Iteration: What is it good for?

(Adapted from the *SCAD Conference* keynote)

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Preface

- Preliminaries
  - Iteration is ubiquitous, not esoteric
  - Likely to contribute to the **core** subject of design process
  - My approach is eclectic (and reflective): you have to connect the dots
- Outline
  - Repetition is iteration's first cousin
  - Iteration examples from limericks, music, and design
  - Lessons learned: what is iteration and what is it good for?

What do you see around you that is repetitive? Why?

- Reasons for repetition in MM- 103 Breed Hall
  - Economies of scale – chairs, windows, students
  - Safety – doors
  - Flexibility – lights
  - Standards – chalkboards, screens

- What about “redundancy” in people?
  - Insurance – arms, feet, fingers, toes, eyes, ears, kidneys, …

And t ecture

But, you are not spending time here to hear the obvious.

- Our subject is: the design process.

  "What is the role of iteration in design cognition or design thinking?"

  Shift: from "repetition" to "iteration," the common term for process.
- I will cover three things
  - Learning from iteration in children's limerick
  - Discovery of a musical "phrase" through iteration
  - Iteration by design experts in architecture
- Will summarize the findings; and you need to connect the dots.

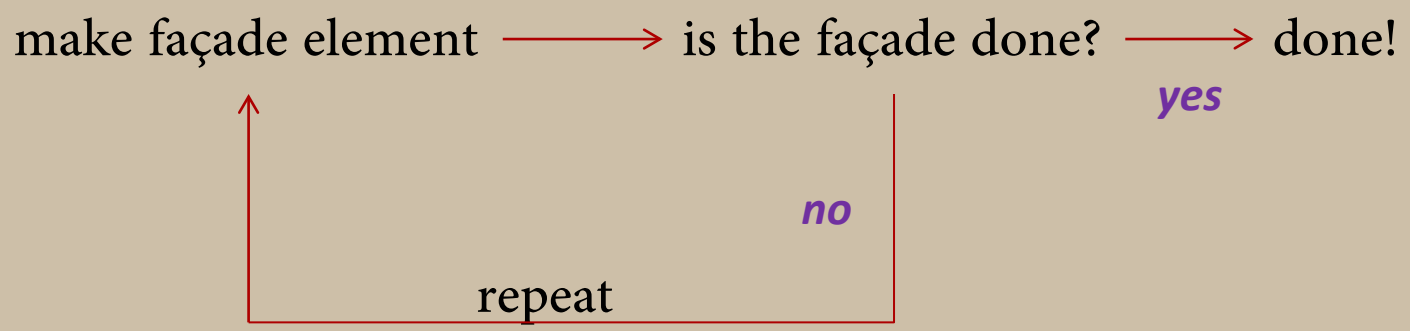
What is Iteration?

- "it•er•ate /ˈ ɪtə ˌreɪt/ [it-uh-reyt], verb, -at•ed, -at•ing
  - *Origin* (latin) "iteratus" = the act of repeating
    1. to utter again or repeatedly;
    2. to do (something) over again or repeatedly;
    3. the act of repeating; a repetition.
  - *Cognitive Science*: Procedure applied to the result of a previous one, as a means of obtaining successively closer approximations to the solution of a problem.

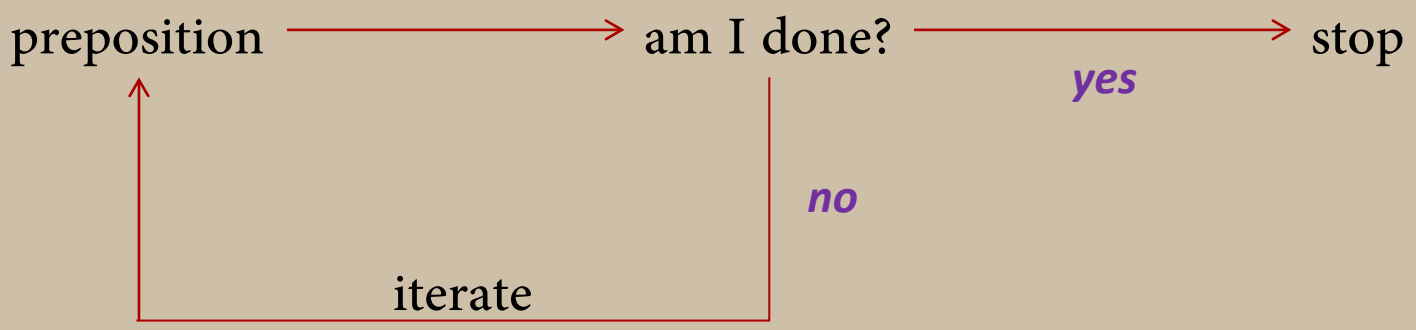
Anatomy of Iteration:

