



Optimizing Building Layouts with BIM Minimizing Walking Distances

@BoostYourBIM
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Speakers

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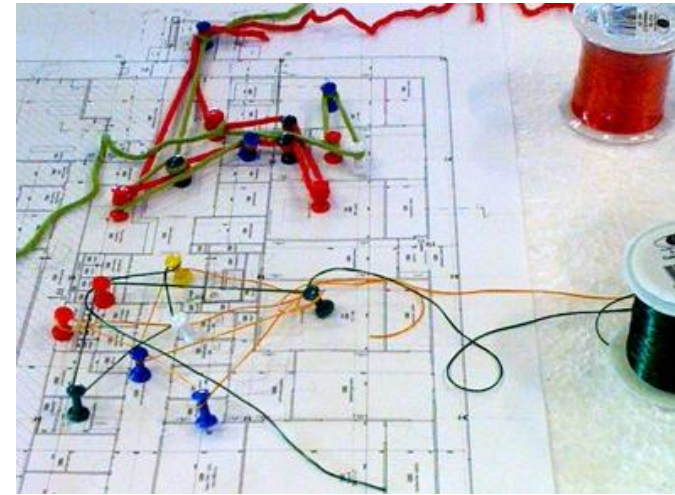
Stantec



Boost Your BIM

Industry Challenge: Make Hospitals More Efficient

“Unlike warehouses... it is very difficult to make dramatic changes to a hospital once it is built.” - Kaizen Institute

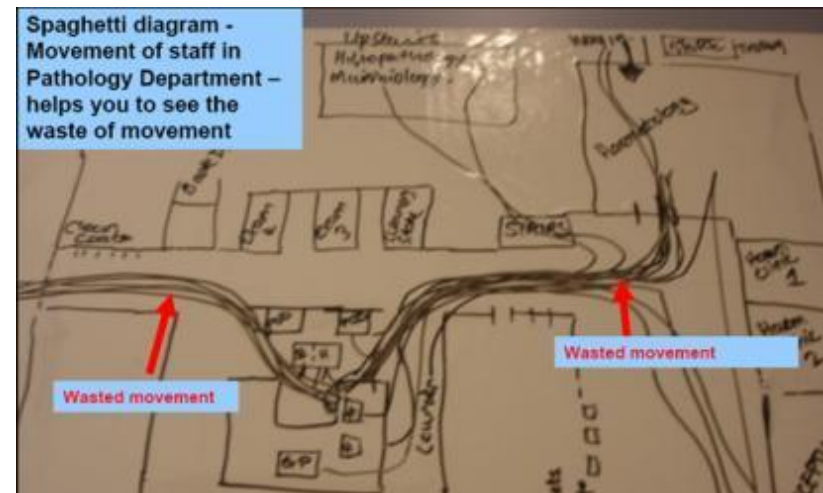


Children's Hospital of Saskatchewan

Goal to reduce walking time by 50%

Virginia Mason Hospital

*Reduced “people travel distance”
by 44%*



Previous Workflow

While slightly more accurate, electronic manual solutions are error prone and take substantial labor.

The screenshot displays a BIM software interface with a floor plan on the left and a data table and comments list on the right. The floor plan includes areas labeled 'STERILE CORE', 'STERILE CORE AREA', 'OPERATING ROOM', 'CAL SUITE', 'SCRUB BAY ALCOVE', and 'STRETCHER ALCOVE'. A red arrow points from a comment in the 'Comments List' to a specific location on the floor plan. Another red arrow points from a table entry to a location on the floor plan.

