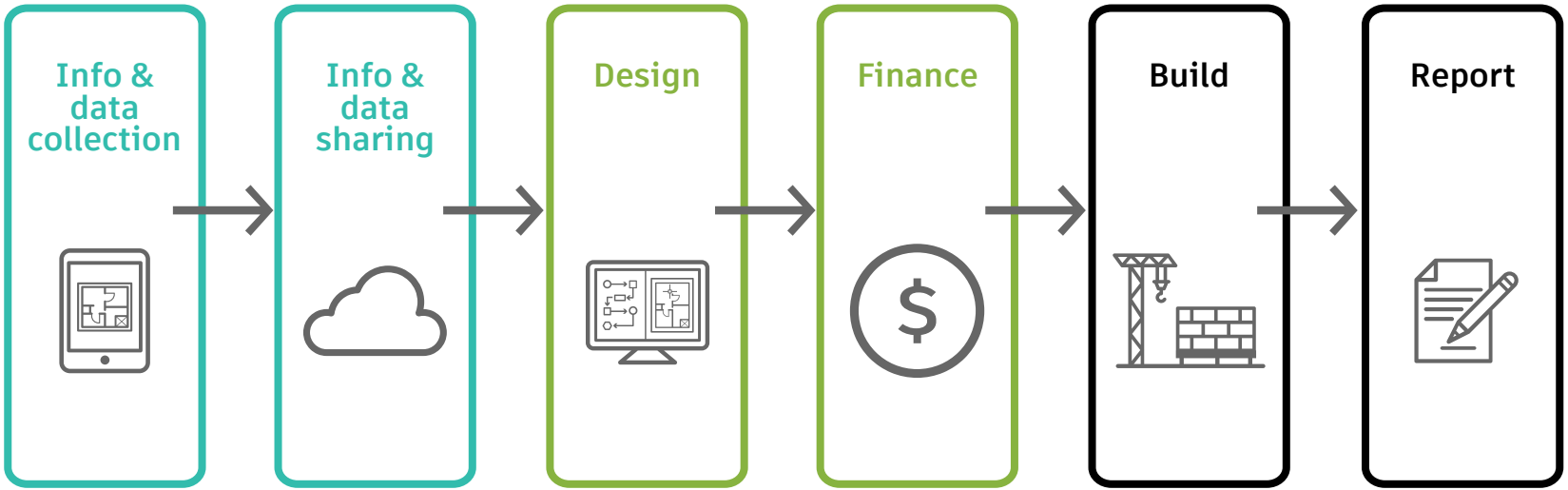
Bogotá, Colombia – 2021

# How can we scale retrofits to protect thousands of families?

# Autodesk Technology at Build Change

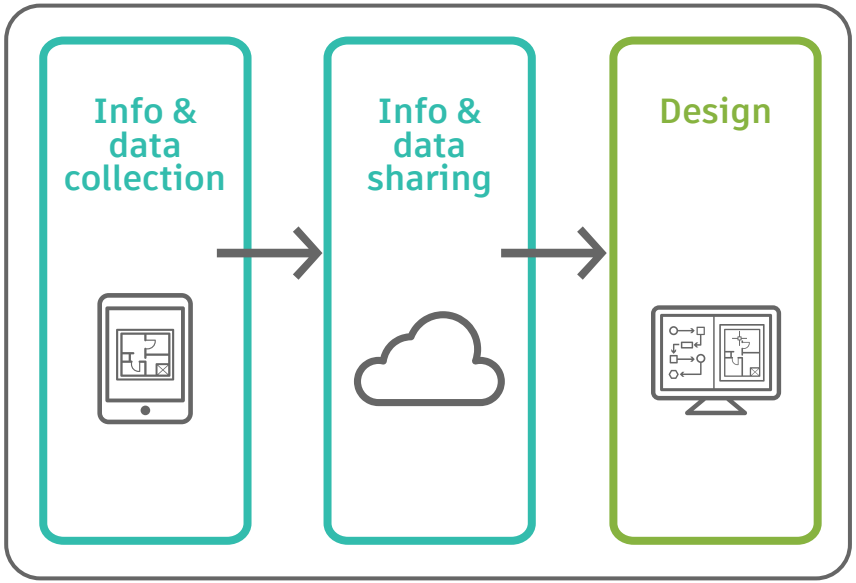
# The construction value chain

Steps in the process of retrofitting a house



# The construction value chain

Steps in the process of retrofitting a house




1. Collecting data on the house and its inhabitants, including its floor plan
2. Storing and sharing that data with partners, architects and engineers
3. Developing a retrofit design tailored to that house

# In the beginning...

AutoCAD for new construction designs

New construction in Indonesia

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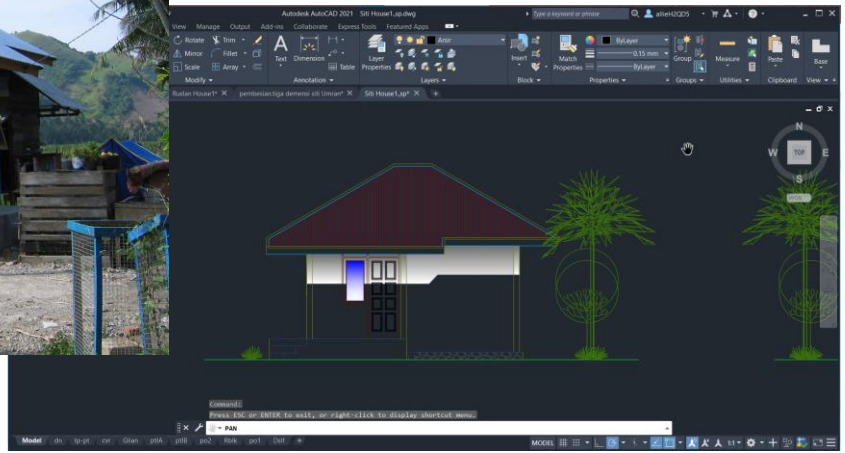
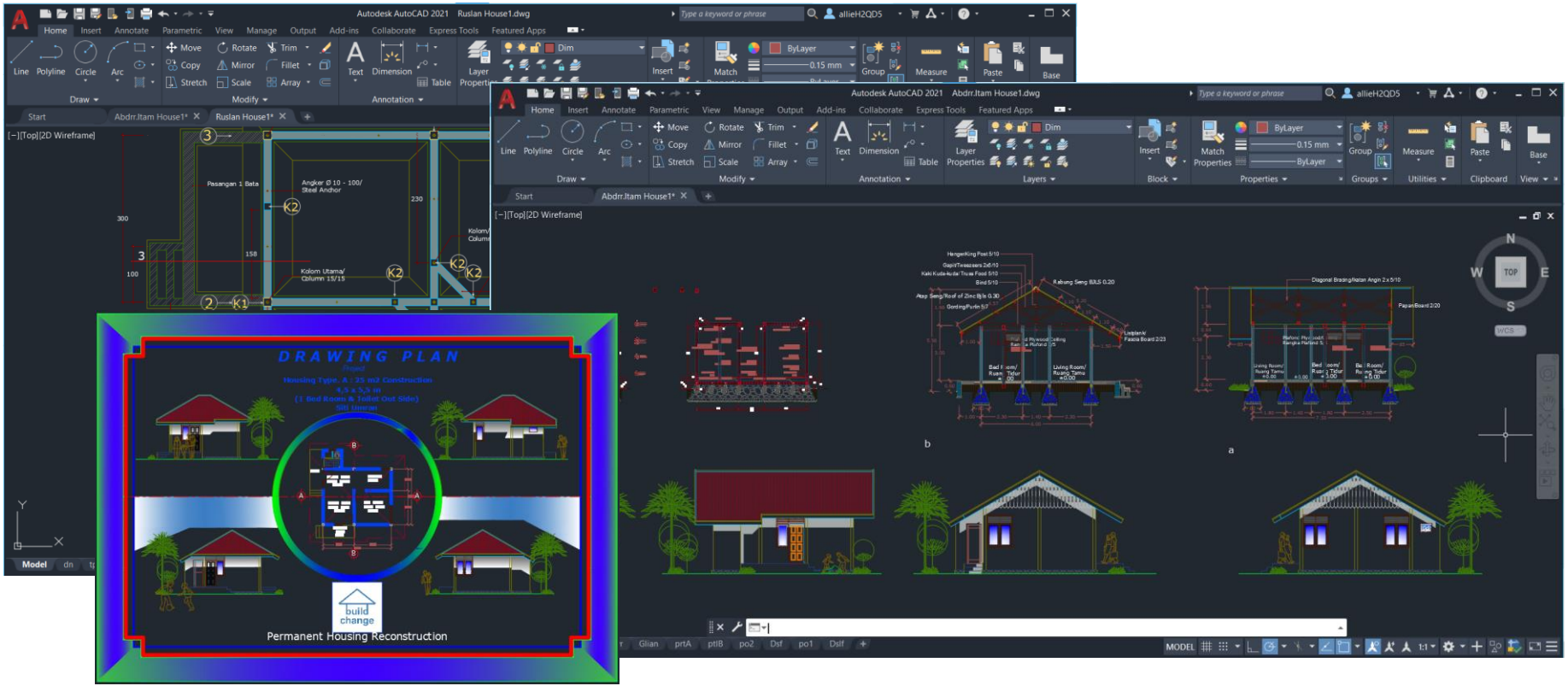