repeating successively for closer approximations to the solution of a problem

for a facade



in general

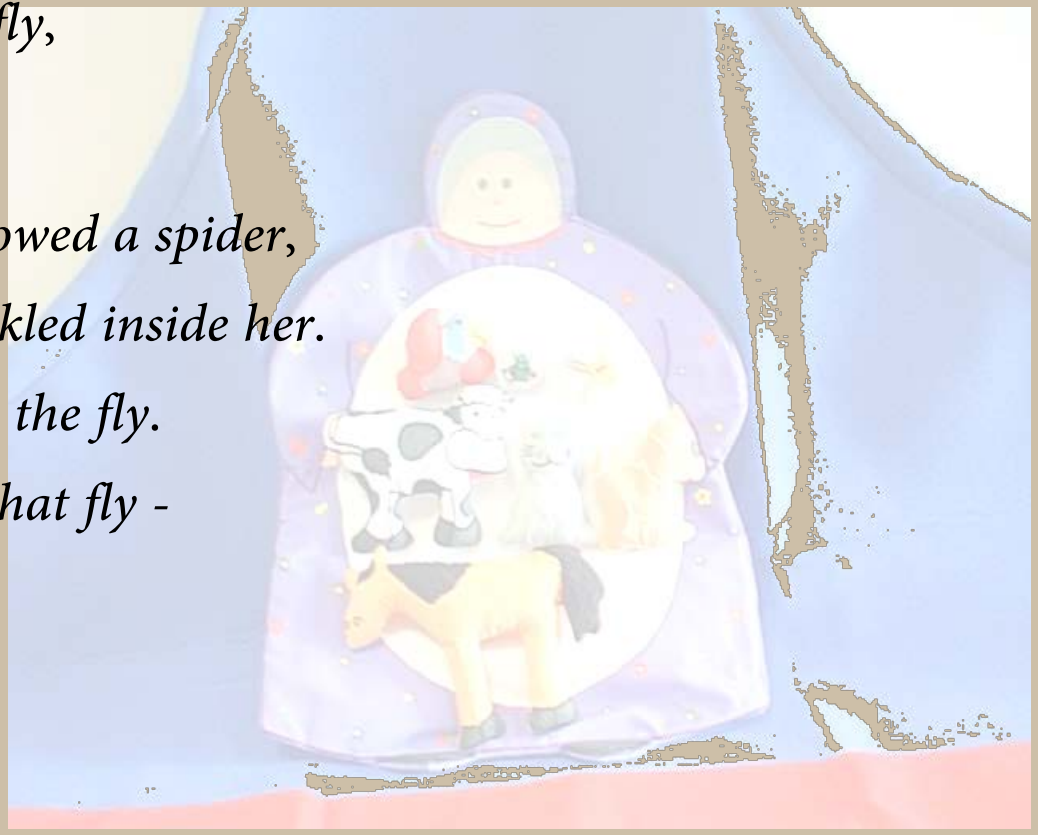


Learning from iteration in children's limerick

Children's limerick: *Old Lady Who Swallowed a Fly.*

There was an old lady who swallowed a fly.
I dunno why she swallowed that fly,
Perhaps she'll die.

There was an old lady who swallowed a spider,
That wiggled and wiggled and tickled inside her.
She swallowed the spider to catch the fly.
But I dunno why she swallowed that fly -
Perhaps she'll die.



Children's limerick: *Old Lady Who Swallowed a Fly.*

(***continued***)

There was an old lady who swallowed a bird;

How absurd, to swallow a bird!

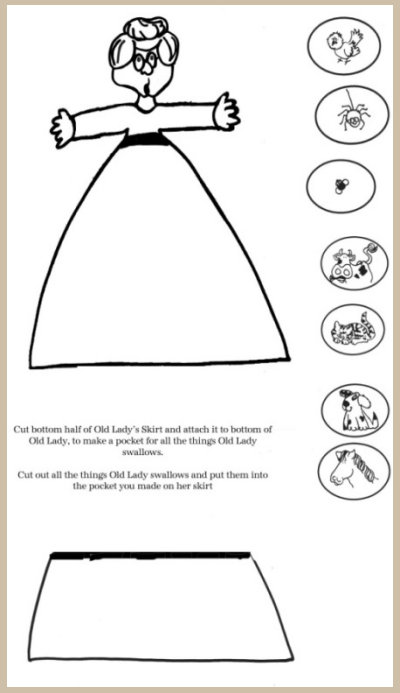
She swallowed the bird to catch the spider

That wiggled and wiggled and tickled inside her.

She swallowed the spider to catch the fly.

But I dunno why she swallowed that fly -

Perhaps she'll die.



Children's limerick: *Old Lady Who Swallowed a Fly*.

There was an old lady who swallowed a cow.

I don't know how she swallowed a cow!

