



AECの分野での今後のAutodeskの クラウドサービスの展望

原田 美佳子
AEC シニアマネージャー デベロッパ テクニカル サービス

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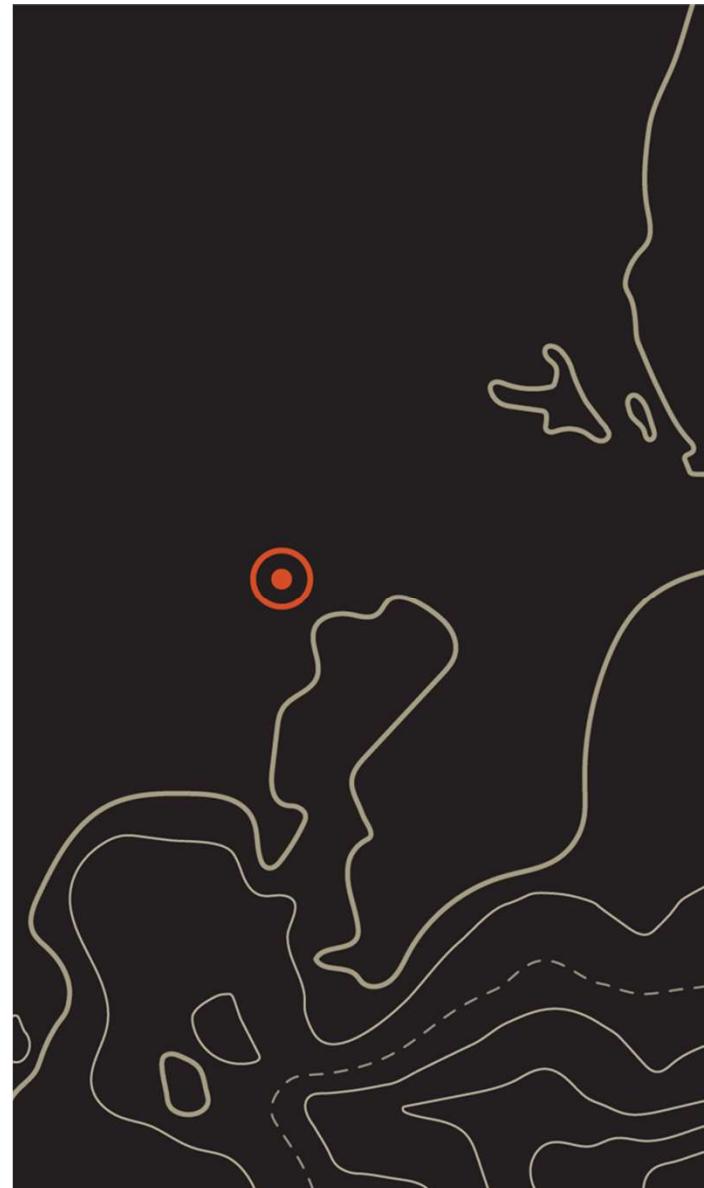
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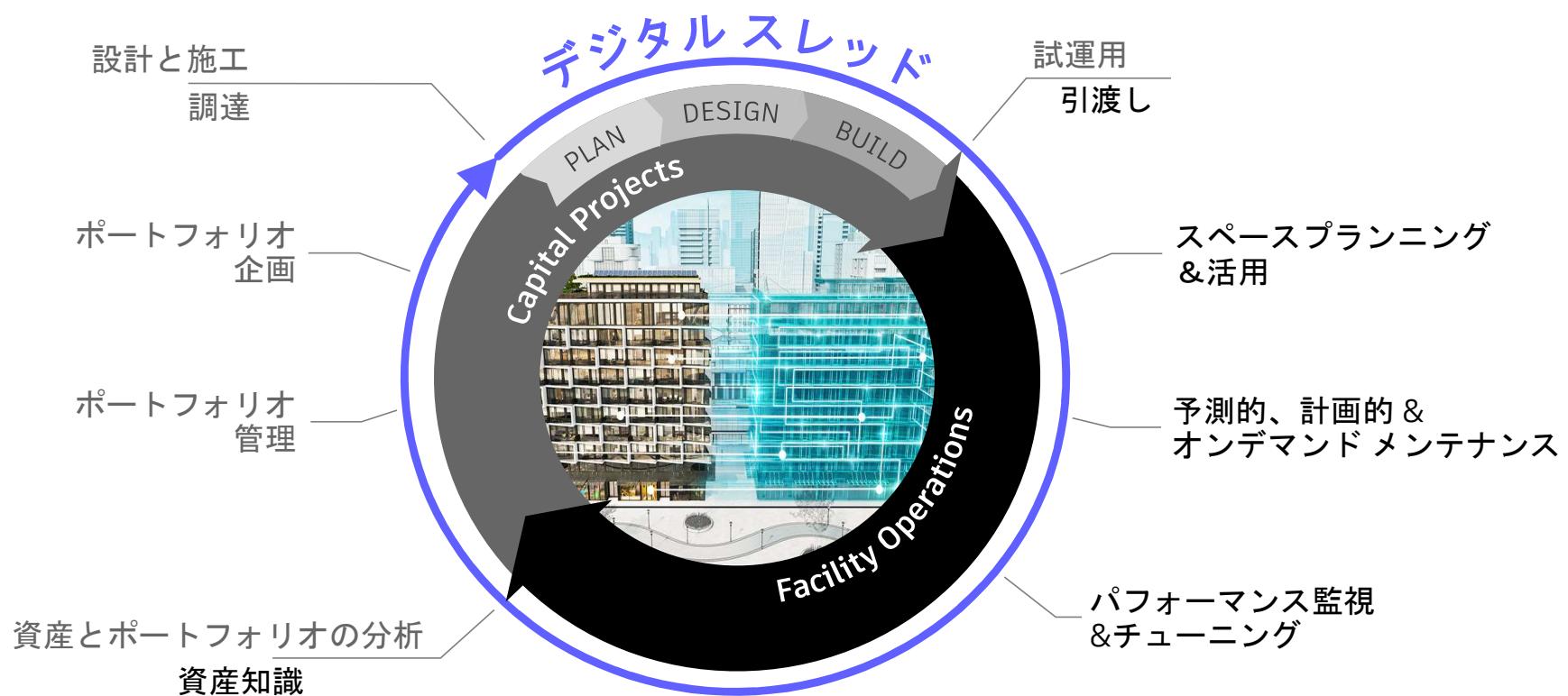
Agenda

- 1 AEC Design Model API
- 2 Autodesk Forma
- 3 Autodesk Tandem



建設資産のライフサイクルの変革

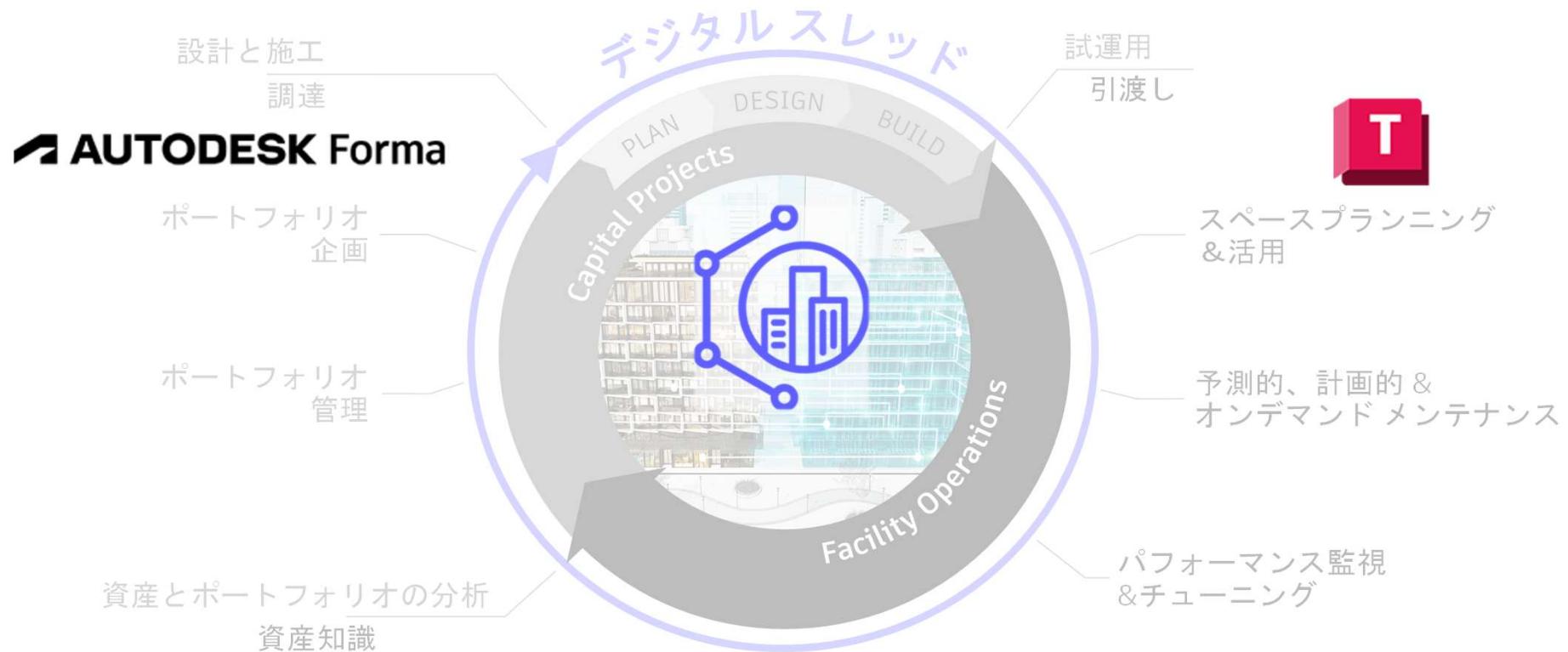
Transforming the Built Asset Lifecycle



*)Autodesk Tandemのスライド引用

建設資産のライフサイクルの変革

Transforming the Built Asset Lifecycle



*)Autodesk Tandemのスライド引用



AEC Data Model API

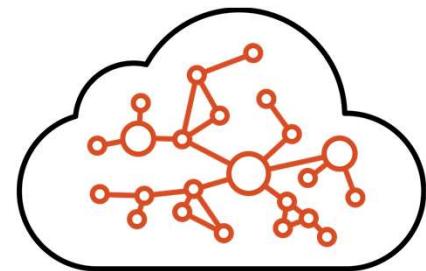
動機、コンセプト、能力

Motivation, concepts and capabilities

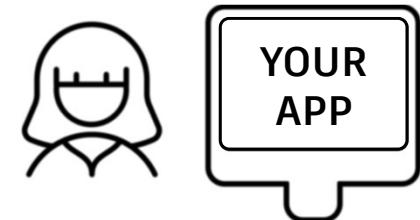
João Martins
Developer Advocate

Agenda

- 1 なぜ AEC Data Model?
- 2 利点
- 3 デモ サンプル
- 4 次のステップは？



Architecture, Engineering
& Construction





なぜAECデータモデル
なのか？

ファイルを扱う苦痛な点(**pain point**)