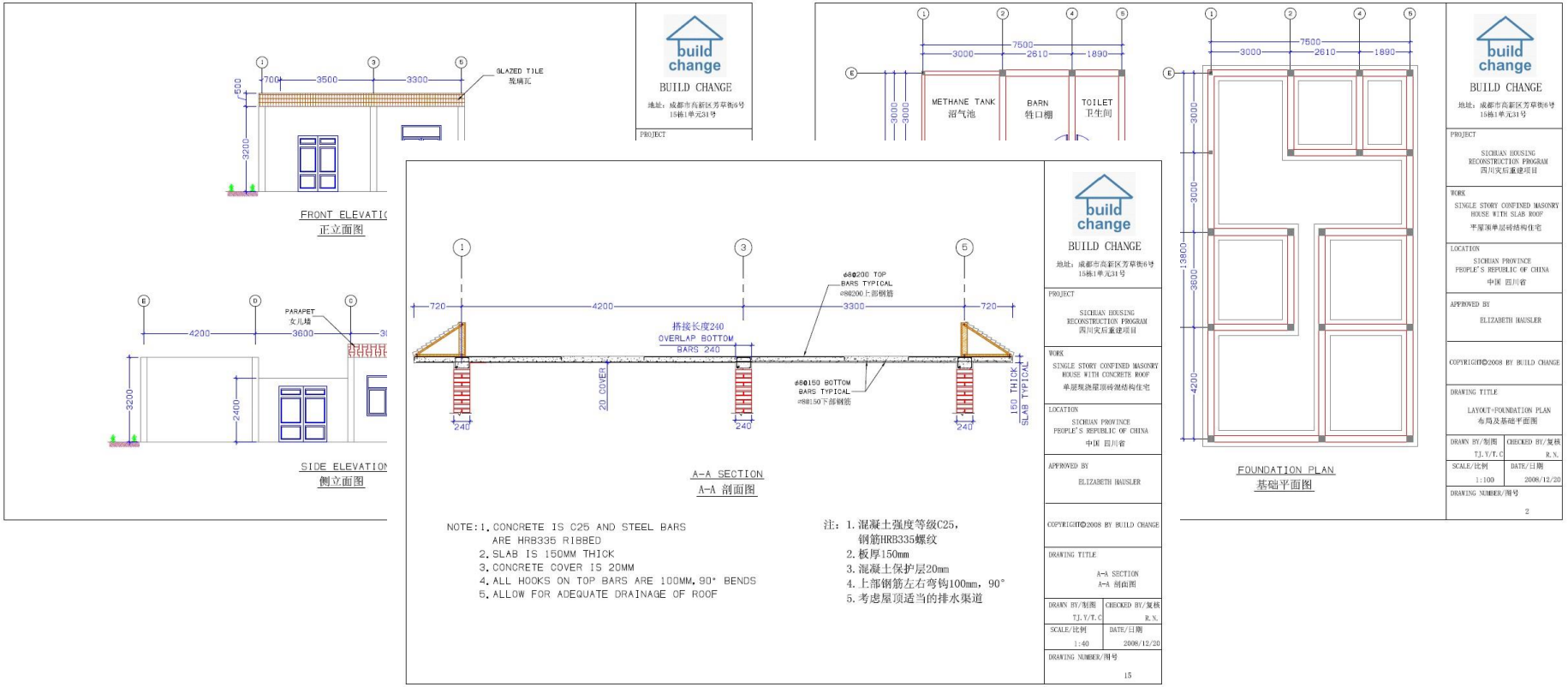
# Indonesia, 2006

AutoCAD for new construction designs



# China, 2009

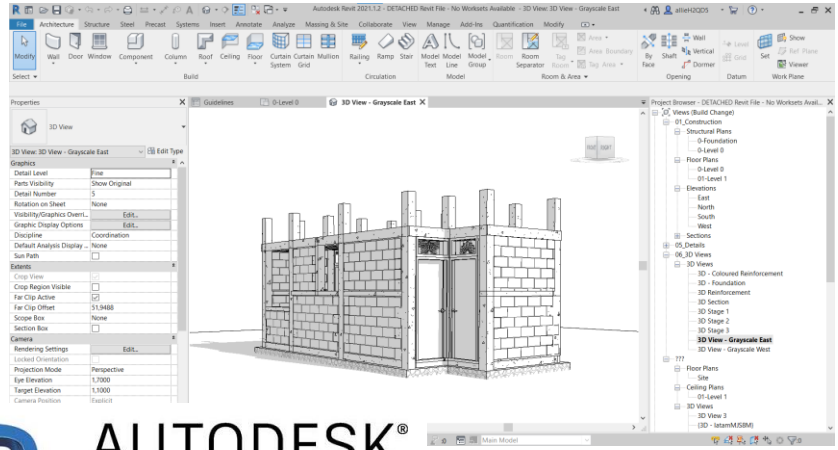
AutoCAD for new construction designs



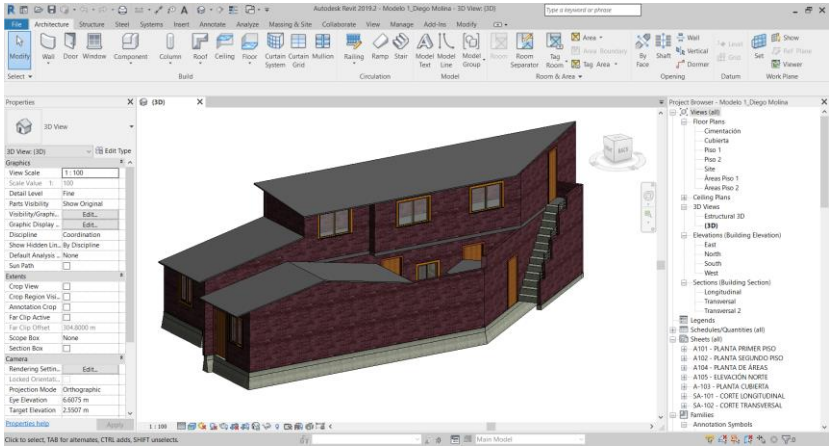
# A shift to Revit

Creating the first templates to make projects more efficient

- Revit was first implemented in Haiti in 2015 and then Colombia in 2017, with the first templates created to make workflows more efficient in retrofit projects



Haiti template



Colombia template

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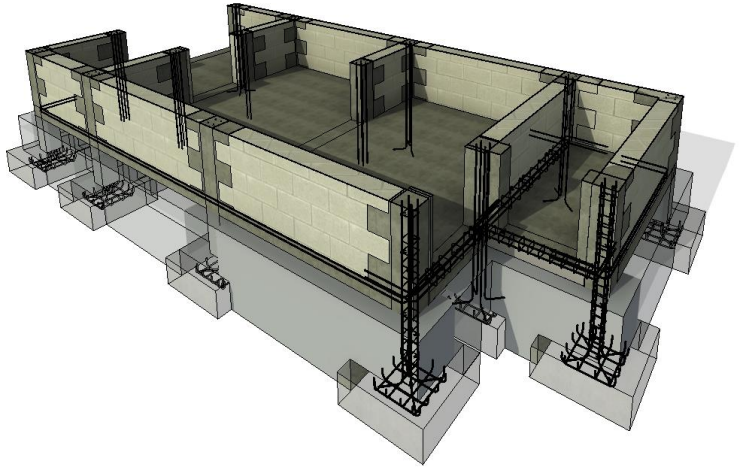
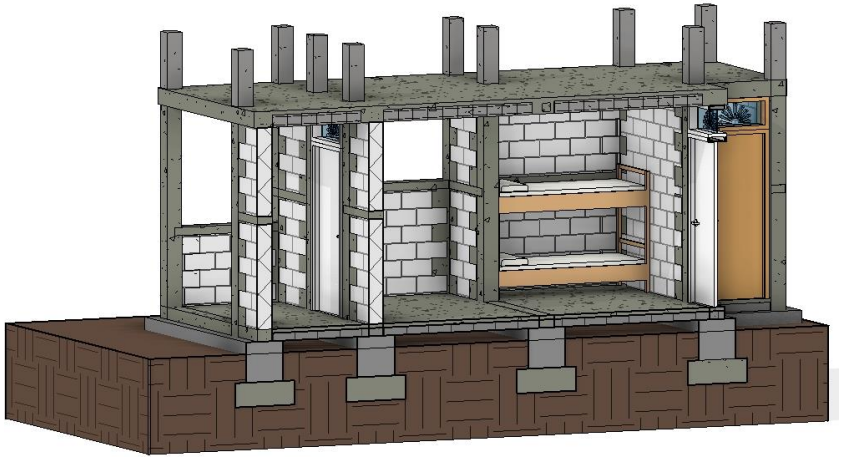
REVIT®