She swallowed the cow to catch the goat

She swallowed the goat to catch the dog

She swallowed the dog to catch the cat

She swallowed the cat to catch the bird

She swallowed the bird to catch the spider

OK, we get the point, we have iteration: first the fly, then the spider, the bird, the cat, the dog, the goat, and the cow…. then what?

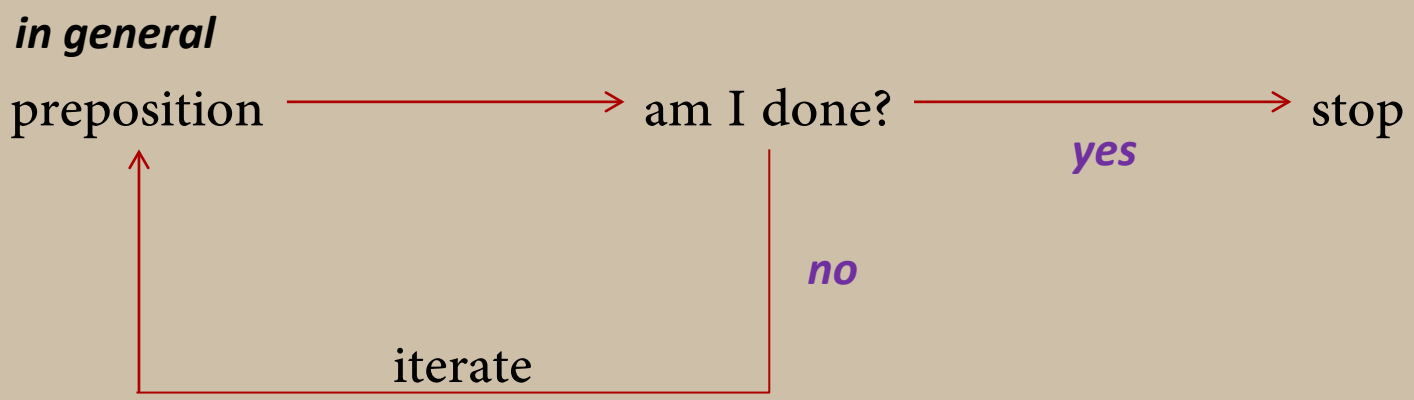
Children's limerick: *Old Lady Who Swallowed a Fly*.

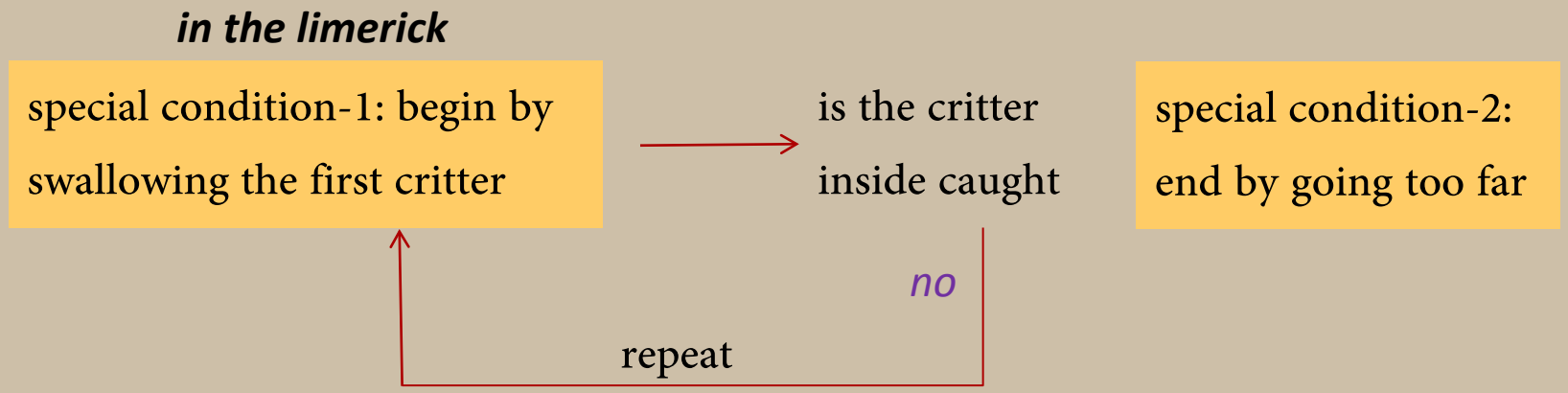
The iterative structure used in the poem is relentless but sets up the priceless finale:

There was an old lady who swallowed a horse

She's dead, of course.