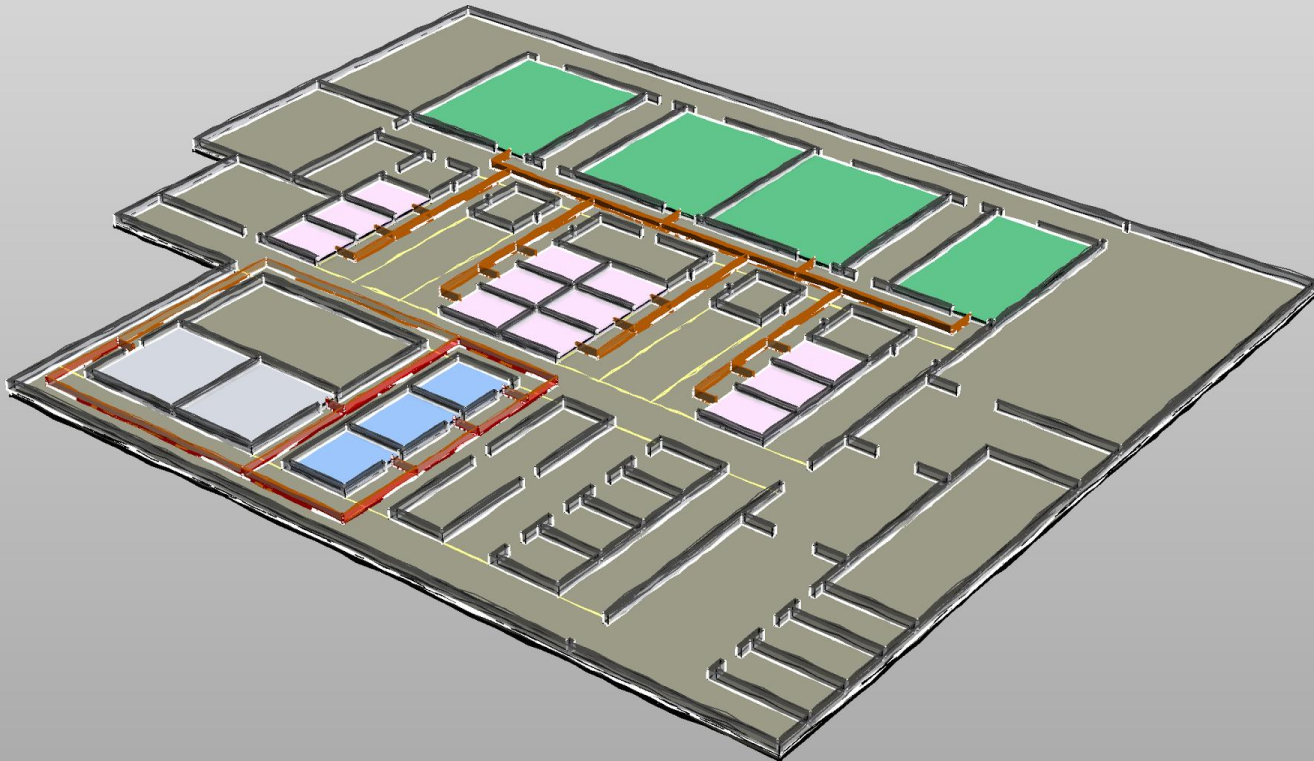
ID	Parent	Subject	Measurement	X	Y
2	ZUBIEZRQVYRXIEBM	301.10 PBay PARR		30.8668 in	4.8788 in
3	TOZISLUZQYSJMXD	301.11 PBay PARR		30.8668 in	6.0580 in
4	DCQVQCXFIPOYUQUC	301.8 PBay PARR		29.2909 in	4.4038 in
5	RLOPVCNRJOTMHKME	301.9 PBay PARR		30.4745 in	4.4037 in
6	QIEBXXJGJRZTPHTX	301.12 PBay PARR		30.8668 in	7.2348 in
7	YQVFPYKZGALVOO	301.15 PBay PARR		30.8668 in	10.7831 in
8	DCGDBSWCOHPVMQSY	301.16 PBay PARR		30.8668 in	11.9555 in
9	TMLYDHBJOJJKYIR	301.13 PBay PARR		30.8668 in	8.4131 in
10	MUJCLCUBNZWOCMLJ	301.14 PBay PARR		30.8668 in	9.6006 in
11	EHQNHECVIBCWHQEZ	301.7 PBay PARR		28.1154 in	4.4038 in
12	ESLYBYRQHGCMFMX	301.2 PBay PARR		27.6667 in	13.1444 in
13	EYPUAPTBDQOZDQUI	301.3 PBay PARR		27.6667 in	11.9595 in
14	PRWFNNSYLCNSMFEJT	301.20 PBay PARR		29.2636 in	12.2522 in
15	WJWYVGDGCFQDMGRXY	301.10 PBay PARR		27.6667 in	14.3271 in
16	DFRHVTXIDQLAHSNW	302.2 PStretcher Negative PARR		26.6749 in	10.3439 in
17	VQULNNOONSXMDZOK	301.6 PBay PARR		27.6667 in	6.0536 in
18	FFCMLGOICRDLQOBX	302.1 PStretcher Negative PARR		26.4533 in	4.3746 in