# A shift to Revit

Creating the first templates to make projects more efficient

- Revit used for type designs of new construction in Haiti





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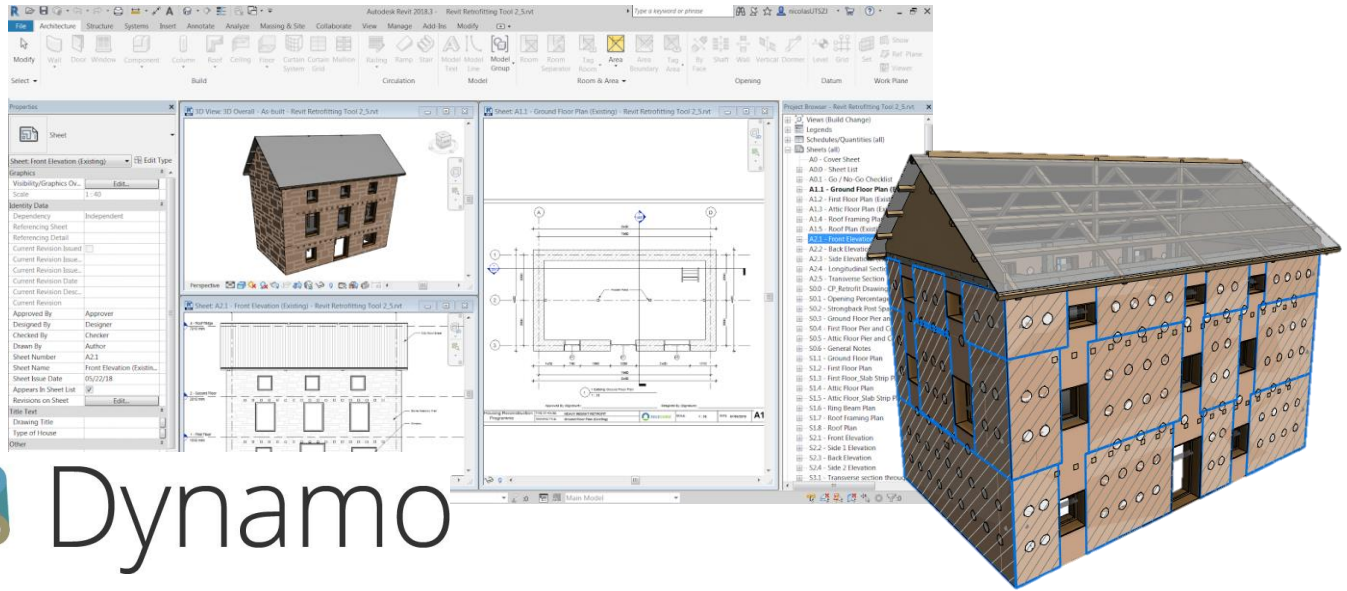
# Nepal, 2017-2018

Automating retrofits in Revit for the first time

- Supported by Autodesk consultants, Build Change first began experimenting with automation in **Dynamo**
- Created our first automated workflows to retrofit houses using specific type designs



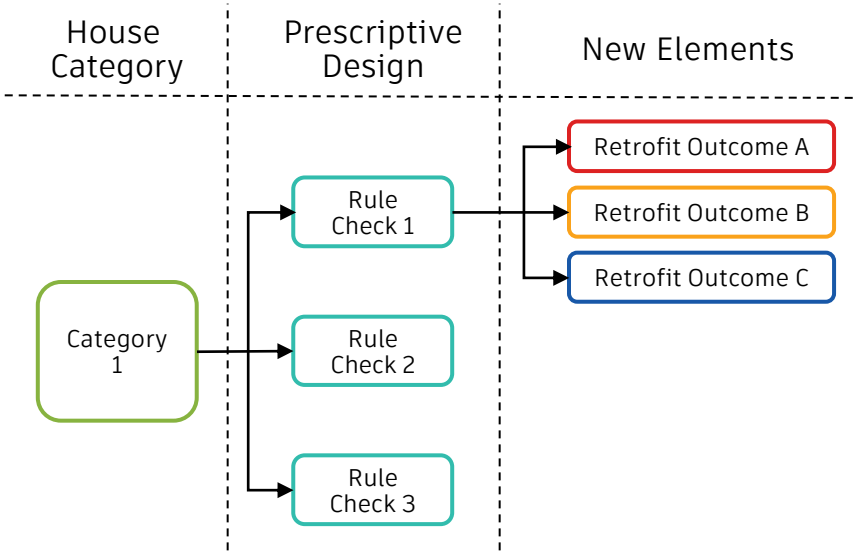
# Nepal: Methodology meets technology

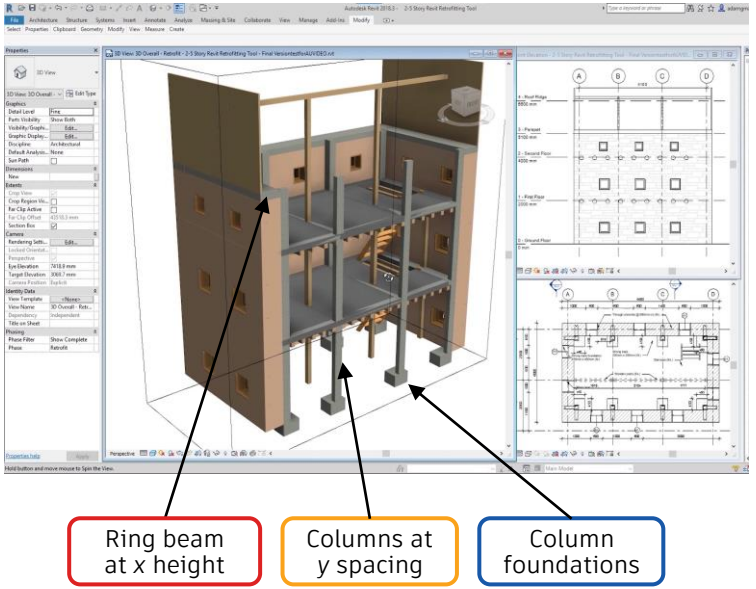
Automating retrofits in Revit for the first time

Virtual tour of a retrofitted house, Eklephant, Nepal

# Dynamo in Nepal

Creating retrofit cards for prescriptive design



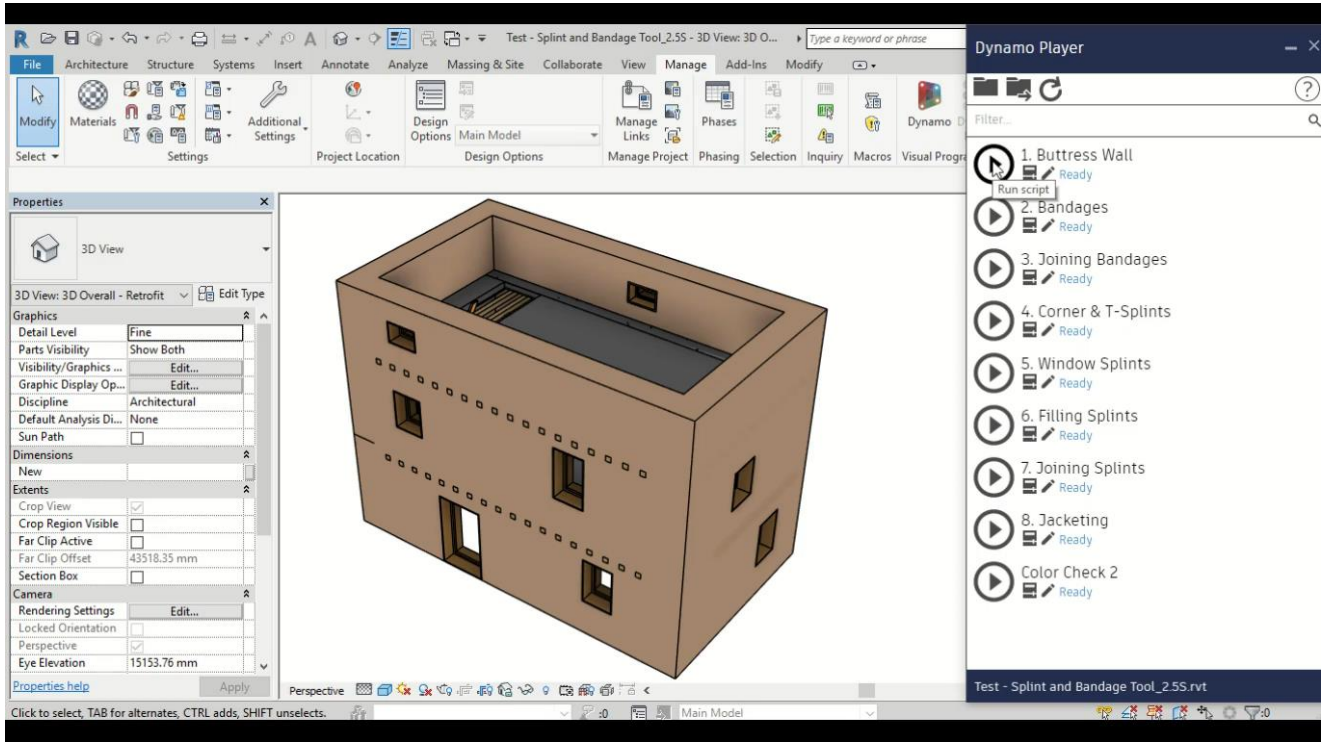
# Dynamo in Nepal

Prescriptive design rules programmed in Dynamo to retrofit houses

Nepal’s first type design & automated Dynamo workflow

# Dynamo in Nepal

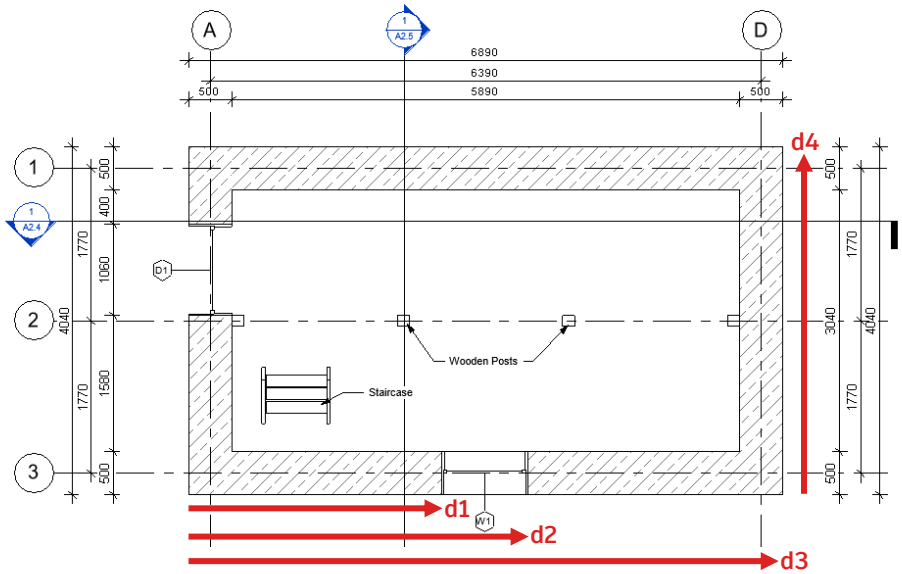
Prescriptive design rules programmed in Dynamo to retrofit houses