最終的には複数のツールや回避策に依存することになる可能性があります

- 他のチームと協力する必要がありますか?
 - データは特定のファイル形式で「ロック」されます。
- 建物の窓を 1 つだけ変更したのですか?
 - 構築ファイル全体をアップロード、保存、処理、共有します。
- デザインのサブセットだけが必要ですか?
 - すべてをダウンロードする必要があります。

データを扱うほうが better

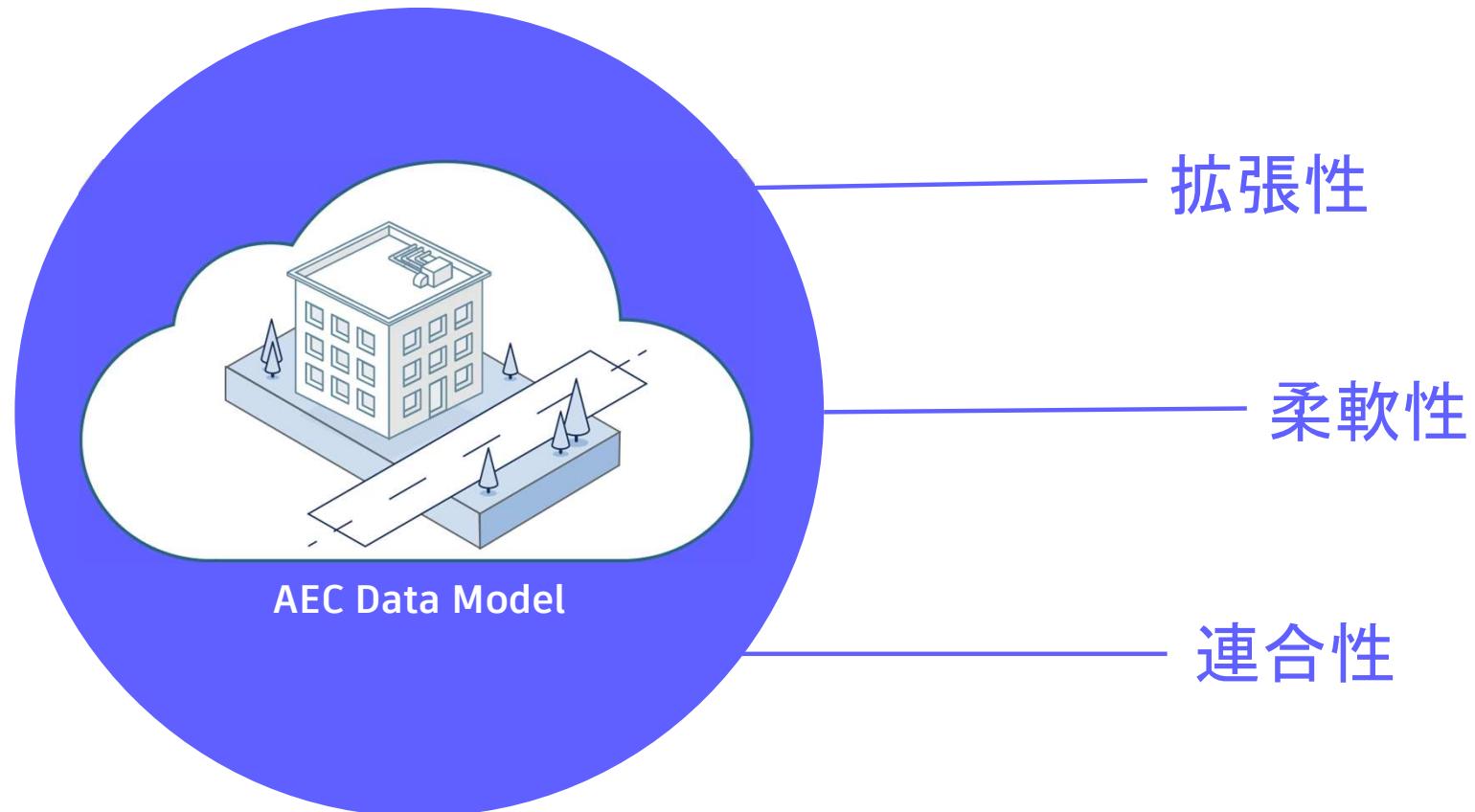
必要なデータのみを処理します

- 他のチームと協力する必要がありますか?
 - クラウド上でデータには細かくアクセスできます。
- 建物の窓を 1 つだけ変更したのですか?
 - その窓のみがデザイン内で処理および変更されます。
- デザインのサブセットだけが必要ですか?
 - 必要なデータのみにアクセスできます。

必要としている解決策は、

- AEC データにアクセスするための共通環境を提供
- きめ細かなアクセスが可能
- 異なるシステム間の接続が可能
- さまざまなソースからのデータをサポートする共通言語を使用
- 効率的なリソースの消費、管理、ストレージを提供

デザインの原則





利点

データ モデル API は GraphQL を採用

あらゆる利点を考慮

- 単一のエンドポイント
- データ交換のための固定構造がない
- オーバーフェッチなし
- リソース的に効率的



AEC Data Model API は GraphQLを用います

あらゆる利点を備えている

- 必要なデータのみを取得

```
query {  
  aecDesignByVersionNumber(designId: "YWVjZH5...EpfSHZ3",  
  versionNumber:1) {  
    elements(filter:{query:"property.name.External ID'==41434aa5-  
    ...0018527b"}) {  
      results {  
        properties(filter:{names:["Length"]}) {  
          results {  
            name  
            value  
            propertyDefinition {  
              units  
            }  
          }  
        }  
      }  
    }  
  }  
}
```



例) 単一の壁の長さのみを取得するクエリ

```
{  
  "data": {  
    "aecDesignByVersionNumber": {  
      "elements": {  
        "results": [  
          {  
            "properties": {  
              "results": [  
                {  
                  "name": "Length",  
                  "value": 11.000000000000002,  
                  "propertyDefinition": {  
                    "units": "Meters"  
                  }  
                }  
              ]  
            }  
          }  
        ]  
      }  
    }  
  }  
}
```



AEC Data Model API は GraphQLを用います

あらゆる利点を備えている

- 人が読でわかりやすい(Human Readable)



| 必要なもの | どのフィルターを使用すればよいか | どの構成で |
|---------------------|---|-------------------|
| 「壁」カテゴリのすべての要素 | 'property.name.category'==Walls | Element |
| すべてのインスタンス | 'property.name.Element Context'==Instance | Element |
| ユーザーによって変更されたすべての要素 | metadata.lastModifiedBy.email== <u>example@autodesk.com</u> | Element or Design |
| 面積と長さのプロパティのみ | names:["Length","Area"] | Property |

AEC Data Model API は GraphQLを用います

あらゆる利点を備えている

- データ管理よりも速くて簡単

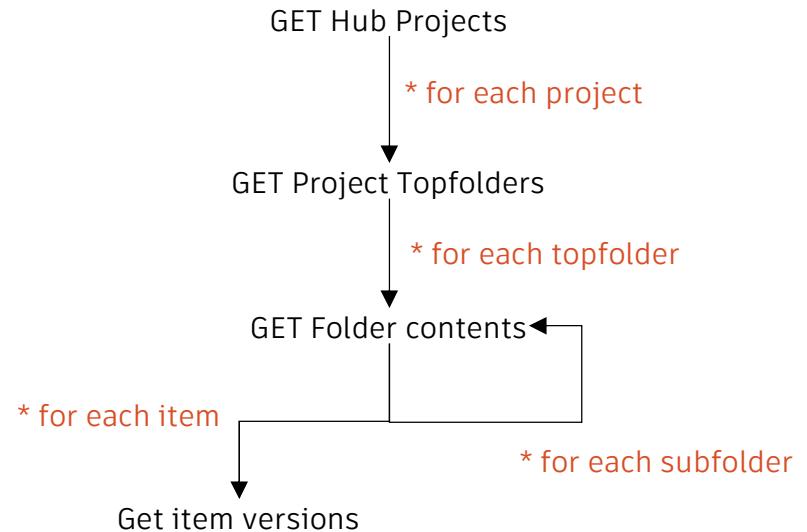


AEC Data Model API *

```
query {  
  aecDesignsByHub (hubId: "b.03f9...5c1") {  
    results{  
      name  
      id  
      lineage{  
        versions{  
          results {  
            versionNumber  
          }  
        }  
      }  
    }  
  }  
}
```