Comments List (34)

- Page 2 11/22/2011 12:04:54 PM
Actual 208.9 to Star 2
72.1 m
- Page 2 11/22/2011 12:18:09 PM
84.0 m
- Page 2 11/22/2011 12:07:32 PM
102.0 m
- Page 11/22/2011 12:23:49 PM
26.0 m
- Page 2 11/22/2011 12:06:11 PM
53.0 m
- Page 2 11/22/2011 12:20:14 PM
73.4 m
- Page 2 11/22/2011 12:21:27 PM
64.8 m
- Page 2 11/22/2011 12:04:13 PM
81.7 m

Our Goal:

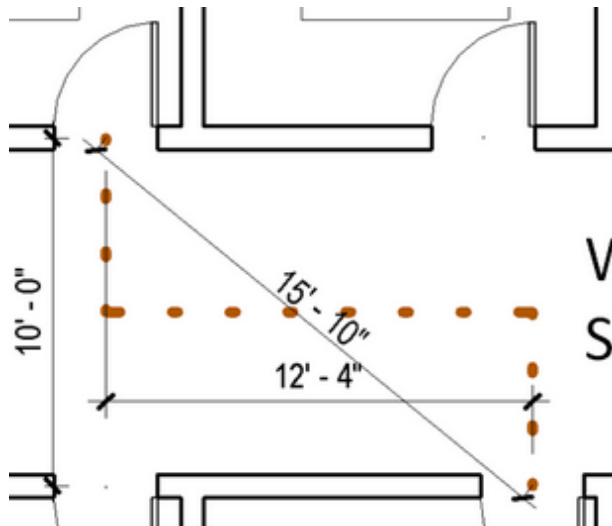
Allow designers using BIM to optimize building design and reduce walking distances in a new hospital



Stantec / Boost Your BIM “PathFinder” Project

Client required measurements showing an efficient corridor circulation system for key paths of travel.

- Compute distances between multiple rooms
- Compare walking distance with straight-line distance
- Follow “walking rules”

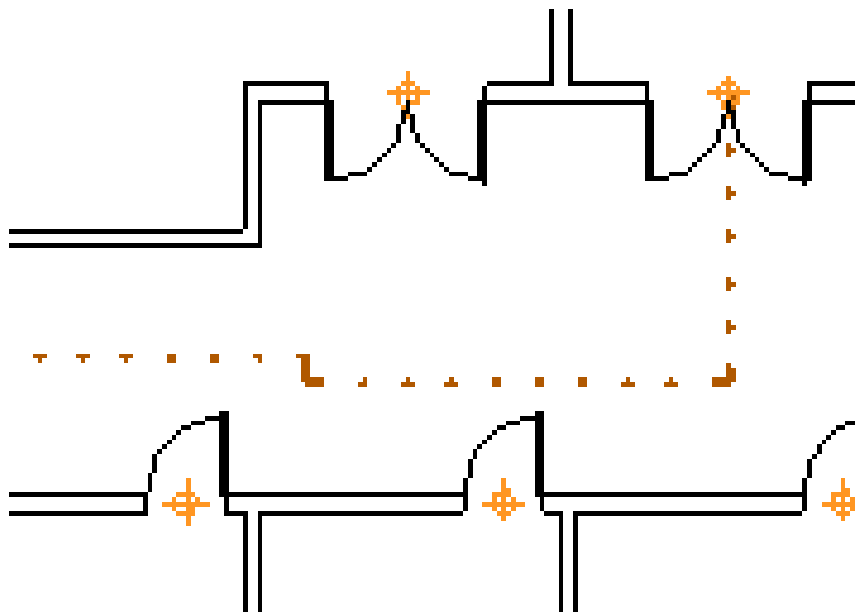


Walking Distance: 22' 4"