Splint and bandage type design, automated Dynamo workflow

# Dynamo in Nepal

Model import process

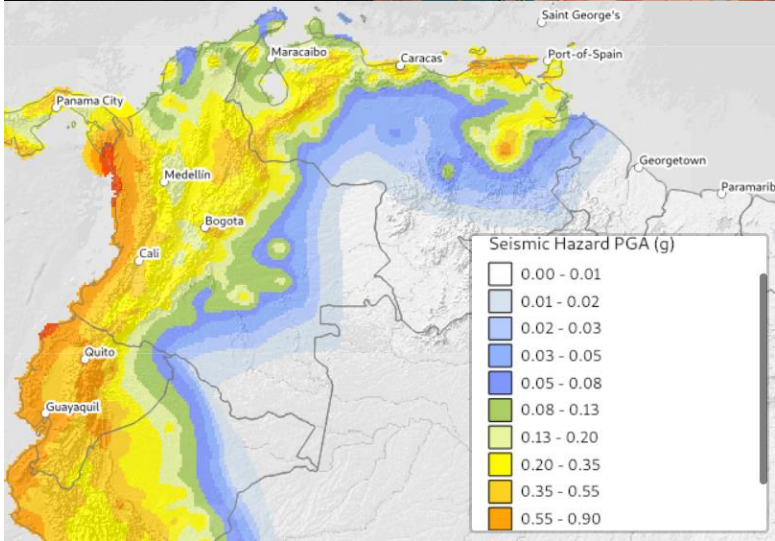


# Autodesk Technology at Build Change: Colombia Case Study

# Urbanization in Colombia

**Colombia has one of the highest rates of urbanization in the world, with almost 80% of its population living in cities.**

Growth of informal neighborhoods means an increase in houses constructed without following technical guidelines – taking place in a region with seismic activity.



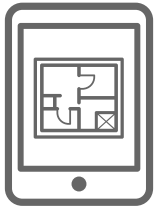
# Retrofitting initiatives in Colombia

Funding from multiple government entities to create retrofit designs for houses in Colombia – aim to impact thousands of families in informal housing

- Caja de la Vivienda Popular
- Ministry of Housing

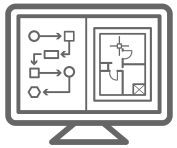
# Retrofits, step by step

## Data Collection



Capturing the floor plan of the house, importing the house to Revit

## Engineering



Performing engineering calculations, generating retrofit design

## Construction Package

Outputting final design documentation for construction

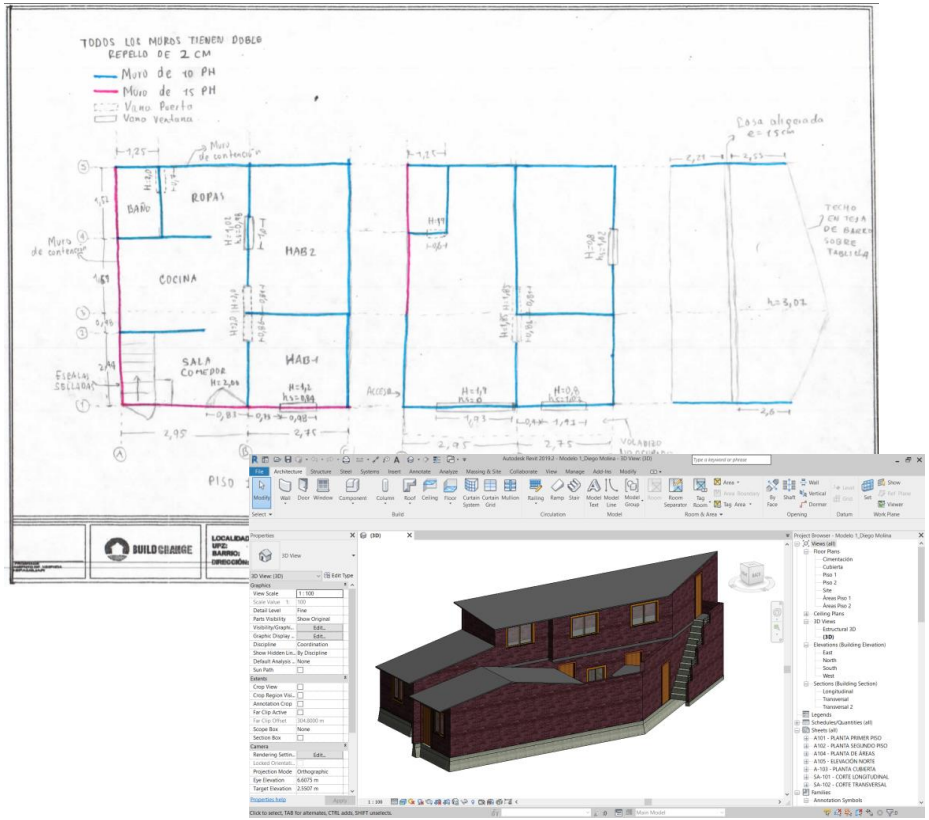
# In the beginning…

Gathering data

Existing house plans drawn manually using pen & paper

- At first, these were transferred to AutoCAD
- After 2017 when our Revit template was developed, the plans were transferred to Revit

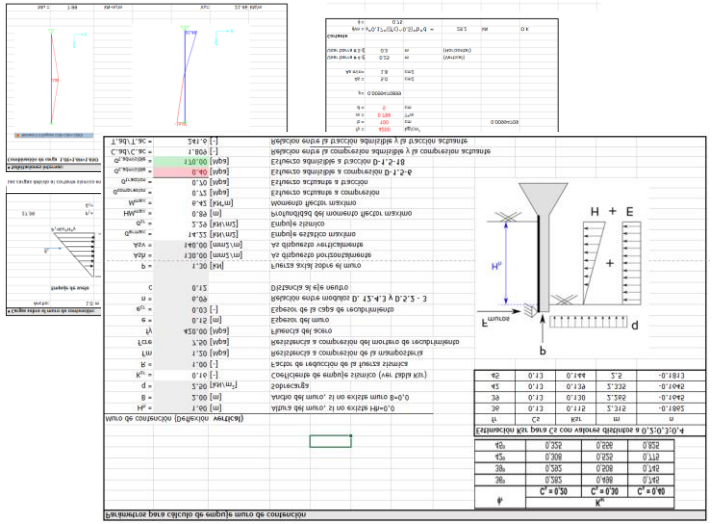
**All plans were drawn twice: by hand and on the computer**



# In the beginning…

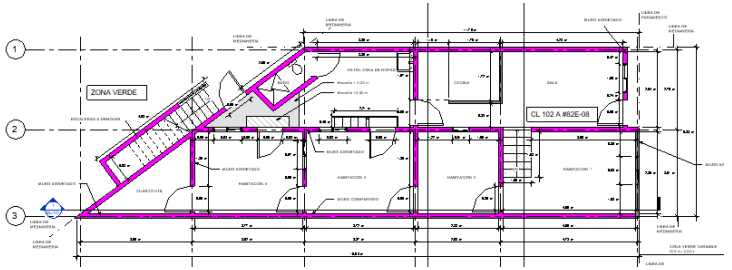
## Engineering calculations

Calculations performed using a series of Excel spreadsheets



Including Wall Area Percentage calculations, requiring many iterations

$$\textbf{Wall Area Percentage} = \frac{Cross\ section\ Wall\ Area}{Area\ of\ the\ House}$$