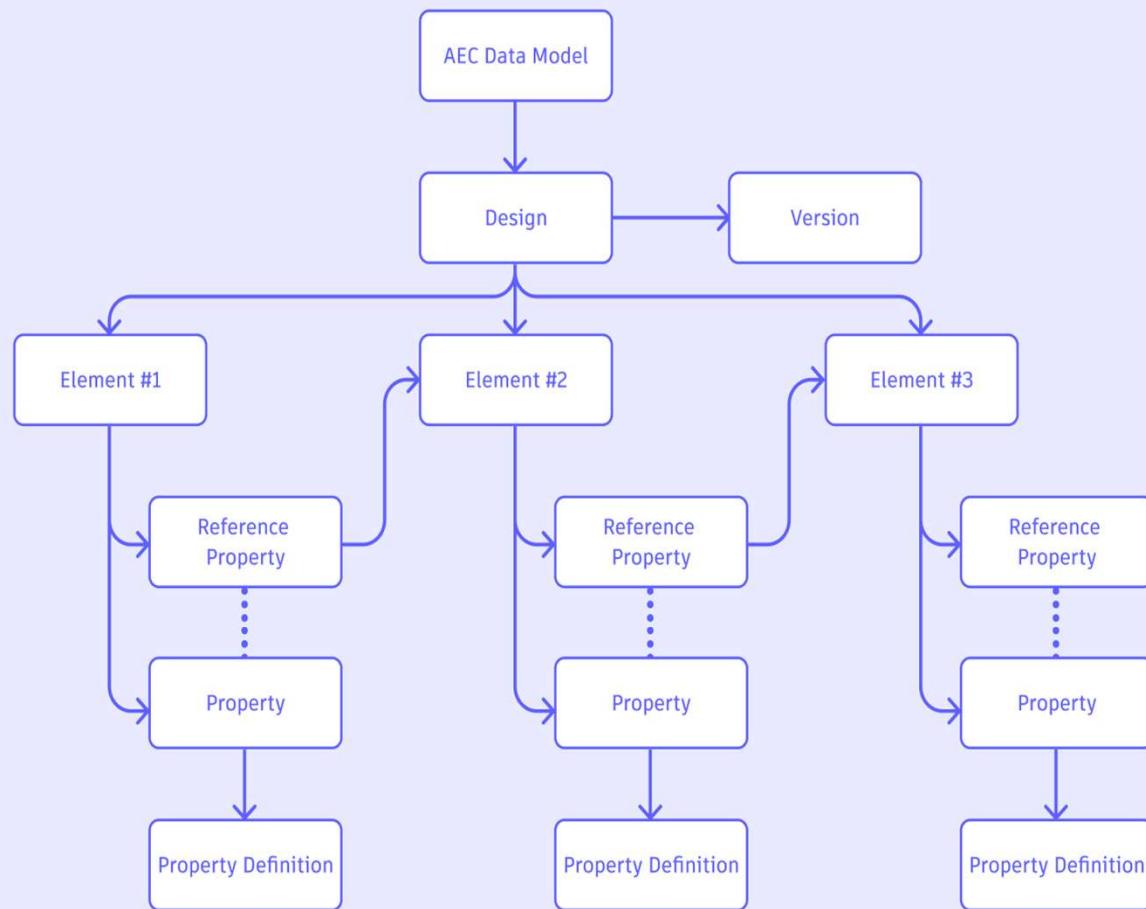
例) 特定のハブのすべてのプロジェクトのすべてのフォルダーから、すべてのデザインからすべてのバージョンを抽出します。

Data Management API



* 現在 Revit 2024 デザインのクエリのみ

Data Model 構成 (Constructs)



Revit を使用したデータ モデル

The screenshot illustrates the integration of Revit data with a GraphQL API. The top half shows a GraphQL query results page, and the bottom half shows the corresponding Revit model.

GraphQL Query Results:

```
query GetElementsFromCategory {
  elements(designId: "YWVjZH5xcTdtR2JYNNV4NDNNVmJES3cwZGVuX0wyQ345V2ZXZ3g0S1E3cW") {
    pagination {
      cursor
    }
    results {
      id
      name
      properties(filter: {names: ["Revit Category Type Id", "Family Name", "Element Name", "Design Option"]}) {
        results {
          name
        }
      }
    }
  }
}
```

The results are displayed in a tree structure:

- Element Type: Stud
- Properties:
 - Revit Category Type Id: Walls
 - Family Name: Basic Wall
 - Element Name: Exterior - 13 5/8" Rainscreen (Two Sides) w Insulation on Metal Stud
 - Design Option: Main Model

Revit Model View:

The bottom part shows the Revit interface with a wall selected. The wall's properties are shown in a context menu:

Basic Wall [619340]

- Comments
- Mark
- Design Option: Main Model
- Type Name: Exterior - 13 5/8" Rainscreen (Two Sides) w Insulation on Metal Stud
- Type Image
- Keynote
- Model
- Manufacturer

The wall is highlighted in blue. A legend indicates the colors used in the diagram:

- Red box: Walls
- Yellow box: Basic Wall
- Green box: Exterior - 13 5/8" Rainscreen (Two Sides) w Insulation on Metal Stud
- Blue box: Stud
- Blue box: Design Option
- Green box: Type Name

Arrows connect the numbered callouts in the GraphQL results to the corresponding elements in the Revit interface.



デモ

AEC Data Model エクスプローラー

- 単純なクエリ (ハブやプロジェクトを取得)
- より複雑なクエリ (特定のカテゴリからすべての要素を取得)
- ビューアーの利用

AEC Data Model Explorer - BETA

aecdatamodel-explorer.autodesk.io

AUTODESK Platform Services AEC Data Model Explorer - BETA

PASTE THE PROJECT ID ITEM/VERSION ID HERE Viewer Logout (João Martins)

GetHubs GetProjects GetDesignsByProject GetElementsFromCategory GetElementsByFilter + GraphiQL

1 # Task 1 - Pick a Hub
2 **query** GetHubs {
3 hubs {
4 pagination {
5 cursor
6 }
7 results {
8 name
9 id
10 }
11 }
12 }

Variables Headers

1

GET HUBS

The screenshot shows the Autodesk AEC Data Model Explorer BETA interface. On the left, there's a code editor window containing a GraphQL query for 'GetHubs'. The query retrieves information about multiple hubs, including their names and IDs. On the right, the results of the query are displayed as a JSON object. The results array contains four hub entries, each with a name and an ID. The interface includes tabs for 'Variables' and 'Headers', and a large 'GET HUBS' button at the bottom.

```
1 # Task 1 - Pick a Hub
2 query GetHubs {
3   hubs {
4     pagination {
5       cursor
6     }
7     results {
8       name
9       id
10    }
11  }
12 }
```

```
{
  "data": {
    "hubs": {
      "pagination": {
        "cursor": null
      },
      "results": [
        {
          "name": "JM Test",
          "id": "a.YnVzaW5lc3M6YXV0b2Rlc2s10Dcy"
        },
        {
          "name": "AEC Data Model Account",
          "id": "b.03f98b13-ec95-461b-b945-765f496165c1"
        },
        {
          "name": "Developer Advocacy Support",
          "id": "b.489c5e7a-c6c0-4212-81f3-3529a621210b"
        },
        {
          "name": "Construction Records Testing",
          "id": "b.768cae14-76b3-4531-9030-25212dab4e48"
        }
      ]
    }
  }
}
```

AEC Data Model Explorer - BE x +

aecdatamodel-explorer.autodesk.io

AUTODESK Platform Services AEC Data Model Explorer - BETA

PASTE THE PROJECT ID ITEM/VERSION ID HERE Viewer Logout (João Martins)

GetHubs GetProjects GetDesignsByProject GetElementsFromCategory GetElementsByFilter + Graph/QL

1 # Task 2 – Pick Projects
2 * query GetProjects {
3 projects(hubId: "b.03f98b13-ec95-461b-b945-765f496165c1") {
4 pagination {
5 cursor
6 }
7 results {
8 id
9 name
10 alternativeRepresentations {
11 externalProjectId
12 }
13 }
14 }
15 }

Variables Headers

1

GET PROJECTS

"YWltcHJvan5iLjAzZjk4YjEzLWVjOTUtNDYxYi1i0TQ1Ltc2NWy00TYxNjVjMX5iLj1MTg2MzE1LW1yNWmtNDKxMC05MzkxLTllMGE4ZjhNmZa5Zg",
 "name": "JM AEC Data Model Samples",
 "alternativeRepresentations": {
 "externalProjectId": "b.25186315-b25c-4910-9391-9e0a8f8f709f"
 },
 {
 "id":
"YWltcHJvan5iLjAzZjk4YjEzLWVjOTUtNDYxYi1i0TQ1Ltc2NWy00TYxNjVjMX5iLjg30GiZMTkxLWRkNmEtNGUXOS04MzQ0LTyzNDU4NjUwNWQ5YQ",
 "name": "DAS AEC DM TEST PROJECT",
 "alternativeRepresentations": {
 "externalProjectId": "b.878b3191-dd6a-4e19-8344-634586505d9a"
 },
 {
 "id":
"YWltcHJvan5iLjAzZjk4YjEzLWVjOTUtNDYxYi1i0TQ1Ltc2NWy00TYxNjVjMX5iLjkyY2Y1ZDMwLTYxZjYtNGE3Yi1iM2JmLWMyZDk0YjZmYjkYg",
 "name": "AECDM API Project",
 "alternativeRepresentations": {
 "externalProjectId": "b.92cf5d30-61f6-4a7b-b3bf-c2d94b6fb2db"
 },
 {
 "id":
"YWltcHJvan5iLjAzZjk4YjEzLWVjOTUtNDYxYi1i0TQ1Ltc2NWy00TYxNjVjMX5iLmUxYzFmMmQ5LTQ1NjctNGI1Yy05N2ZhLWUwZGQwNza00DA5Yw",
 "name": "AEC Data Model API Private Beta Project",
 "alternativeRepresentations": {
 "externalProjectId": "b.e1c1f2d9-4567-4b5c-97fa-e0dd0704809c"
 },
 {
 "id":
"YWltcHJvan5iLjAzZjk4YjEzLWVjOTUtNDYxYi1i0TQ1Ltc2NWy00TYxNjVjMX5iLmYzYjU50GYwLWJhZWItNGIwNi1hYmFmLTQxDlmZDJjZDIZNw",

AEC Data Model Explorer - BETA

aecdatamodel-explorer.autodesk.io

AUTODESK Platform Services AEC Data Model Explorer - BETA

PASTE THE PROJECT ID urn:adsk.wipprod:fs.file: Viewer Logout (João Martins)