Straight-Line Distance: 15' 10"

Measurement Rules from Client

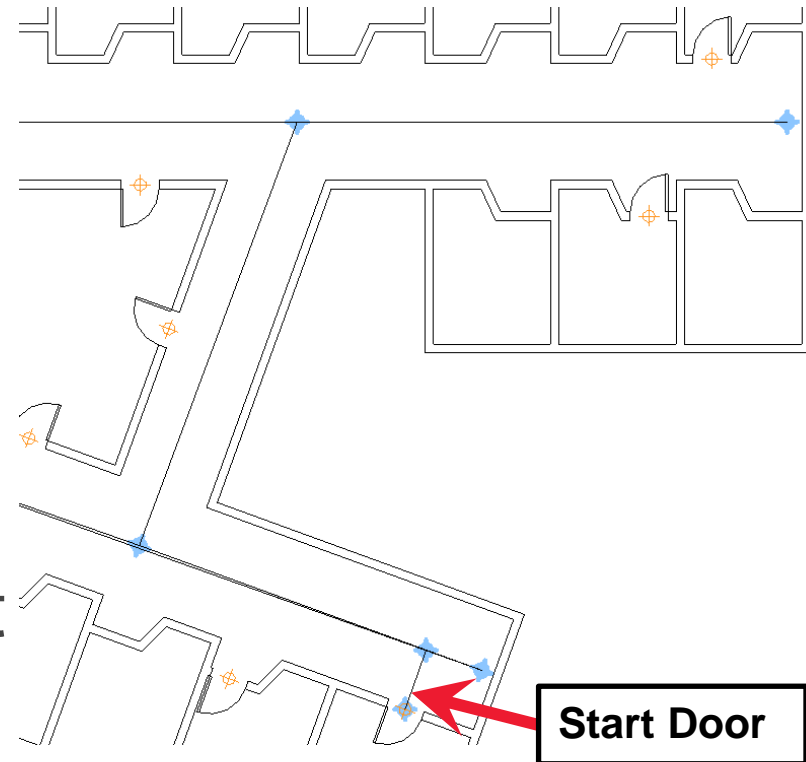
- Paths measured along the center of corridors
- Paths start and end at door centers
- Remain at least 1200mm from the wall
- Travel through sterile zones is prohibited



Where is the center of this corridor?

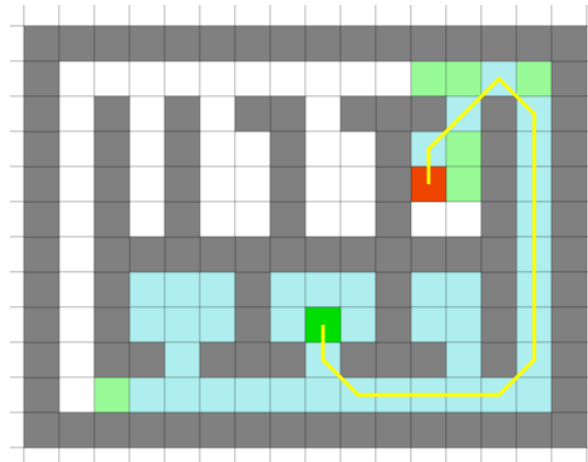
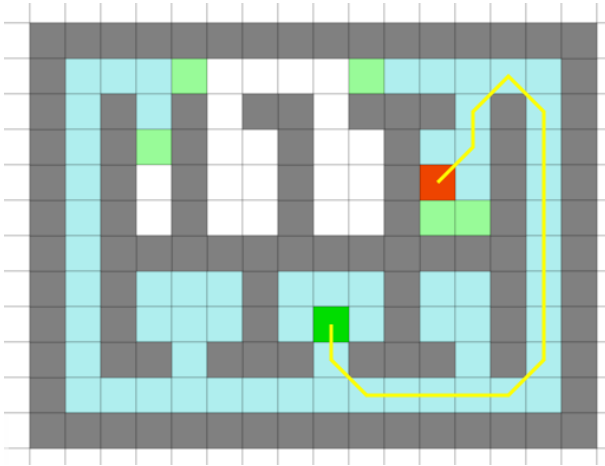
Read BIM data to build path network

- Find all pairs of rooms, for example:
 - *From every Critical Care Room to every Imaging Room*
- Find doors & “points of entry”
- Find all walls & doors in corridors
- Get data about spaces (is it sterile?)