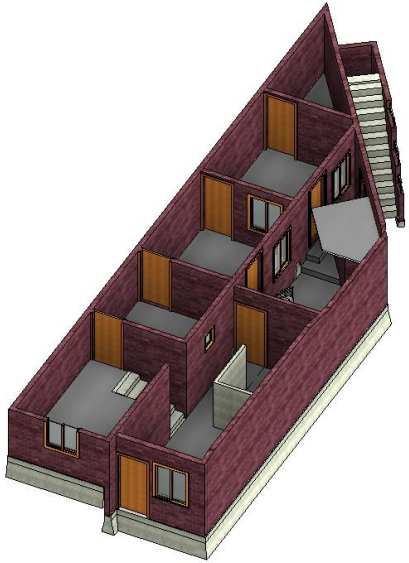


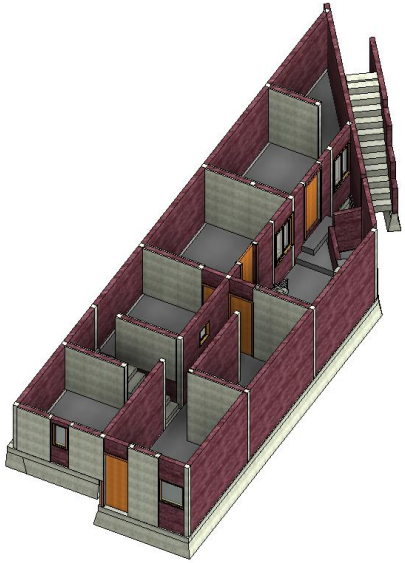

$$Actual\ WAP \geq Required\ WAP$$

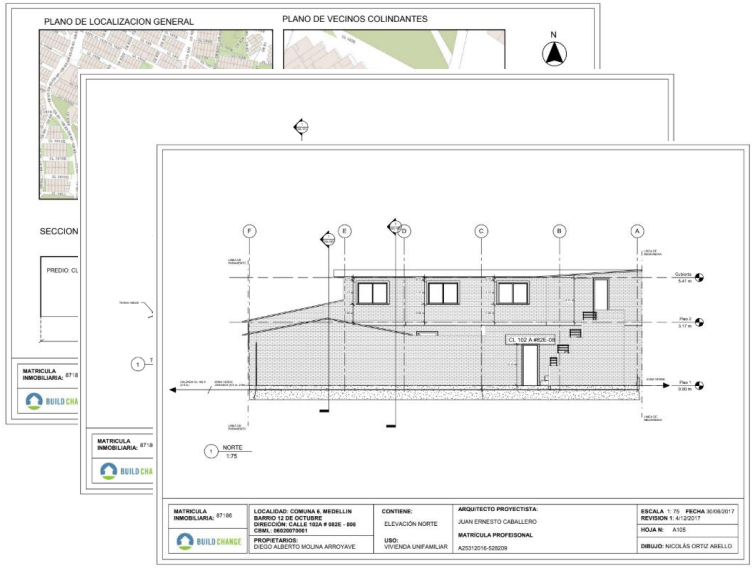
$$Retrofit\ WAP_1$$
$$\vdots$$
$$Retrofit\ WAPx$$

# In the beginning...

Creating the construction package







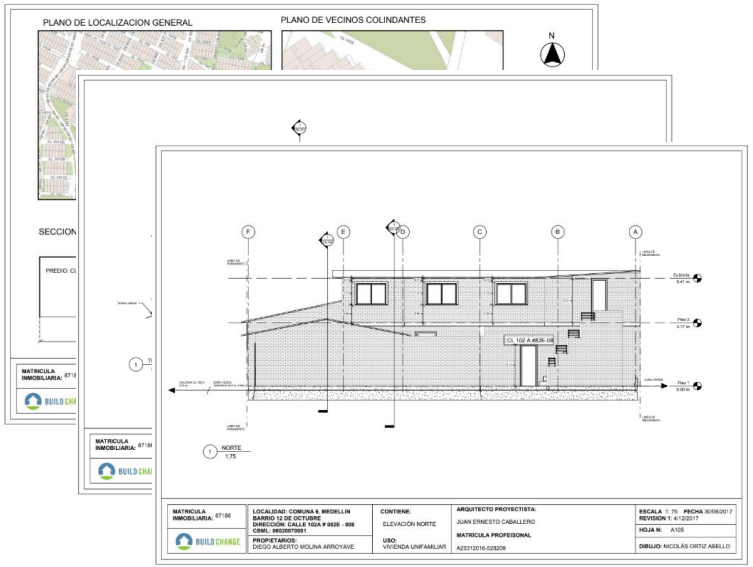

**Existing Model**

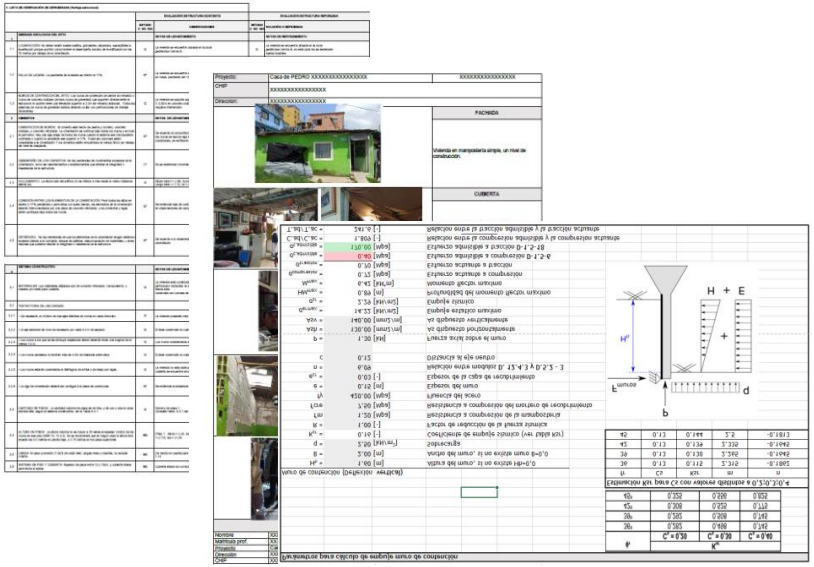
**Retrofit Model**

**Construction Package**

# In the beginning...

Creating the construction package

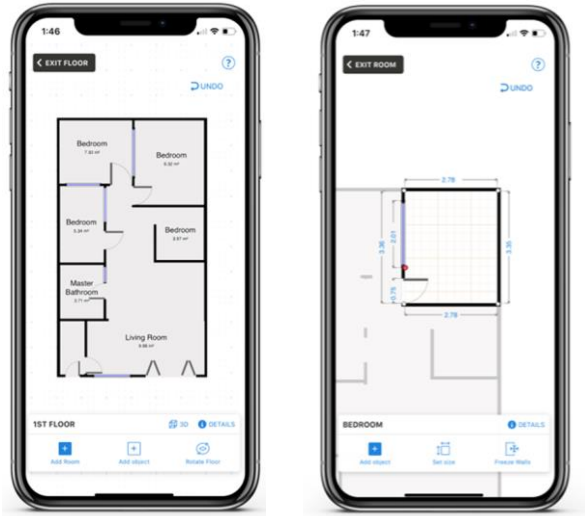


**Construction Package**

# Automated workflow: importing to Revit

Floor plan capture to import

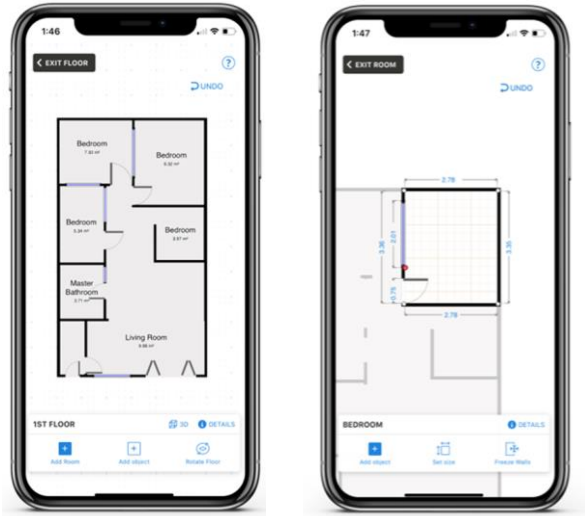



magicplan


Fulcrum

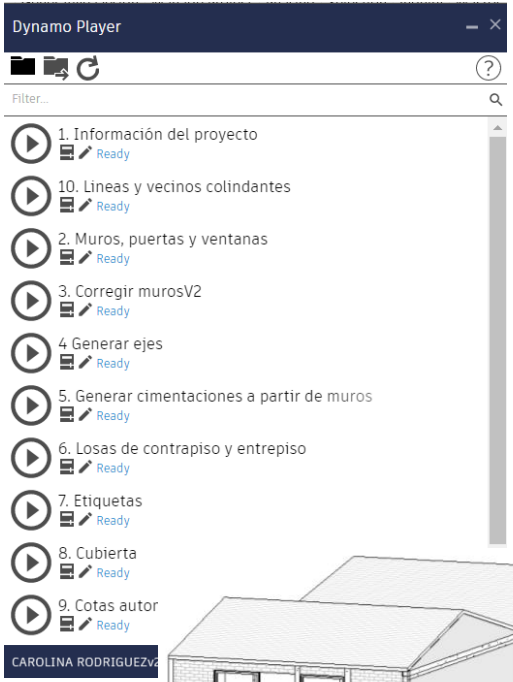
# Automated workflow: importing to Revit

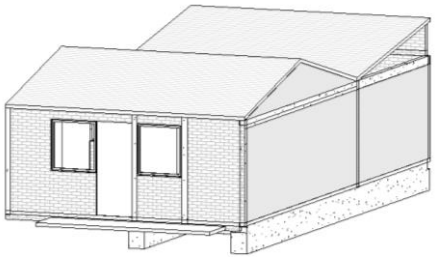
Floor plan capture to import




magicplan

XML



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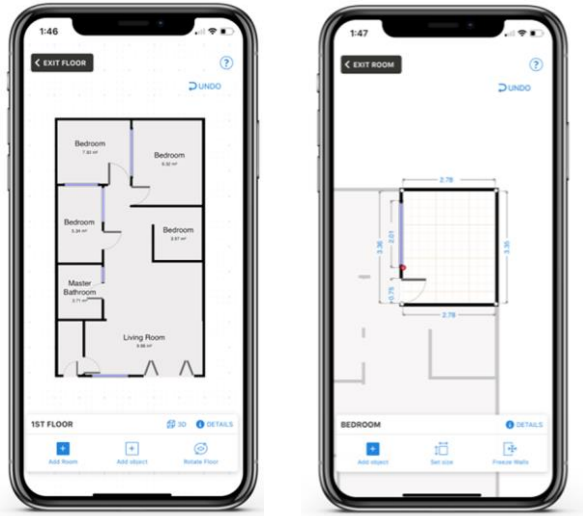