GetHubs GetProjects GetDesignsByProject GetElementsFromCategory GetElementsByFilter + GraphQL

```
1 # Task 3 - Retrieve designs from project
2 query GetDesignsByProject {
3   aecDesignsByProject(projectId: "YWltcHJvan5iLjAzZjk4YjEzLWvjOTUtNDYxYi1iOTQ1LT"
4     pagination {
5       cursor
6     }
7   results{
8     name
9     id
10    alternativeRepresentations{
11      fileUrn
12      fileVersionUrn
13    }
14  }
15}
16}
```

Execute query (Ctrl-Enter)

version=1

"id": "YWVjZH5xcTdtR2JYNVV4NDNNVmJES3cwZGVuX0wyQ35kTVhZWEZZ1RmZW5xRmduVfgyLUZn",
"alternativeRepresentations": {
 "fileUrn": "urn:adsk.wipprod:dm.lineage:dMXYXIYgTfengFgnTX2-Fg",
 "fileVersionUrn": "urn:adsk.wipprod:fs.file:vf.dMXYXIYgTfengFgnTX2-Fg?
}

},
{
 "name": "simple_houservt_added_windows.rvt",
 "id": "YWVjZH5xcTdtR2JYNVV4NDNNVmJES3cwZGVuX0wyQ35zWHczenNVWVQ3T1FkZ2tqaEpfSHZ3",
 "alternativeRepresentations": {
 "fileUrn": "urn:adsk.wipprod:dm.lineage:sXw3zsUYT70QdgkjhJ_Hvw",
 "fileVersionUrn": "urn:adsk.wipprod:fs.file:vf.sXw3zsUYT70QdgkjhJ_Hvw?
version=1"
 }
},
{
 "name": "Snowdon Towers Sample Architectural-2.rvt",
 "id": "YWVjZH5xcTdtR2JYNVV4NDNNVmJES3cwZGVuX0wyQ345V2ZX3g0S1E3cWxNRGIwVXNNUFLB",
 "alternativeRepresentations": {
 "fileUrn": "urn:adsk.wipprod:dm.lineage:9WfWgx4KQ7qlMDb0UsQPYA",
 "fileVersionUrn": "urn:adsk.wipprod:fs.file:vf.9WfWgx4KQ7qlMDb0UsQPYA?
version=1"
 }
},

Variables Headers

1

GET DESIGNS



Home FRONT

undo redo rotate hand zoom person camera pencil eraser selection settings info

AEC Data Model Explorer - BETA

aecdatamodel-explorer.autodesk.io

AUTODESK Platform Services AEC Data Model Explorer - BETA

PASTE THE PROJECT ID urn:adsk.wipprod:fs.file: Viewer Logout (João Martins)

GetHubs GetProjects GetDesignsByProject GetElementsFromCategory GetElementsByFilter +

Graph/QL

```
1
2
3 *2ZXZ3g0S1E3cWxNRGIwVXNRUFLB", filter: {query:"property.name.category=Walls"}}
4
5
6
7
8
9
10
11
12
13
```

Variables Headers

1

GET ELEMENTS

```
{
  "data": {
    "elements": {
      "pagination": {
        "cursor": "Y3Vyc35NZz09fjUw"
      },
      "results": [
        {
          "id": "YWVjZX5xcTdtR2JYNVv4NDNNVmJES3cwZGVuX0wyQ345V2ZXZ3g0S1E3cWxNRGIwVXNRUFLBXzEwMGMzNw",
          "name": "Generic - 21\",
          "properties": {
            "results": [
              {
                "name": "External ID",
                "value": "049439b4-5467-47c4-a72e-459e7fd736c2-00100c37"
              },
              {
                "name": "Revit Category Type Id",
                "value": "Walls"
              }
            ]
          }
        }
      ]
    }
  }
}
```

複数のデザインにわたるクエリ

- ハブ、プロジェクト、またはフォルダー全体のクエリ
- カスタムクエリ
 - ElementsByHub
 - ElementsByProject
 - ElementsByFolder
- RSQL フィルター

さらにクエリをエクスプロア...

特定のランプ 種類のすべてのタイプの照明器具をリストします。

```
1▼ query GetElementsByAssemblyDescription {
2  elementsByProject(
3    projectId: "YWltcHJyan5iLjAzZik4YjFzLWVjOTUtNDYxYi1jOTQ1LTc2NWY00TYxNjVjMX5iLjg3QGIzMTkxLWRkNmEtNGUXOS04MzQ0LTYzNDU4NjUwNWQ5YQ"
4    filter: {query: "property.name.category='Lighting Fixtures' and 'property.name.Lamp'=contains='A-19' and 'property.name.Element Context'='Type'"}
5  ) {
6    results {
7      id
8      name
9      properties{
10        results
11        {
12          name
13          value
14        }
15      }
16    }
17  }
18 }
```

AEC Data Modelダッシュボードのサンプル

- ハブ、プロジェクト、またはフォルダー全体のクエリ
- カスタムクエリ
 - ElementsByProject
- RSQL フィルター

RoomsTakeoffTable

| Name | Occupancy | Number | Perimeter | Area | Element Name | Volume |
|------------------------|-----------------|--------|--------------------|--------------------|----------------------------|--------------------|
| Mezzanine Dining | Restaurant | 200 | 47.980600000001 | 78.83278588250101 | Mezzanine Dining 200 | 308.3623252579909 |
| Green Roof | Outdoor Public | R100 | 192.90260875714014 | 481.0047946108535 | Green Roof R100 | 1172.858857099484 |
| Bandstand | Outdoor Public | R101 | 33.83867428193778 | 68.20579906442748 | Bandstand R101 | 266.886404671778 |
| Storage | | R103 | 14.23669999999978 | 10.753037969687455 | Storage R103 | 26.220207785285847 |
| Private Patio | Outdoor Private | 507A | 23.34960510134908 | 18.961167650554856 | Private Patio 507A | 144.485809618188 |
| Stair | | S1 | 18.54199999999984 | 17.14980440999774 | Stair S1 | 449.9962552855003 |
| Stair | | S3 | 18.21179999999965 | 16.728353639999906 | Stair S3 | 438.9239191873754 |
| Stair | | S2 | 19.15160000000034 | 17.927867369999998 | Stair S2 | 470.7719214707844 |
| Elevator | | E1 | 9.601199999999784 | 5.741923999999774 | Elevator E1 | 151.46776894593538 |
| Elevator | | E2 | 9.601199999999803 | 5.741923999999776 | Elevator E2 | 151.46776894593592 |
| Café | Restaurant | 101 | 57.502244385108874 | 59.73364167011721 | Café 101 | 375.93595003801977 |
| Café Kitchen | Restaurant | 102 | 31.851600000000452 | 40.2614618156243 | Café Kitchen 102 | 133.96598804530828 |
| Outdoor Covered Dining | Restaurant | 103 | 34.925000000736073 | 62.670237608188216 | Outdoor Covered Dining ... | 405.3879596092288 |
| Pocket Park | Outdoor Public | 104 | 68.71524305028896 | 164.9790137125825 | Pocket Park 104 | 1118.2448412644496 |

RoomsTakeoffChart

| Room Category | Room Name | Volume (approx.) |
|-----------------|---------------------------|------------------|
| Mezzanine | Mezzanine Dining 200 | 3.0 |
| Storage | Storage R100 | 1.0 |
| Stair | Stair S1 | 1.0 |
| Residential | Residential Lobby 103 | 1.0 |
| Commercial/Beta | Studio Unit 203 | 1.0 |
| Beta | Office Unit 301 | 1.0 |
| Work | Studio Unit 304 | 1.0 |
| Two Story | Live/Work Unit 308 | 1.0 |
| Studio | Two Story Studio Unit 408 | 1.0 |
| Unit | Studio Unit 404 | 1.0 |
| Two Story | Live/Work Unit 408 | 1.0 |
| Studio | Studio Unit 404 | 1.0 |
| Unit | Condo 502 | 1.0 |
| Parking | Parking Garage P01 | 1.0 |
| Machine Room | Machine RM P03 | 1.0 |
| Master Bedroom | Master Bedroom 206 | 3.0 |
| Bath | Bath 203 | 3.0 |
| Hall | Entry Hall 201 | 3.0 |
| Bath | Bath 103 | 3.0 |
| Mechanical | Mech 102 | 3.0 |

DoorsTakeoffTable

| Height | Width | Element Name |
|------------------|------------------|-------------------------------------|
| 2.78764999999929 | 1.82880000000029 | Door-Curtain-Wall-Double-Storefront |
| 2.66000000000006 | 1.43999999999997 | Entrance door |
| 2.64159999999993 | 1.82879999999998 | Door-Curtain-Wall-Double-Storefront |
| 2.64159999999993 | 1.82879999999998 | Door-Curtain-Wall-Double-Storefront |
| 2.54000000000005 | 2.4384 | Access Door |
| 2.43840000000001 | 0.91440000000001 | Door-Curtain-Wall-Single-Storefront |
| 2.38760000000004 | 1.82880000000044 | Door-Curtain-Wall-Double-Storefront |
| 2.18439999999993 | 0.91440000000001 | Door-Curtain-Wall-Single-Storefront |

DoorsTakeoffChart

| Door Type | Volume (approx.) |
|-------------------------------------|------------------|
| 3'4" x 6'4" (60 MIN) | 25 |
| 3'6" x 6'4" (60 MIN) | 20 |
| 3'6" x 8'4" | 20 |
| 2'6" x 8'4" | 5 |
| 3'2" x 8'4" | 5 |
| 3'6" x 8'4" (pool) | 8 |
| 3'6" x 8'4" (20 MIN) | 5 |
| 3'6" x 8'4" (Core) | 10 |
| Access Door | 2 |
| 7'8" x 10' | 2 |
| 3'6" x 8'4" (16 MIN) | 5 |
| Door-Curtain-Wall-Double-Storefront | 2 |
| Door-Curtain-Wall-Single-Storefront | 2 |
| 3'6" x 8'4" (60 MIN) | 10 |
| 3'6" x 8'4" (Exterior) | 2 |
| 3'6" x 8'4" (Exterior) | 2 |
| 7'2" x 8'4" | 2 |
| 8'0" x 2'10" | 28 |
| Entrance door | 8 |
| Curtain Wall Double Glass | 12 |
| 7'0" x 2'9'6" | 12 |