Finding the Shortest Path...?

<http://qiao.github.io/PathFinding.js/visual/>



Select Algorithm

A*

Heuristic

- Manhattan
- Euclidean
- Chebyshev

Options

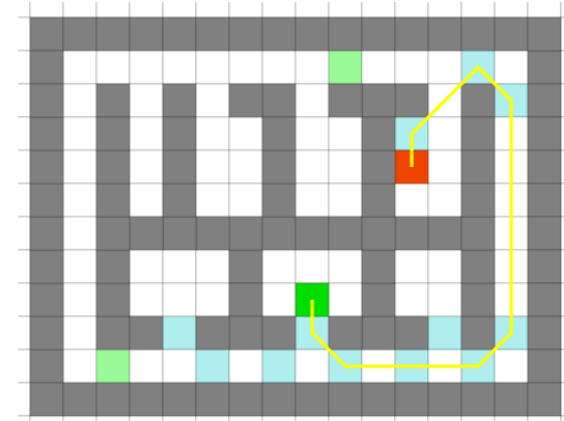
- Allow Diagonal
- Bi-directional
- Don't Cross Corners
- Weight

Breadth-First-Search

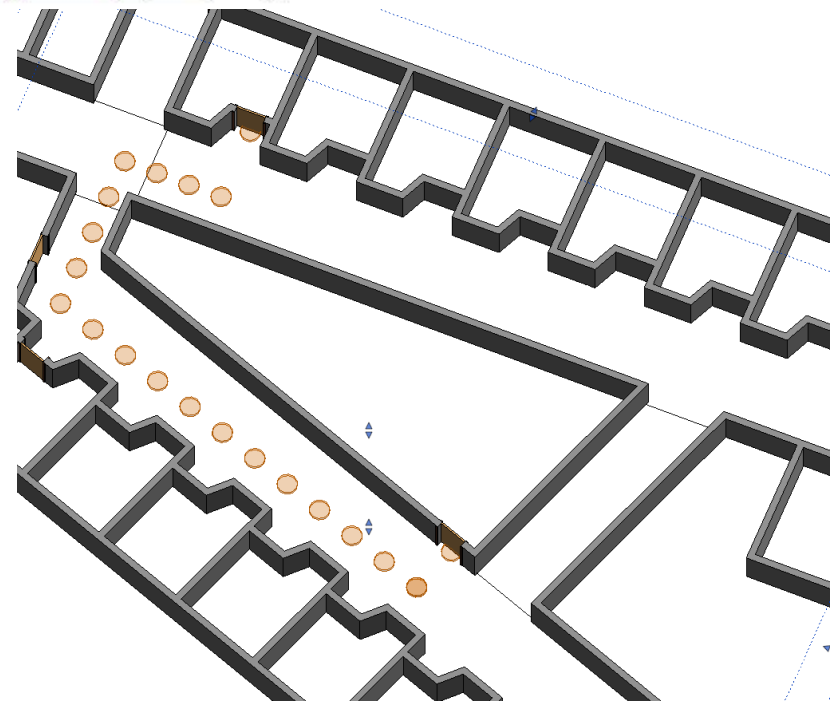
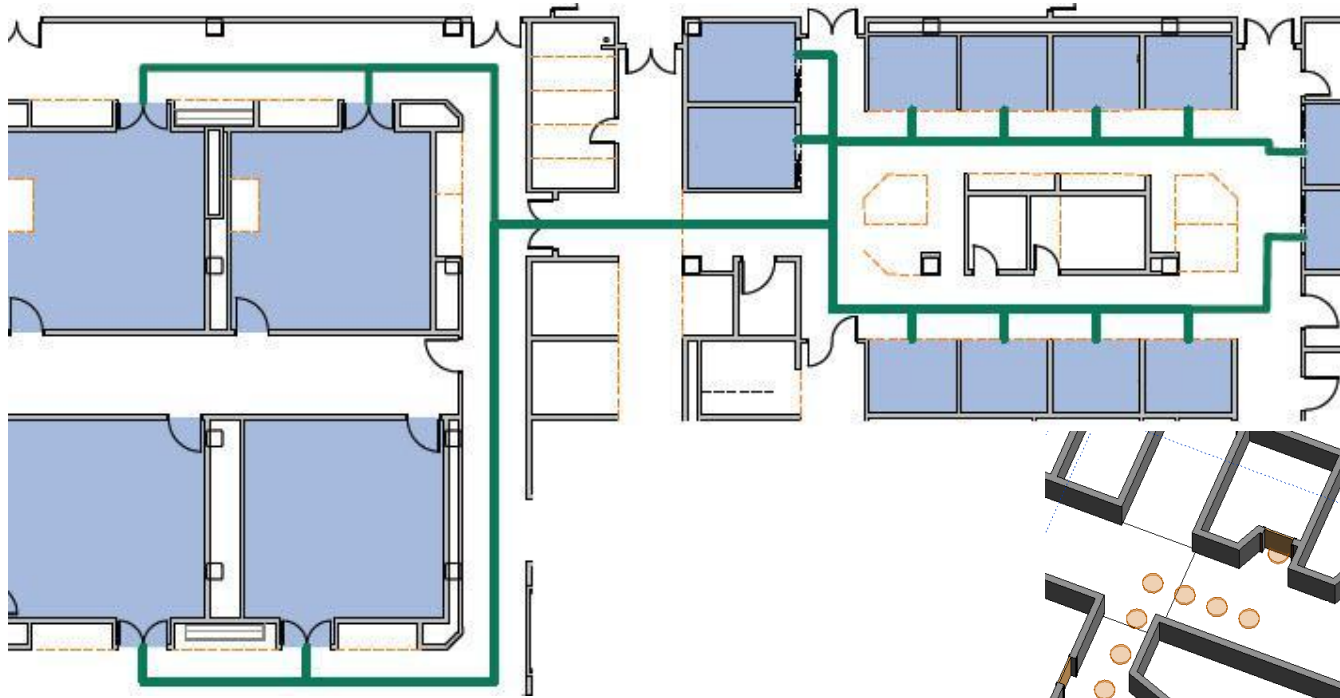
Best-First-Search