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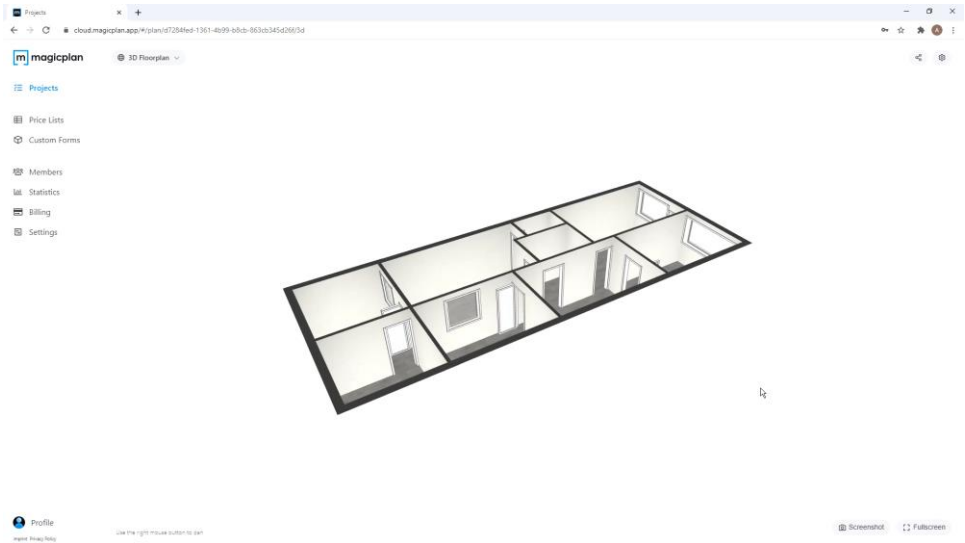
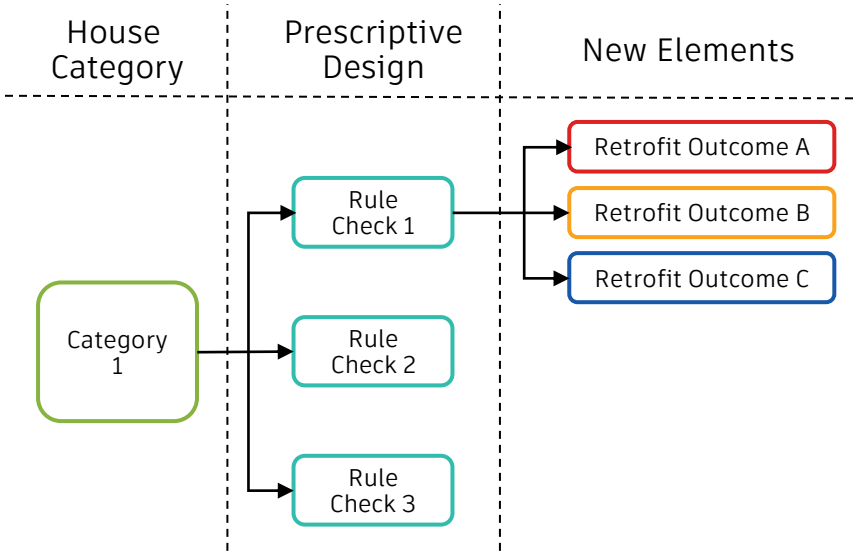


# Automated workflow: retrofitting the house

Modifying and adding new structural elements to the house



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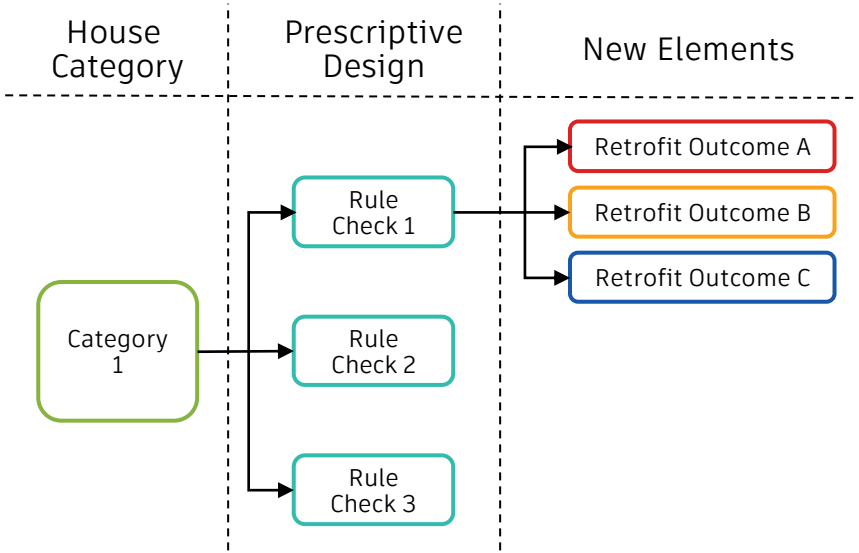
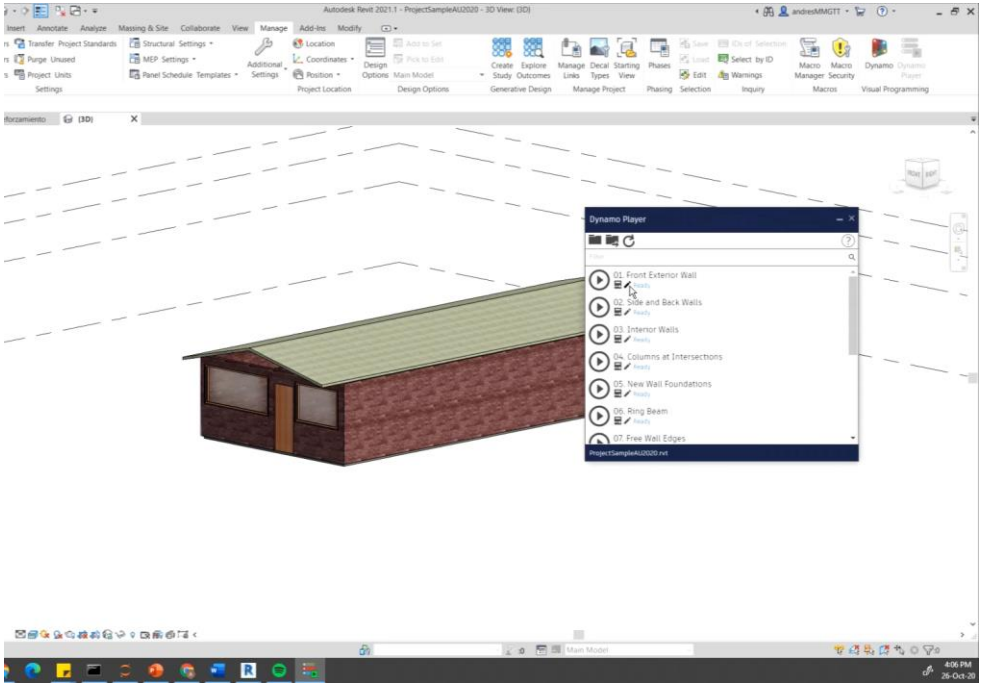
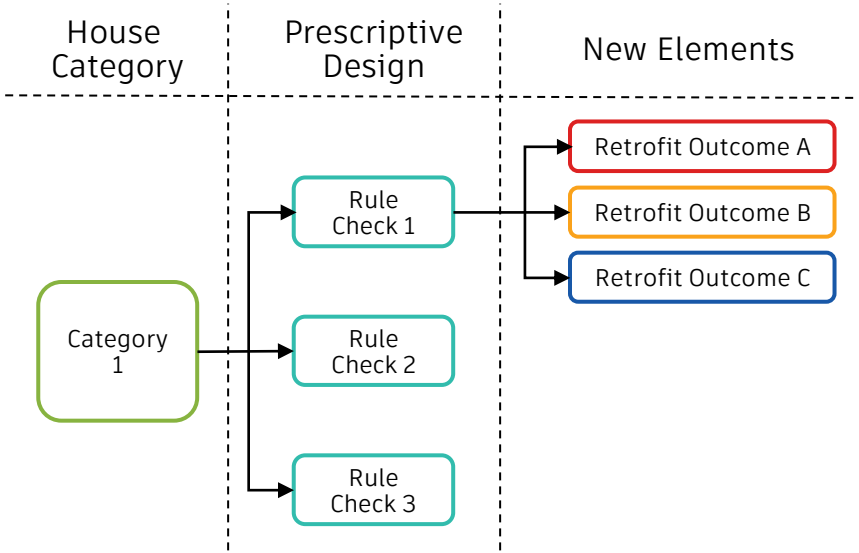