\times \ddagger Family Name, Element Name, Material, Frame Material, Finish

RSQL を使用したクエリ

- ハブ、プロジェクト、フォルダー全体にわたる検索のような機能

```
1▼ query GetElementsByAssemblyDescription {
2  elementsByProject(
3    projectId: "YWltcHJvan5iLjAzZjk4YjEzLWVjOTUtNDYxYi1i0TQ1LTc2NWY00TYxNjVjMX5iLjg3OGIzMT
4    filter: {query: "'property.name.Assembly Description'=contains=Furniture"}
5  ) {
6    results {
7      alternativeRepresentations {
8        externalElementId << The Element ID
9      }
10   design {
11     alternativeRepresentations {
12       fileVersionUrn << The Model URN
13     }
14   }
15 }
16 }
17 }
```

その他のクエリ？

- あなたにとって重要なクエリはどれですか？
- 不足しているデータはありますか？
- 教えてください！

aps.help@autodesk.com



次のステップは？



AEC Data Model

パブリック ロードマップ



<https://aps.autodesk.com/aec-data-model-roadmap>



実際に使うことに興味がおありますか？

AEC Data Model ベータ

- Revit 2024 にアクセスできることを確認してください
- あなたのACC ハブが AEC データ モデルと連携できるようにします 
- 既存のサンプルを活用する
- 独自のクエリを作成する

AEC Data Model API

ステータスのまとめ

- AEC Data Model | MFG Data Model | M&E Data Model
- AEC Data Model
 - データモデルは読み取り専用です
 - https://aps.autodesk.com/en/docs/aeccimdata/v1/developers_guide/overview/
 - Coming soon - Public beta before AU (?)
- Data Exchangeとの関係
 - スキーマは AEC Data Model (i.e., 用語) を使用するようになりました。
 - GraphQL - パブリックデータ
 - SDK - プライベートデータ。.NET、ジオメトリ。「書き込み」機能。STEP
 - 「ビュー」をベースに
- Parameters APIとの関係
 - スキーマ サービス

デザインデータにアクセスする方法

Model Derivative Model Properties Design Automation Data Exchange AEC Data Model

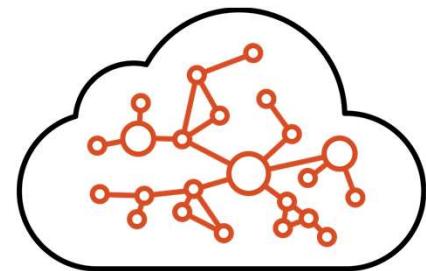


| APS | ACC/BIM 360 | Platform | ACC | Platform |
|------------------|-------------|----------------------|--------------------------|-----------|
| ファイルベース | ファイルベース | ファイルベース /RCM | クラウドにホスト | クラウドにホスト |
| モデル全体 | モデル全体 | モデル全体 | 部分的モデル | 部分的モデル |
| Light weight クエリ | フルクエリ・フィルタ | add-in と同じレベルのコントロール | 現状で限られている | 現状で限られている |
| Read | Read | Read/write | Read/write ^{*1} | Read |
| 現在 | 現在 | 現在 | 将来 | 将来 |

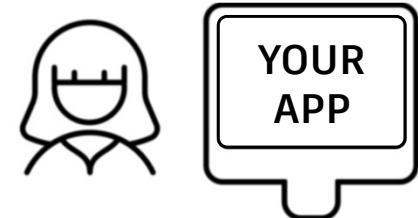
*1) not update

まとめ

- 1 なぜ AEC Data Model?
- 2 利点
- 3 デモ サンプル
- 4 次のステップは？



Architecture, Engineering
& Construction





Autodesk Forma



Autodesk Forma

Forma とは？

- “SpacemakerAI”より名前を変更
 - 2023 年 5 月 8 日より
- プランニングおよび初期段階の建築コンセプト設計のためのクラウドベースのソフトウェアサービス
 - 意思決定のサポート
 - 概念設計を探索する
 - 効率とコラボレーション
 - 自動化と AI を活用した洞察
 - 反復的なタスクを減らす
 - 建築現場周囲の環境品質を評価する
- <https://app.autodeskforma.com/>



Autodesk Forma

ユーザーインターフェース

- Hub
- デザインモード

プロジェクトの作成

- エリアのマップ
- データの注文
- レイヤーの編集
- メンバーを招待

モデルのインポート

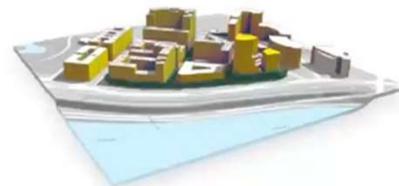
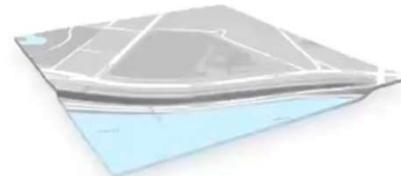
- 座標の設定
- キャンパスに設置

モデルの詳細定義

- 3Dスケッチツールを用いてモデルの編集

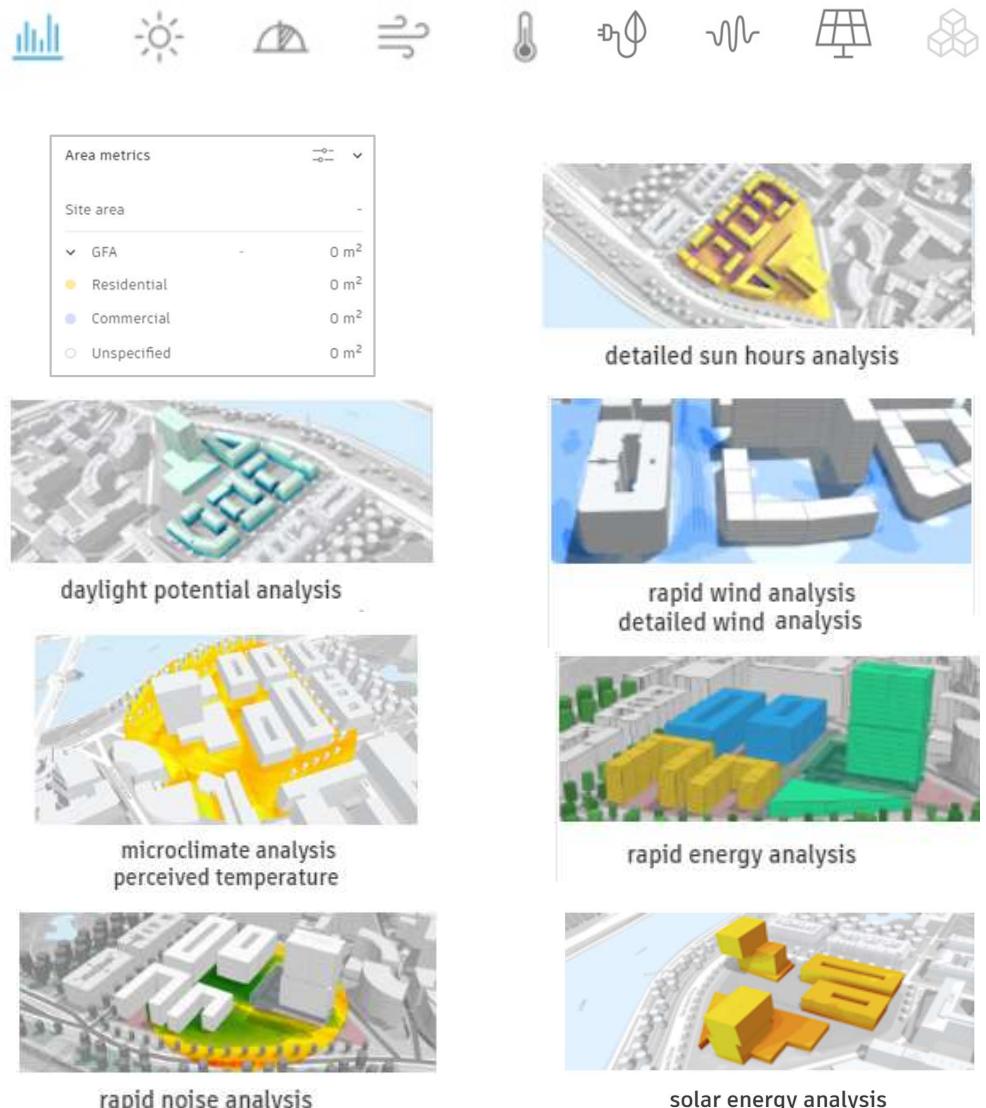
モデルの解析

- エリアの定義
- 結果の検査
- 視覚化による比較
- Revitへ送る



Autodesk Forma 解析(Analysis)

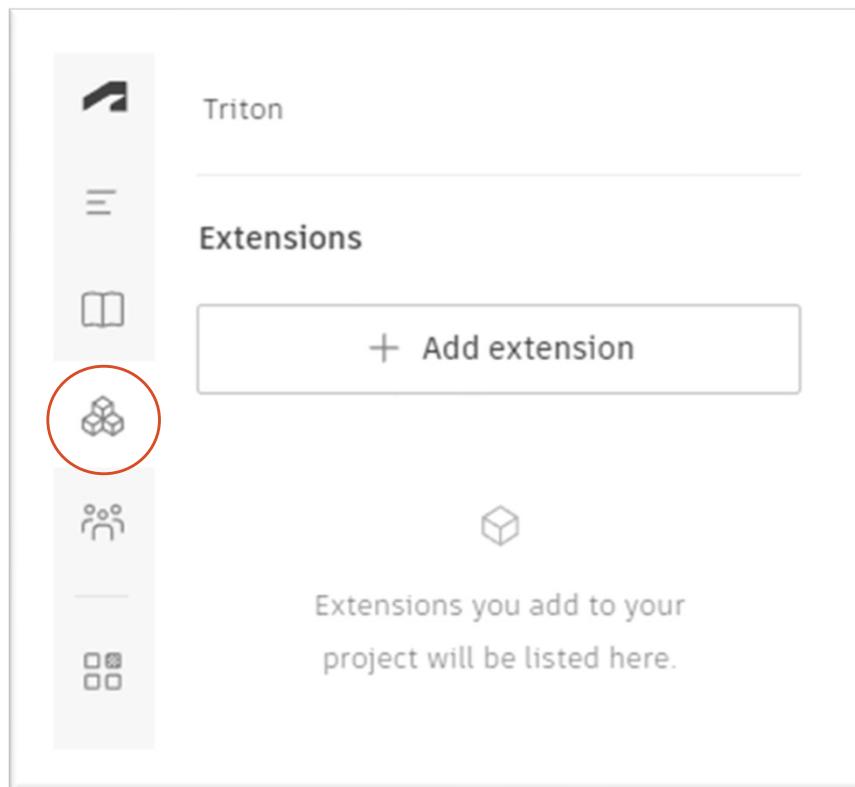
- 面積分析
- 日照時間の分析
- Daylight の可能性
- 簡易/詳細 風の解析
- マイクロ気候
- オペレーションによるエネルギー
- 簡易騒音解析
- 太陽エネルギー分析*BETA