Children's limerick: *Old Lady Who Swallowed a Fly.*

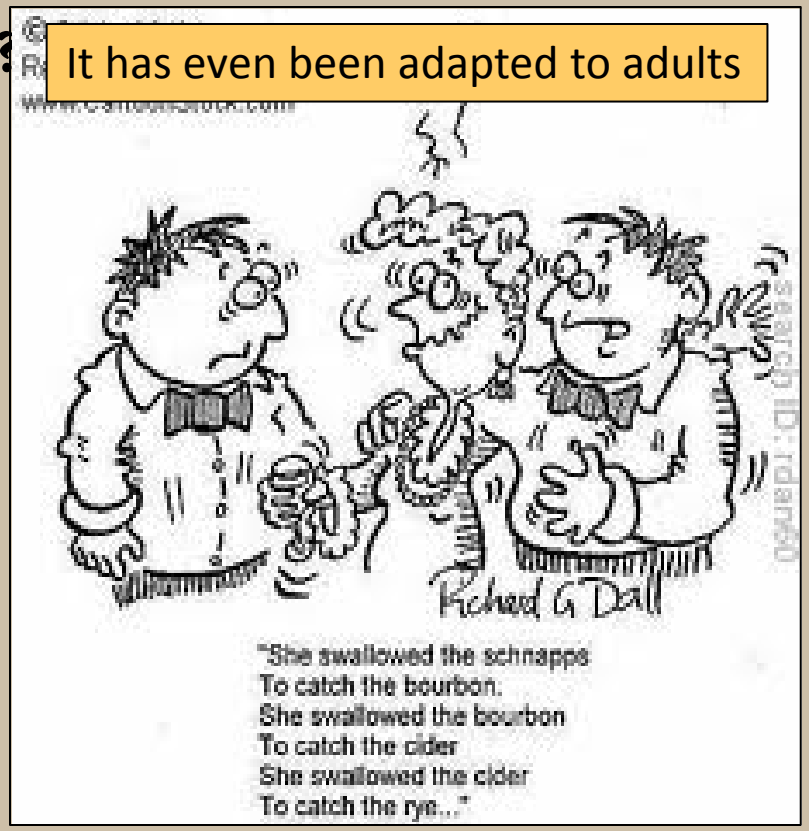




Children's limerick: *Old Lady Who Swallowed a Fly.*

Why is this <u>children's</u> limerick useful?

- It **simplifies** content that would be too **complex,** at the end, for a child
- It does this by performing **successive approximations**
- It establishes hierarchy: placing **detail** within **context**
- It provides a repeated structure – for **familiarity**
- It **teaches** about animals, taking risks ...

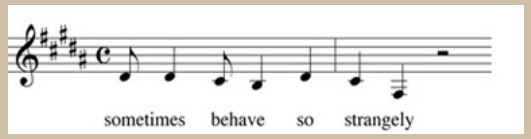


Discovery of a musical “phrase” through iteration

Discovery of a musical "phrase" through iteration

The Speech to Song Illusion (or transforming the problem)

- Deutsch, Diana (2008) "Relationship of Speech and Song" *The 156th Meeting of the Acoustical Society of America*, Miami, Florida, November 10-14, 2008.
- Accidental, infinite loop LISTEN: Sound Demo 1.
- Spontaneous transformation from speech to song LISTEN: Sound Demo 2.



Discovery of a musical "phrase" through iteration

The Speech to Song Illusion (S2SI)

- Prof Deutsch found that "S2S Plasticity" is sensitive to:
  - jumbling of syllables (no melody is perceived),
  - the LACK of repetition (no melody is perceived)
  - transposition of repetition (no melody is perceived),

Iteration by design experts in architecture

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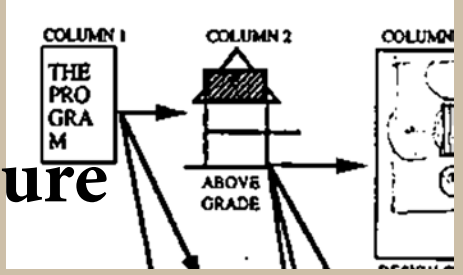
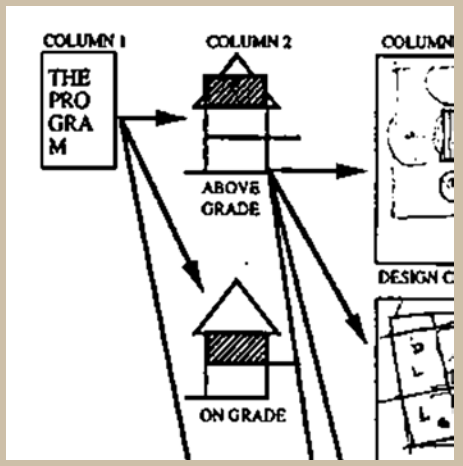
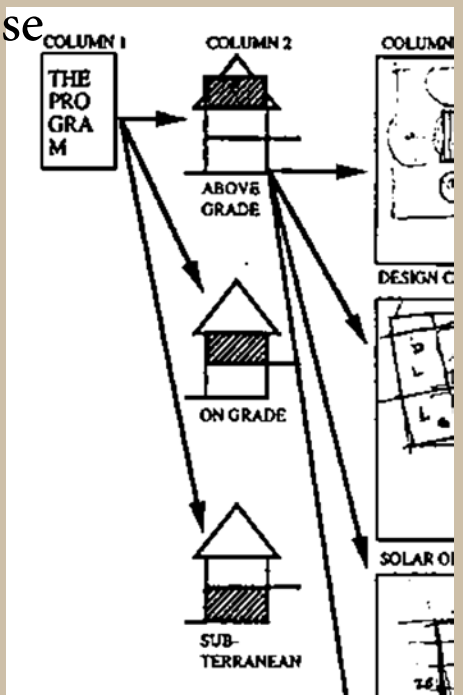




Iteration Type One: In the beginning, find many, alternative starting points.