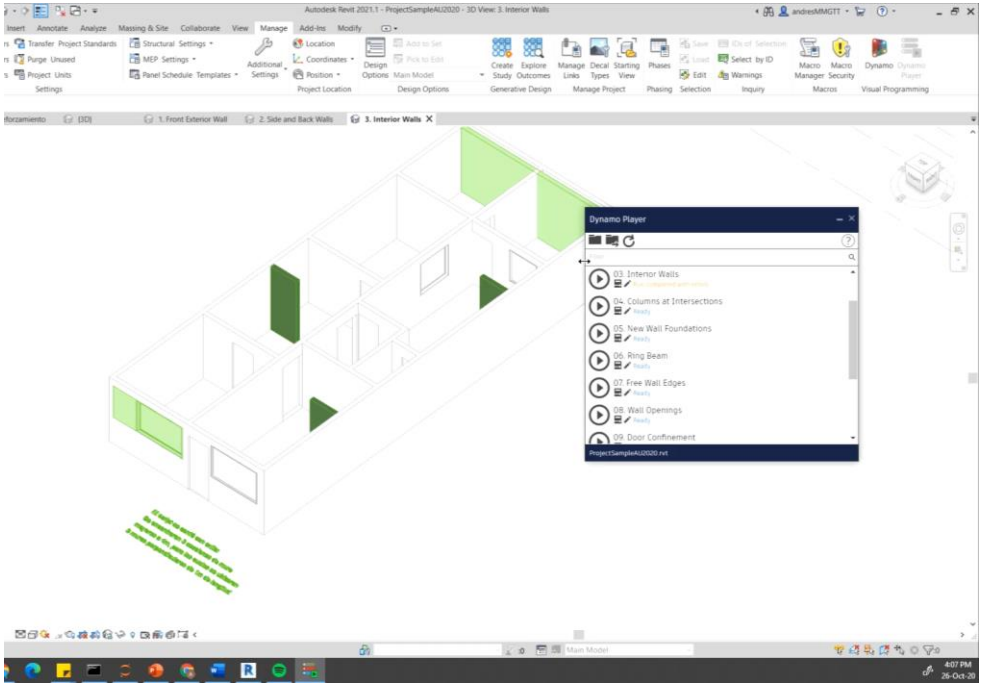




Front exterior wall script

# Automated workflow: retrofitting the house

Modifying and adding new structural elements to the house

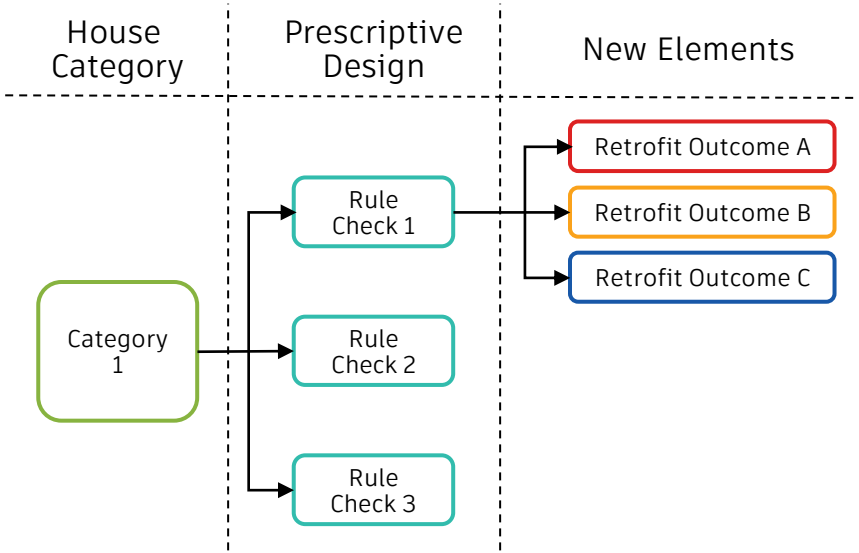


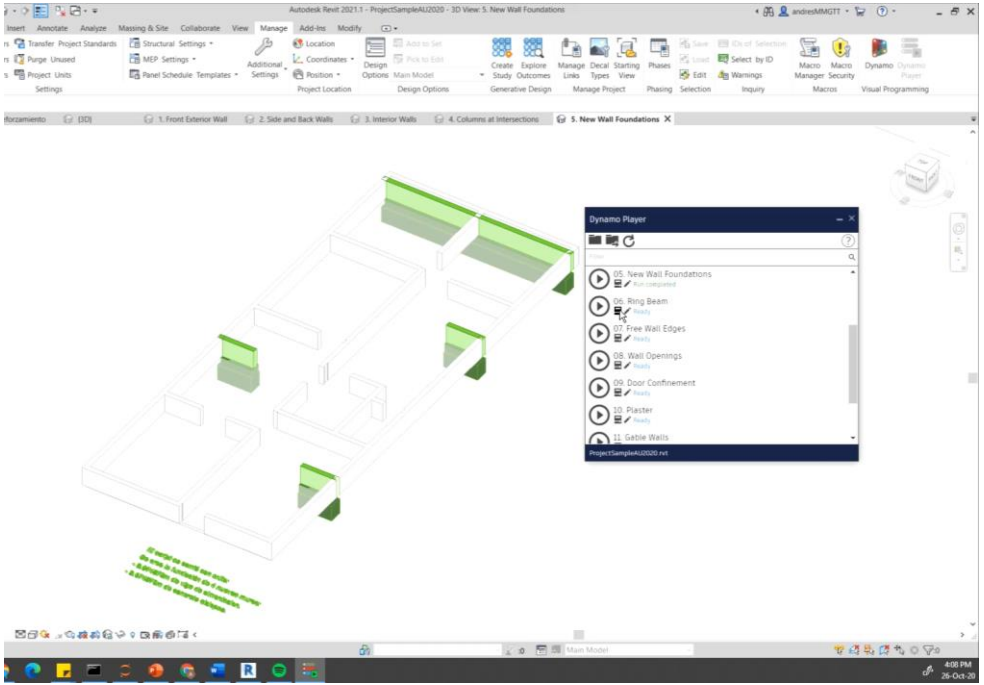




Columns at intersections of new walls script

# Automated workflow: retrofitting the house

Modifying and adding new structural elements to the house

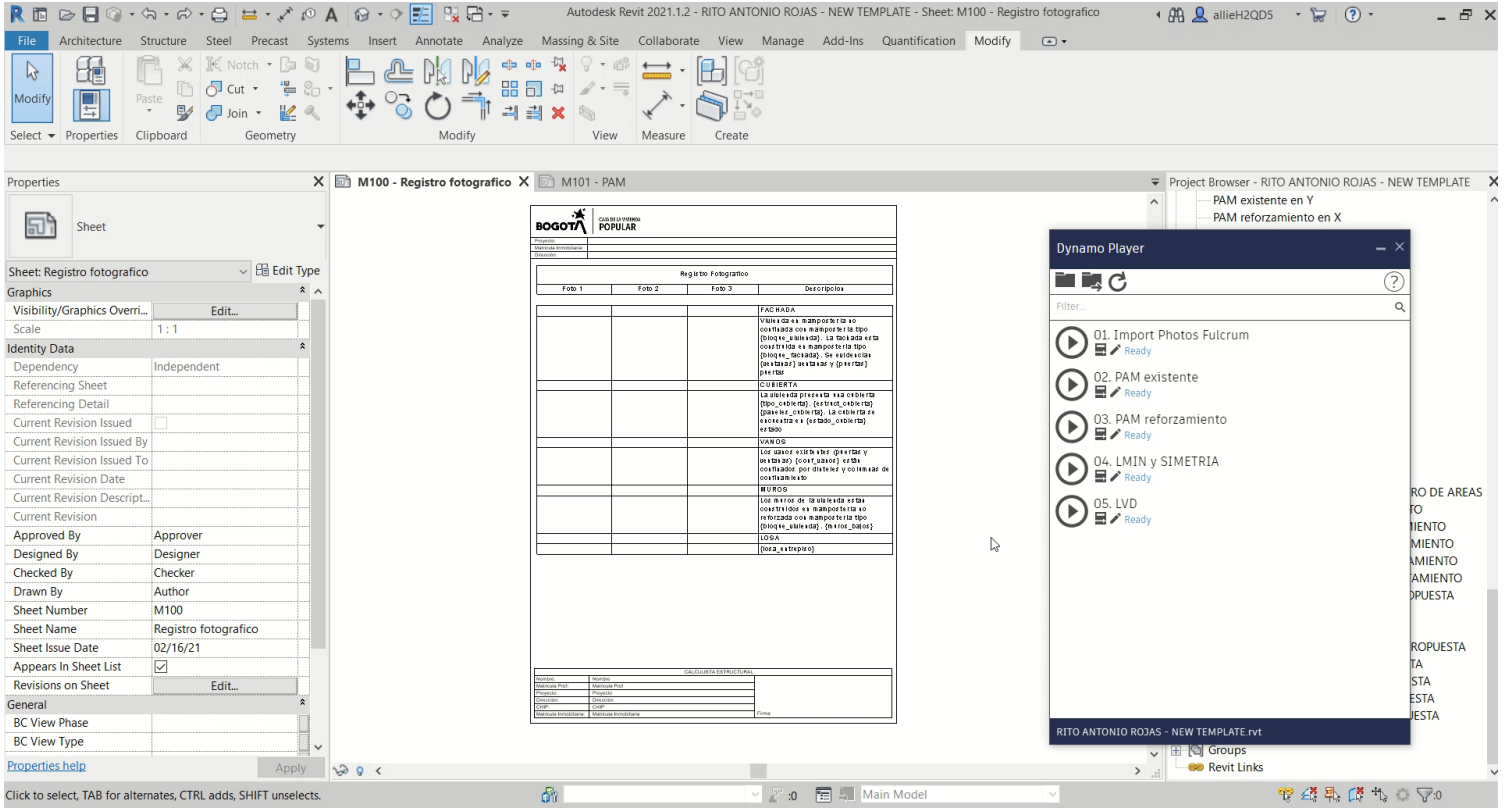



Ring beam and free wall edges scripts

# Automated workflow: retrofitting the house

Interoperating with other platforms & performing calculations automatically



# Future Developments

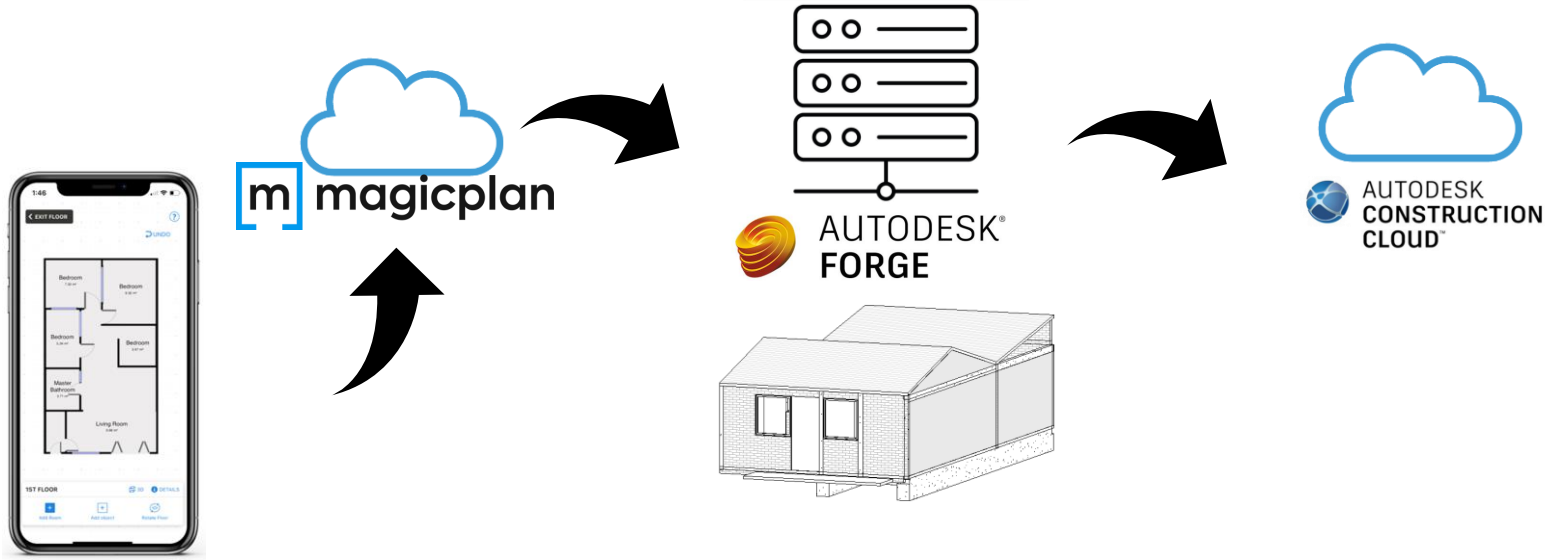