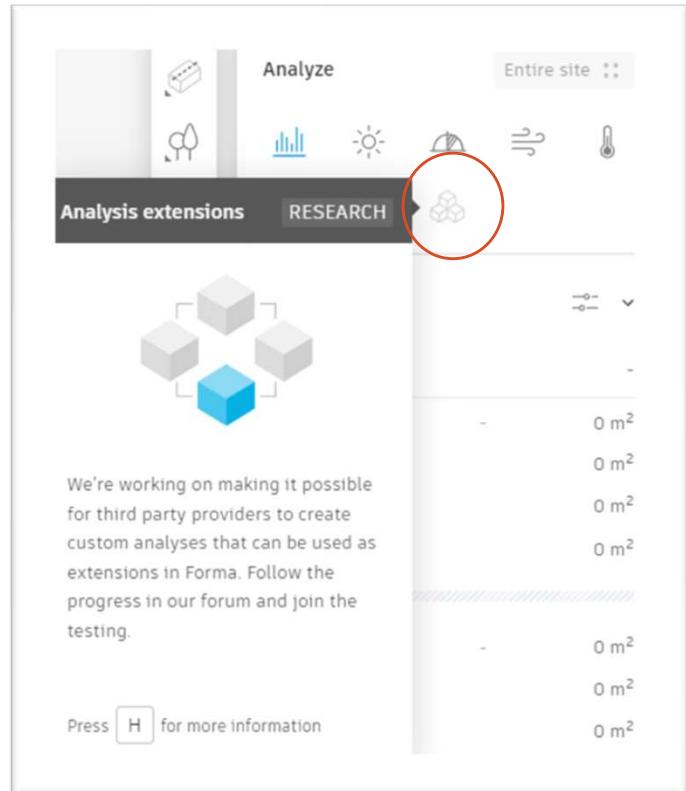
3rdパーティの機能を使用してFormaと接続、機能拡張



Forma Extensions



左側のメニュー



右側のAnalysis(分析)メニュー

Forma Extensions

Extensions Unpublished X

The screenshot shows the Autodesk Extensions interface with a sidebar containing icons for Home, Recent, Categories, and Help. The main area displays four extension cards:

- Revit add-in** (BETA): A card featuring a Revit model with a bridge and terrain. It includes a "Download" button.
- Rhino add-in** (BETA TEST): A card featuring a Rhino model with a bridge and terrain. It includes a "BETA TEST" button.
- ShapeDiver** (BETA): A card showing a cloud-based platform with users interacting with data and scripts. It includes an "Add" button.
- TestFit** (BETA): A card showing a 3D rendering of a parking lot with green areas. It includes an "Add" button.

Below each card, there is a brief description and a "Provided by" link:

- Revit add-in: For designers needing to add a greater level of detail to their Forma proposals. The Forma Add-in for Revit converts your Forma proposal into a developed BIM, including terrain, buildings, and other elements. Once connected to a Forma proposal, Revit users can Update data from Revit to the Forma environment.
 - [Documentation](#)
- Rhino add-in: The Forma team is developing software to help you move data between Forma and Rhino. Here, you will be able to download our Forma Add-in for Rhino, read documentation, test functionality, report any issues, post questions, comments, and feature requests to help improve the offering before a production quality release.
- ShapeDiver: Run your Grasshopper scripts in Forma using ShapeDiver's cloud service.
Provided by ShapeDiver GmbH
- TestFit: Create parking with TestFit and discover the possible parking utilization of your site.
Provided by TestFit, Inc

At the bottom left, it says "Provided by Autodesk".

Forma App Store

AUTODESK App Store English ▾ Publisher Guide | Sign

Welcome to Autodesk App Store for Autodesk® FORMA
Created by the community for the community, Autodesk App Store helps you customize your software to meet your unique and specific design needs.

Forma Apps Publishers

Generators Search Apps Forma Show All

Featured Apps

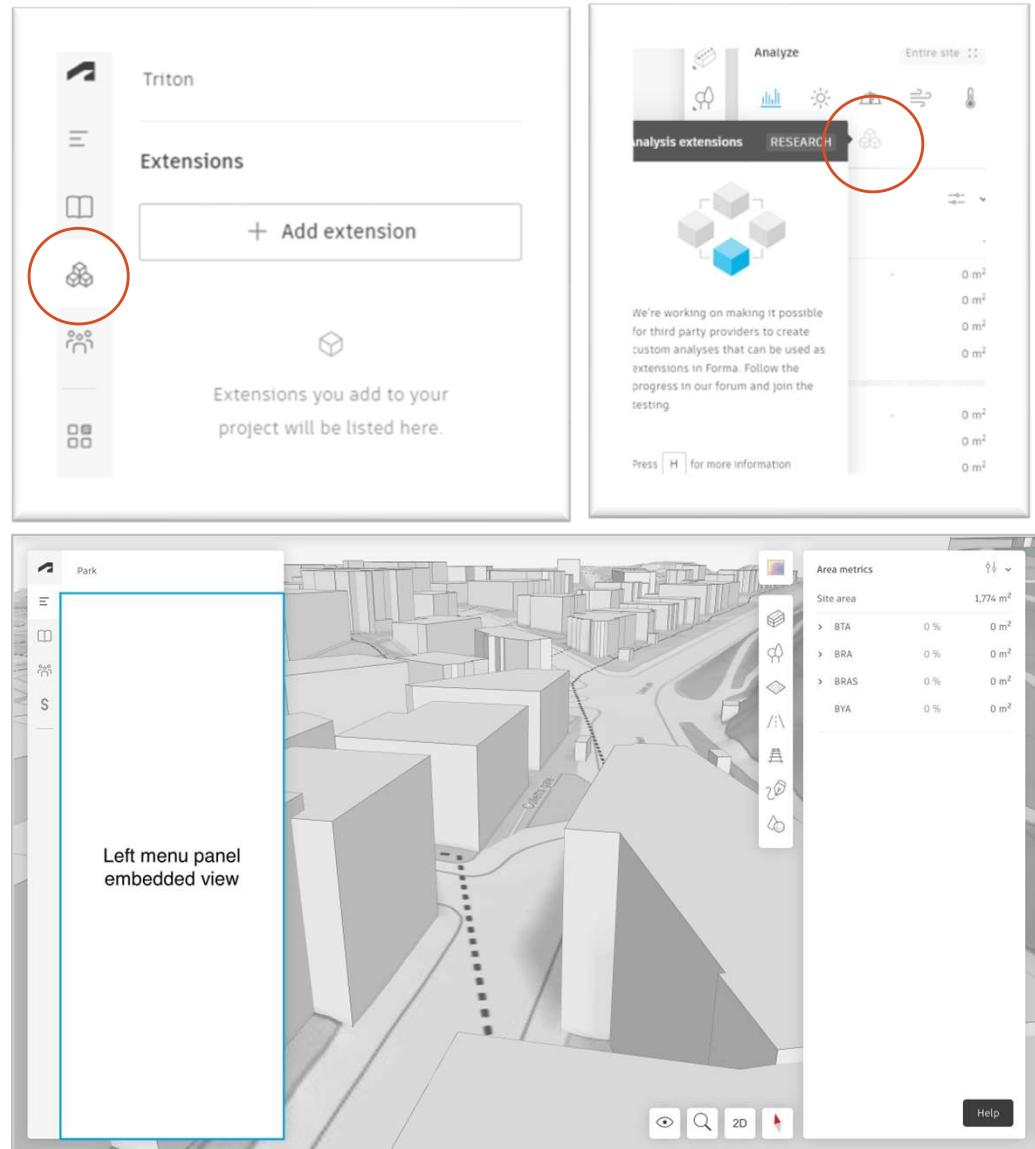
 Autodesk Forma™ Add-In for Revit
Transfer your Autodesk Forma™ proposals into Autodesk® Revit® projects and use Forma to analyze your Revit designs.
0 Free

 TestFit Parking Generator
TestFit's real estate feasibility platform makes it easy to do site planning. Our real-time AI configurators allow for rapid iterations to get deals done quickly.
0 Free

 ShapeDiver
Load parametric algorithms created in Grasshopper and hosted on ShapeDiver into Autodesk® Forma projects.
0 Free

Forma API

- Extension
 - Forma ライブラリと同期した外部ジオメトリ
 - 既存の Forma UI に機能を追加する
 - カスタム ジオメトリ コンフィギュレーター
 - Cross-Origin Resource Sharing (CORS)
 - 3つの方法
 - Script (java script)
 - iFrame
 - Http-based generator (return urn)



Forma API

- Element systems/エレメント要素
 - Geometry (ジオメトリ) , e.g.
 - 3D: Mesh (メッシュ) as GLB
 - 2D: GeoJSON
 - Raster: イメージ フォーマット
 - Category (カテゴリー)
 - Properties (プロパティ)
 - Custom analysis data (カスタム 解析データ)
- <https://aps.autodesk.com/en/docs/forma/v1/working-with-forma/element-system/>

```
type Namespace = "adsk-forma-elements"
type System = string
type Id = string
type Revision = string
type AuthContext = string
export type Urn = `urn:${Namespace}:${System}:${AuthContext}:${Id}:${Revision}`

type ISO8601DateTime = string
type TrackingID = string
type Metadata = {
    /** Pointer to the previous version of this element */
    predecessor?: Urn
    createdAt?: ISO8601DateTime
    createdBy?: TrackingID
}

export type Link = {
    /** Relative path to file. Assume same domain, follow redirects */
    url: string
    /** Optional id, if present consumers should extract specific node from file */
    id?: string
    /** Data format of file. */
    format?: "glb" | "geojson" | string
    /** Additional metadata about the file */
    properties?: { [key: string]: any }
}

type Category = "building" | "vegetation" | string
export type Properties = {
    category?: Category
    geometry?: {
        volumeMesh?: Link
        footprint?: Link
        [key: string]: Link | undefined
    }
    [key: string]: any
}

/** Column-major 4x4 matrix. Translation values use metres as unit. */
export type Transform = [
    number,
    number,
    number,
    ...
    number,
    number
]

export type Element = {
    urn: Urn
    metadata?: Metadata
    properties?: Properties
    transform?: Transform
    children?: Urn[]
}
```

エレメント データ モデル

Forma API

- プライベートベータ
- <https://aps.autodesk.com/autodesk-forma>

興味のある方?