- What is the role of many starting points in the solutions space?
- In the example of acarriage-house design problem these alternative starting points are:
  - Place carriage house over existing garage
  - Place carriage house under existing garage
  - Place carriage house in place of existing garage



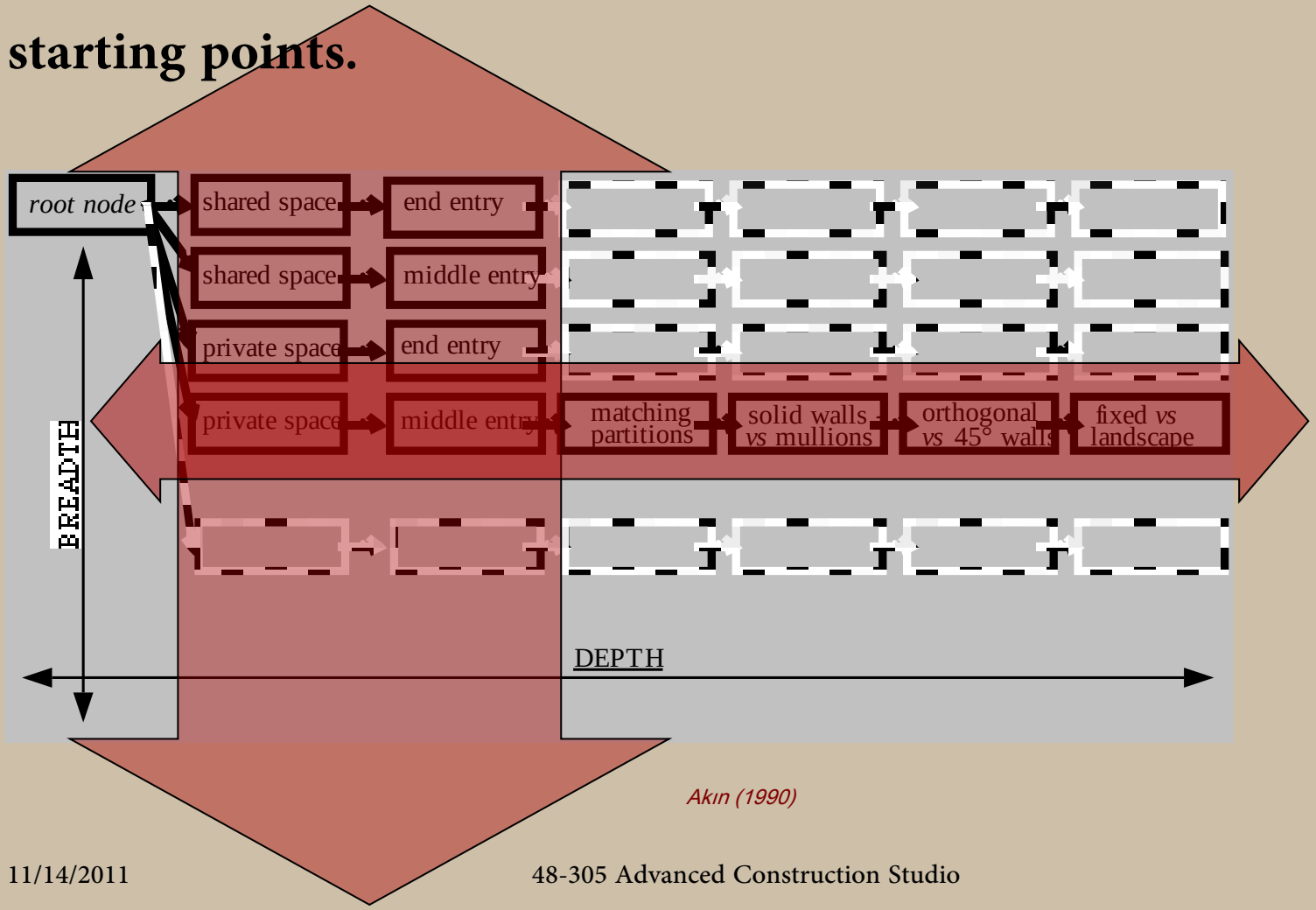
Iteration by design experts in architecture

Iteration Type One: In the beginning, find many, alternative starting points.