Dijkstra

Jump Point Search



Graphic Results



Tabular Results

	A	B	C	D	E	G	H	I
1	Rule ID	Rule Name	Start Room	End Room	Actual Design Distance	Actual + Penalty	Euclidian Distance	Corridor Efficiency
2	003	Surgery OR's to PARR	CRH-DT04-35	CRH-DT04-09.01	37.28	37.28	25.78	0.69
3	003	Surgery OR's to PARR	CRH-DT04-35	CRH-DT04-09.02	40.23	40.23	28.93	0.72
4	003	Surgery OR's to PARR	CRH-DT04-35	CRH-DT04-09.03	43.43	43.43	32.12	0.74
5	003	Surgery OR's to PARR	CRH-DT04-35	CRH-DT04-09.04	46.89	46.89	35.68	0.76
6	003	Surgery OR's to PARR	CRH-DT04-35	CRH-DT04-10.01	39.39	39.39	26.57	0.67
	003	Surgery OR's to PARR	CRH-DT04-35	CRH-DT04-10.02	36.94	36.94	27.78	0.70

48.25	Average Actual	33.14	Average Euclidean
	Corridor Efficiency	68.68%	
	Travel Efficiency	63.36	Lower = 3.75 points
	RFP Min:	101.00	
	RFP Max:	88	
	Tech Submission was	41.55	
	December 05 was	65.03	
	7-Jan	63.69	

Other Potential Applications

Airports, where people walk from

- Entrance to gate
- Gate to baggage claim / customs / tram
- Tram to gate

Campus Planning

Educational/Research Buildings

- Classroom Buildings
- Lab Buildings

Life Safety

- Farthest from stair exit
- Total exit travel distance

Key Take-aways

Think of BIM as more than software that can count elements, measure areas, and keep data consistent across multiple views.

Seek opportunities to analyze the building and better understand how it will be used to better meets your clients' goals.

Consider extending BIM with API solutions