- forma-api-beta@autodesk.com (英語)
- <https://aps.autodesk.com/en/docs/forma/v1/overview/welcome-to-forma/>

The screenshot shows the Autodesk Platform Services website with a dark header. The main title is "Autodesk Forma extensions and APIs". Below it is a subtitle: "Generate geometry within Forma UI by using custom logic". There are two buttons: "View documentation" and "Launch an APS free trial". To the right is a large image of a computer monitor. Below the title is a photograph of two people working at desks in an office. To the right of the photo is a section titled "Get to know the Autodesk Forma industry cloud" with a "Learn more" button. At the bottom left is a section titled "What are the Autodesk Forma extensions and APIs?" with a small explanatory text and a "Learn more" button. To the right is another photograph of a person working at a desk.

Autodesk Forma

プロダクトについて

- さらに詳しく
- <https://app.autodeskforma.com/>
 - Trial
 - AEC Collection (英語)
- www.autodesk.com/products/forma/overview
- https://help.autodeskforma.com/en/articles/7972972-learning-webinars-register-for-live-sessions-or-watch-on-demand#h_48c63aecbd

The screenshot shows the Autodesk AEC Collection product page. At the top, there's a navigation bar with the Autodesk logo, a search bar, and links for 'JP' (Japan), 'Products', 'Support', 'Learning', and 'Community'. Below the navigation, the text 'Autodesk AEC Collection' is displayed, along with links for 'Purchase Inquiry' and 'Download Trial Version'. The main content area is titled 'Included Software' and describes the Autodesk Architecture, Engineering & Construction Collection. It highlights the powerful BIM and CAD workflow for design and construction. On the left, there's a sidebar with sections for 'Overview', 'Architecture', 'Infrastructure', 'Construction', and 'Included Software'. The 'Included Software' section lists several products: Revit (BIM software for multi-disciplinary design), InfraWorks (土木インフラのコンセプト設計と解析のためのソフトウェア), Civil 3D (土木エンジニアリング設計と設計図書作成のためのソフトウェア), and Autodesk Docs (クラウドベースの共通データ環境でプロジェクトを管理できます). Each product is represented by a small icon and a brief description.

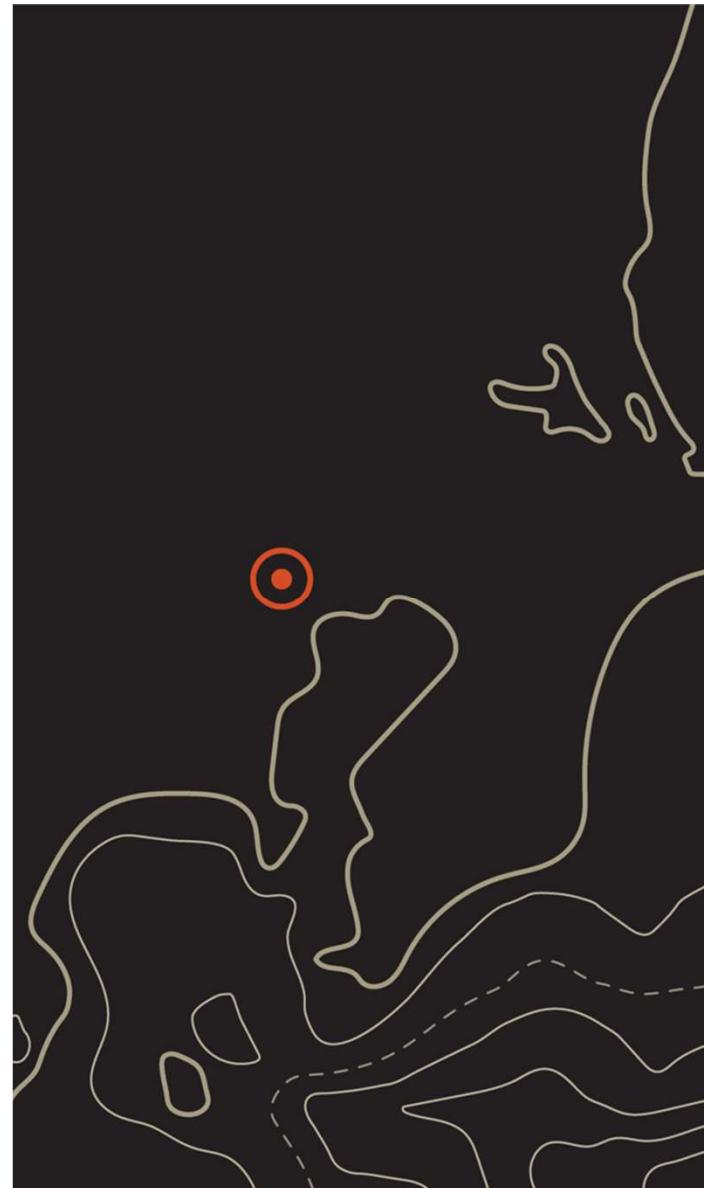


AECにおけるデジタルツイン

James Awe, Michael Beale, Jan Liska

Agenda

- 1 デジタルツインとは
- 2 Autodesk Tandem プロダクトの紹介
- 3 Autodesk Tandem API



デジタルツインとは？

What is a Digital Twin?

物理資産に関するすべての情報をすぐに利用できる、構築された資産のデジタルレプリカ。
双方向接続により、双子は現実世界の状況に基づいて意思決定をシミュレート、予測し、通知するために必要な運用上および行動上の認識を持つことができる。