- Observe that the designer, thinking in breadth, considers each alternative laterally and then develops one (placing the carriage house on top) in depth, or vertically, through several detailed issues, like orientation, geometry, layout organization, and *plan parti*.
- In another layout design problem experts display similar **breadth-first-depth-next** search with different top-level design options: *location of entrance* and *private versus shared space*

Iteration by design experts in architecture

Iteration Type One: In the beginning, find many, alternative starting points.

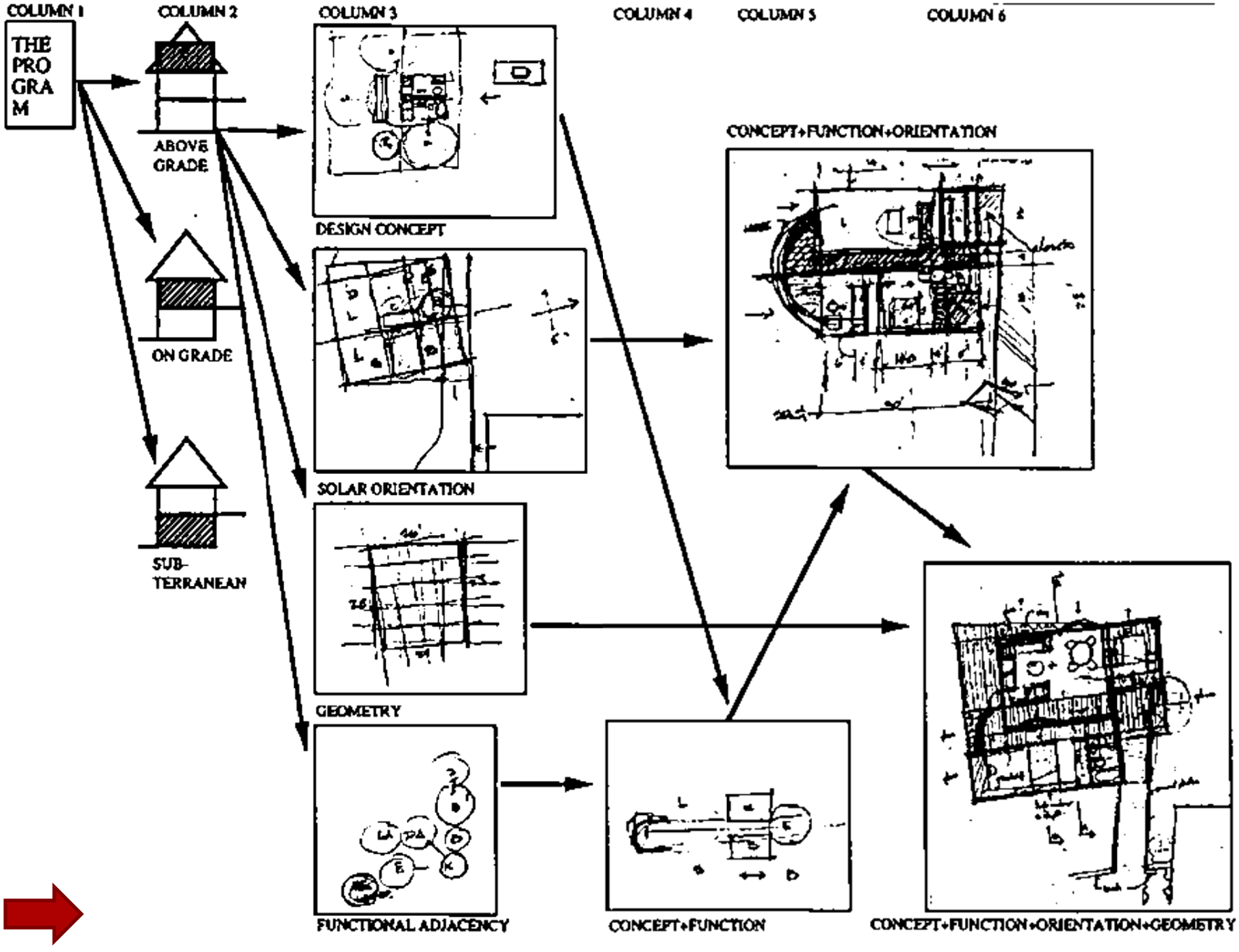


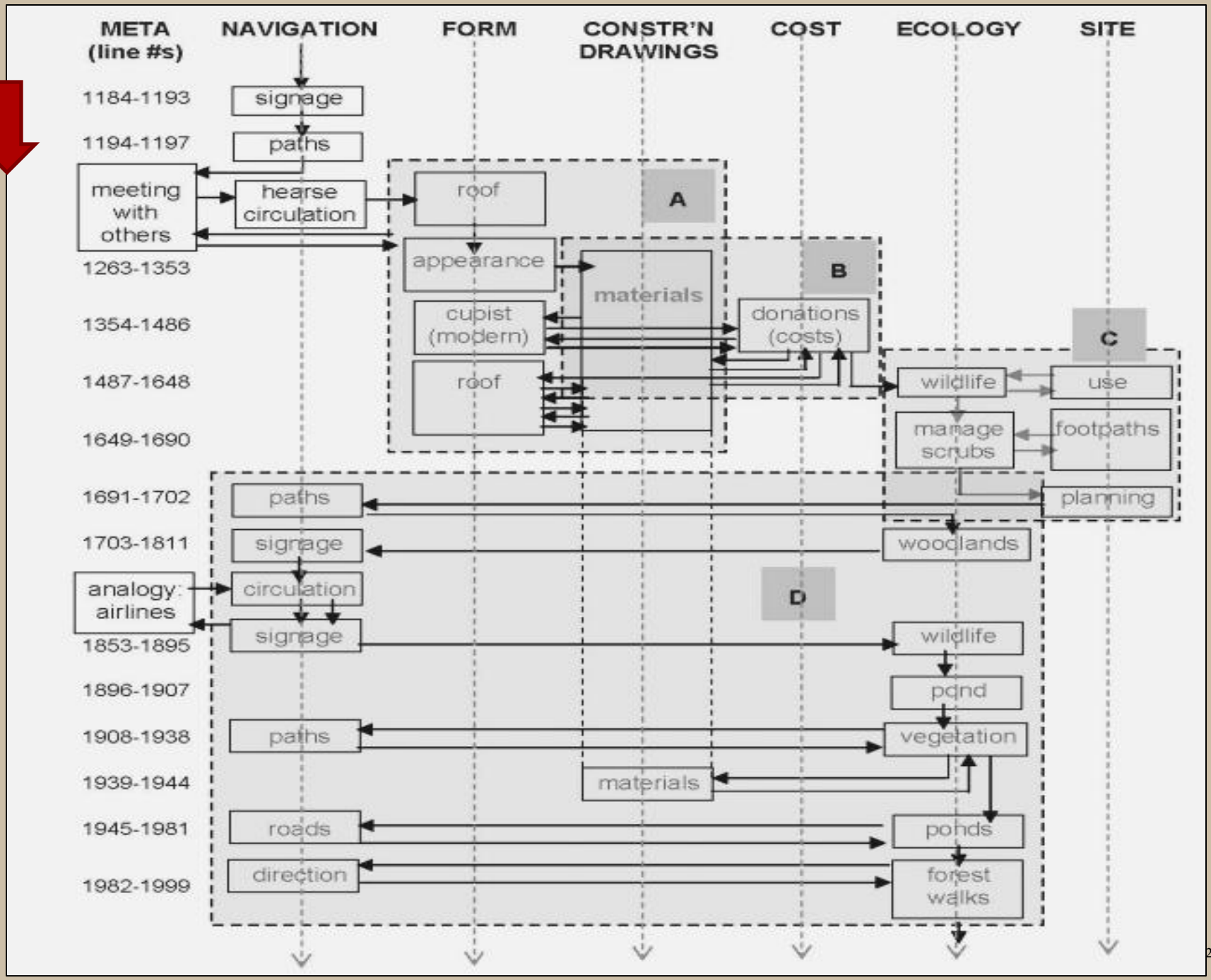
Akın (1990)

Iteration by design experts in architecture

Iteration Type Two: In middle design, exploring with the Simple to Reach the Complex

Question-2: With the limitations of the STM, and the myriad of design issues – which may include *orientation*, *geometry*, *layout organization*, and *plan parti or concep*t, etc. – can targeted solutions to such design aspects be taken to their successively approximate comprehensive solution, all at once? Or, do designers use a piecemeal approach that accumulates partial solutions into complete ones?