**Goal:**

**A workflow that is automatic and accessible to users with limited Revit experience.**

# Current developments

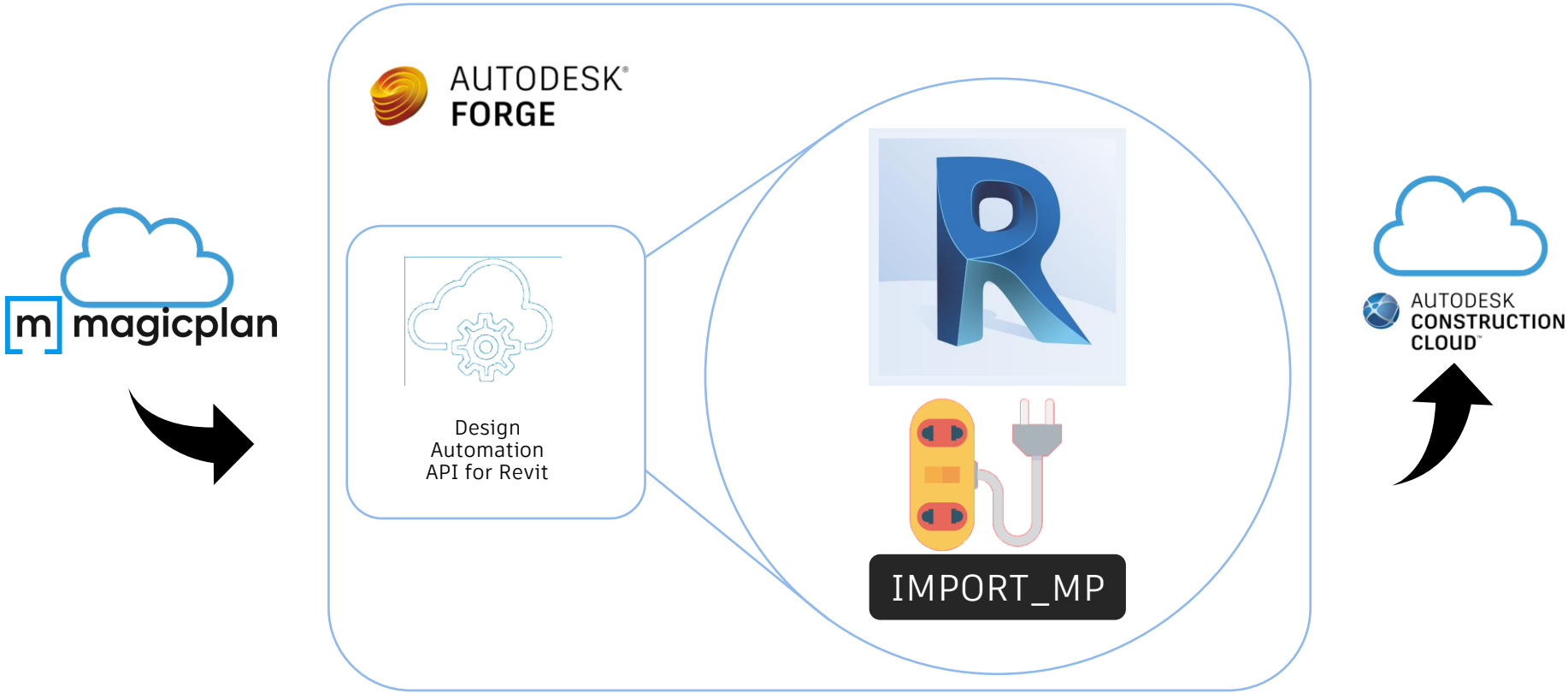
Moving the import process to the cloud

- First implementation of Forge – moving our import process to the cloud, allowing the user to catch errors in the Revit model in the field



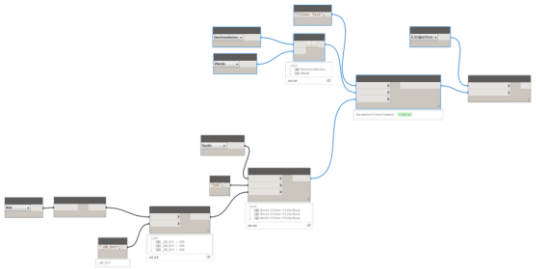
# Current developments

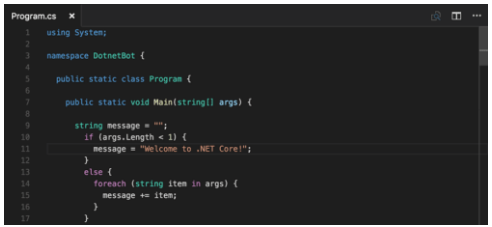
Moving the import process to the cloud



# Current developments

Moving the import process to the cloud

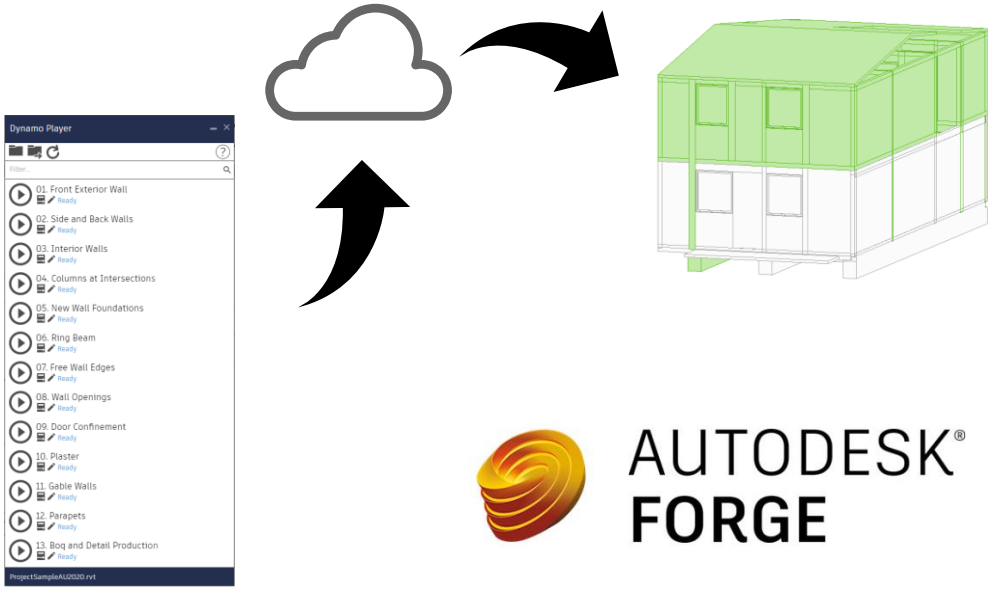




# Next steps…

## Moving more to the cloud

- Moving the automated retrofit workflow into the cloud – allowing users to run the workflow without needing to use Revit



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