COLUMN 1
COLUMN 2
COLUMN 3
COLUMN 4
COLUMN 5
COLUMN 6
THE PRO GRA M
ABOVE GRADE
ON GRADE
SUB-TERRANEAN
DESIGN CONCEPT
SOLAR ORIENTATION
GEOMETRY
FUNCTIONAL ADJACENCY
CONCEPT+FUNCTION+ORIENTATION
CONCEPT+FUNCTION
CONCEPT+FUNCTION+ORIENTATION+GEOMETRY


META (line #s)
NAVIGATION
FORM
CONSTR'N DRAWINGS
COST
ECOLOGY
SITE
1184-1193
signage
1194-1197
paths
meeting with others
hearse circulation
1263-1353
roof
A
appearance
materials
B
1354-1486
cubist (modern)
donations (costs)
C
1487-1648
roof
wildlife
use
1649-1690
manage scrubs
footpaths
1691-1702
paths
planning
1703-1811
signage
woodlands
analogy airlines
circulation
D
1853-1895
signage
wildlife
1896-1907
pond
1908-1938
paths
vegetation
1939-1944
materials
1945-1981
roads
ponds
1982-1999
direction
forest walks

Iteration by design experts in architecture

Iteration Type Three: In the end, finishing after looking at many solutions–

Question-1: How many solutions are needed? In other words, how many times a designer should attempt before terminating design (either a solution or a dead-end is found); each iteration being a full cycle of picking a starting point and carrying out successive approximations until none needs to be carried out?

Iteration in Design Cognition

Iteration Type Three: In the end, finishing after looking at many solutions–

Design protocol experiment in which subjects solved one of three different sites with varying levels of difficulty. Say:

- **Place carriage house over existing garage**
- **Place carriage house under existing garage**
- **Place carriage house in place of existing garage**

- They found many distinct solutions before settling down to one.

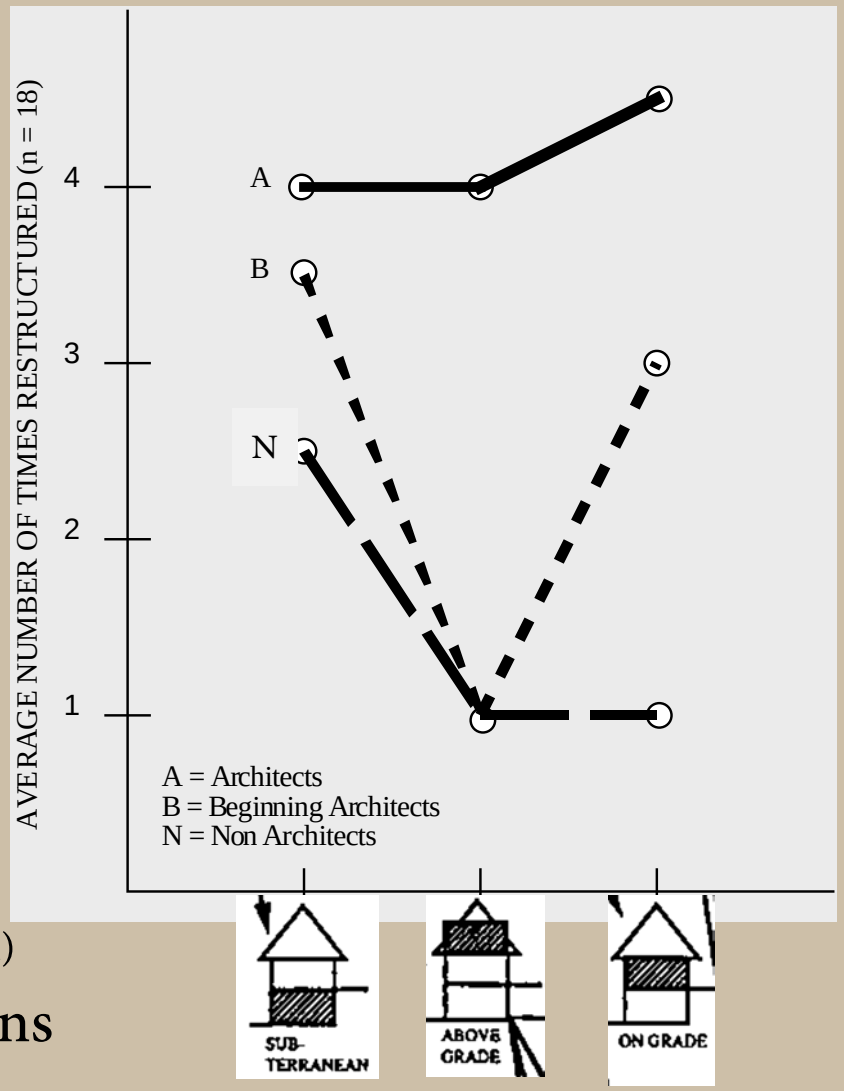
Iteration in Design Cognition

Iteration Type Three: In the end, finishing after looking at many solutions –

- Participants:
  - Non-architect (N)
  - Beginner/student (B)
  - Expert Architect (A)

$I_{(Architect)} > I_{(Beginner)} > I_{(Non\text{-}arch)}$

where I is the number of iterations



Take-away: Notes On the Anatomy of Iteration

- **Iteration at Large**
  - It helps approximate a solution through repetition; reach complexity through simple steps; and achieve precision through detailing in phases
- **In Architectural Design**
  - Experts consider many alternative beginning options
  - Experts manage design complexity by pairwise (three-way) integration
  - Experts decide on a solution after finding many alternative solutions
- Process and Product Dependency: iteration-based *designing* leaves iteration-based marks in *designs*
- Designer's Cognitive Mechanisms: in the ease of learning, *designing* is cognized by the same iterative information processors as are *designs*

Iteration: What is it good for?

One thing is for sure: It is good for learning.

QUESTIONS?