Simulate/シミュレートする

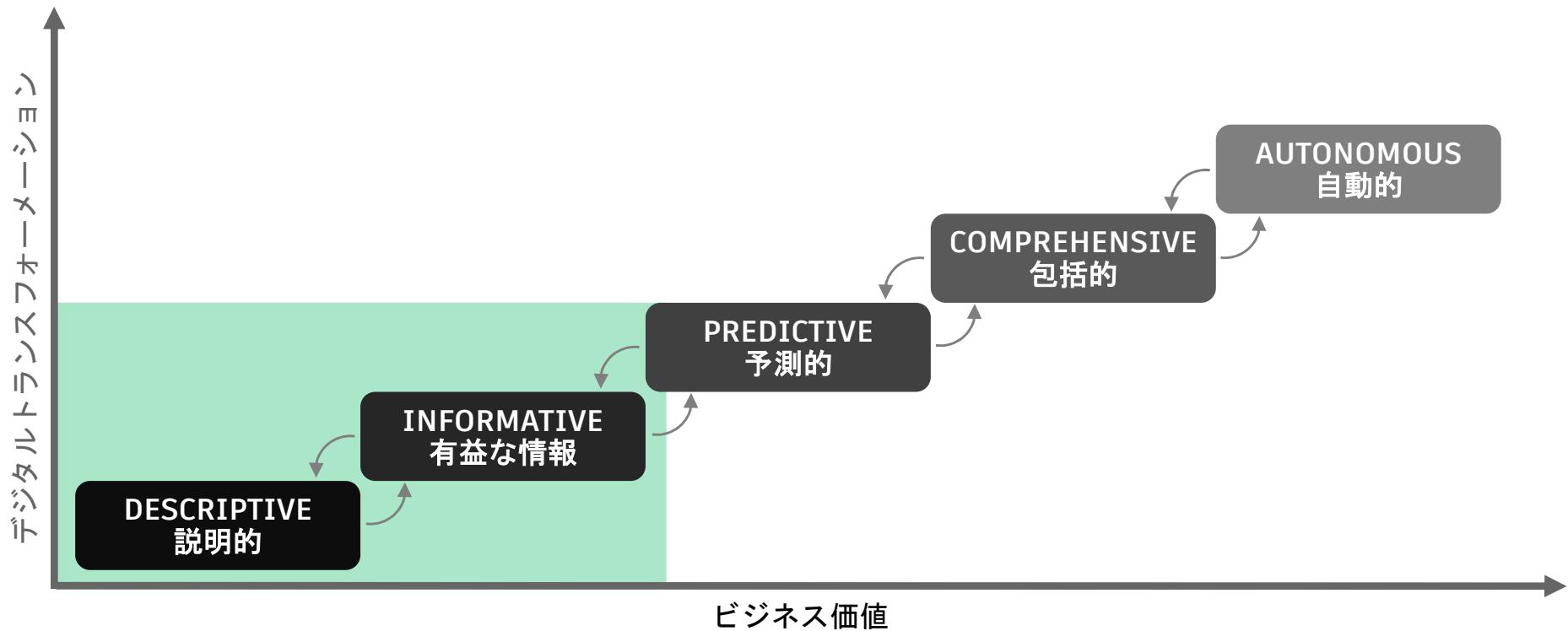


Predict/予測する



Inform/知らせる

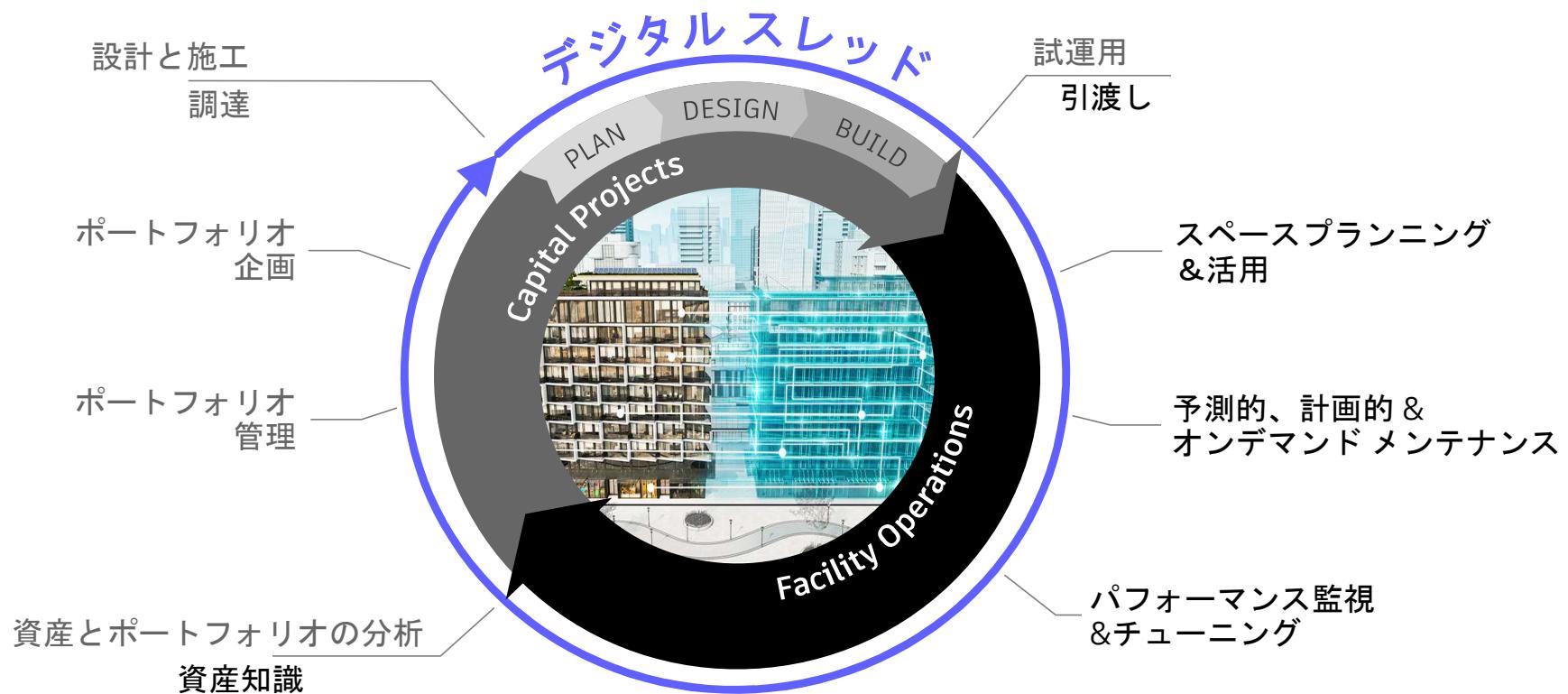
デジタルツイン成熟度モデル Digital Twin Maturity Model



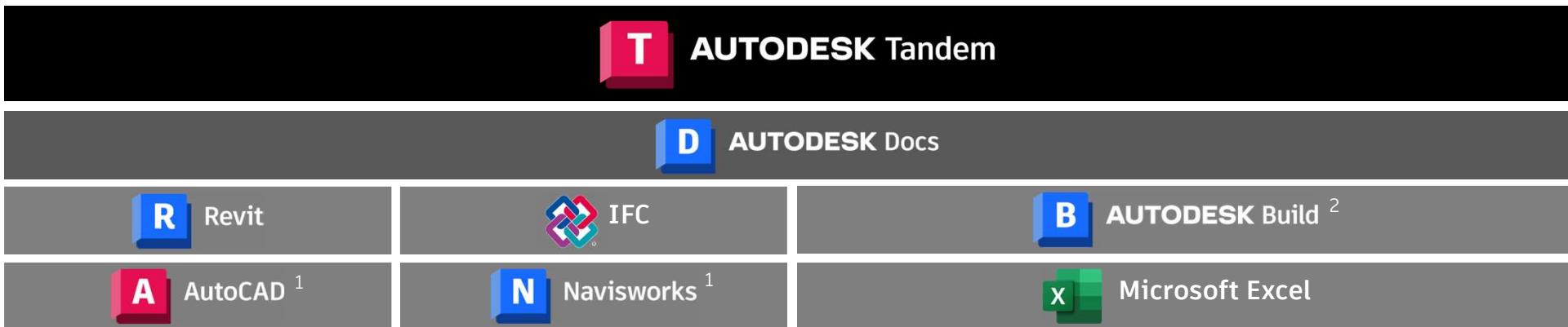
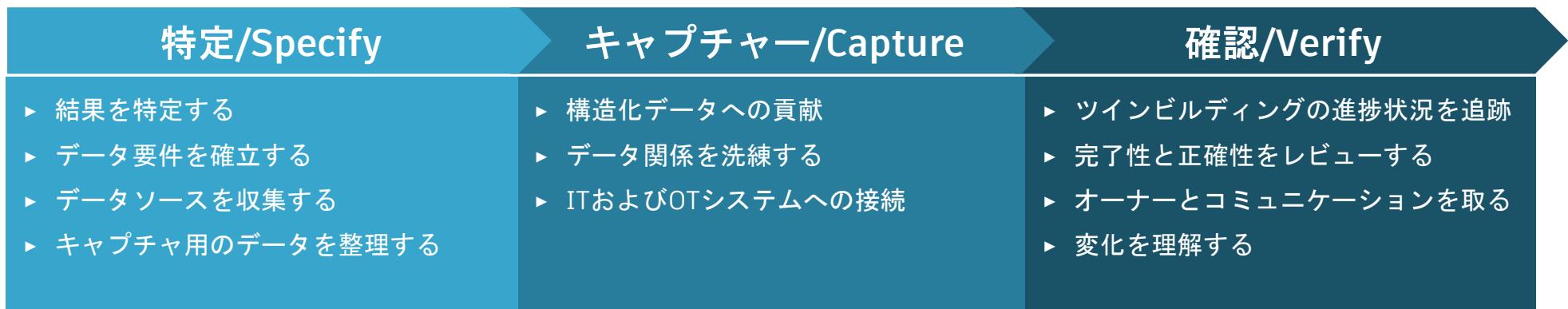
Source: Verdantix - Smart Innovators: Digital Twins For Buildings, June 2020

建設資産のライフサイクルの変革

Transforming the Built Asset Lifecycle



AEC プロジェクト実施中のビルディングをツイン Twin Building During AEC Project Delivery



¹ Coming Soon ² Planned Future Integration

洞察力に富んだオペレーション Insightful Operations

モニター/Monitor

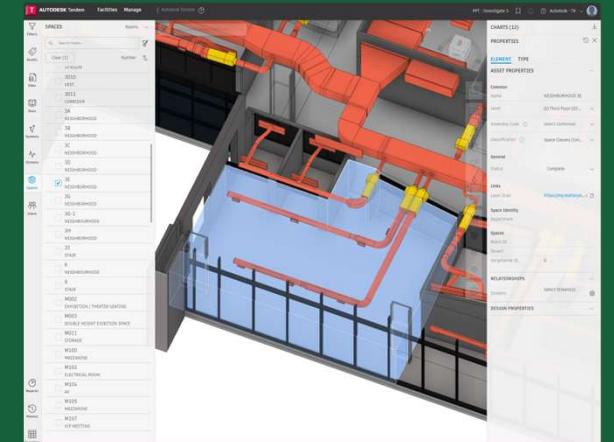
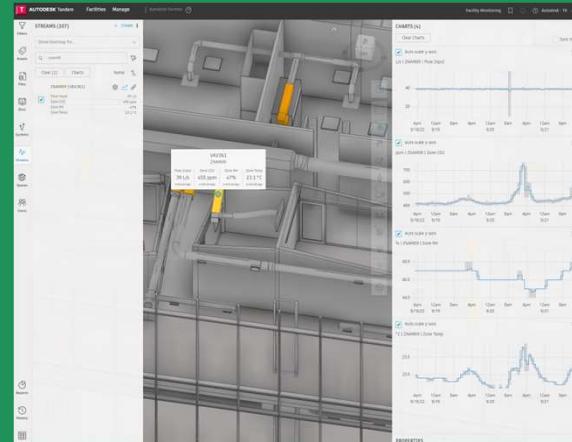
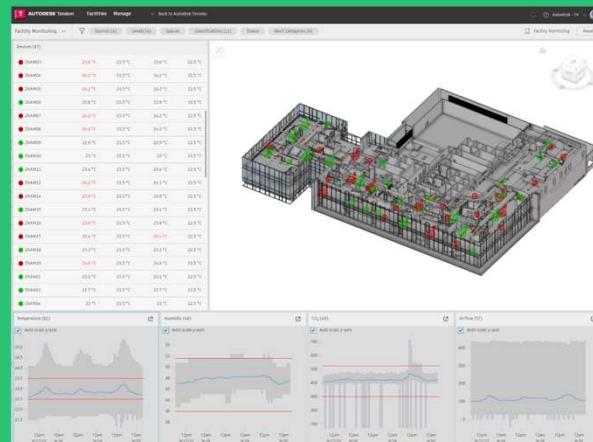
- ▶ 注意が必要なものに注目する
- ▶ 傾向のレビュー
- ▶ 異常を特定する

調査/Investigate

- ▶ 適切なデータをドリルダウンする
- ▶ 関係を追跡する
- ▶ 簡単にナビゲート

行動/Act

- ▶ 洞察を行動に移す
- ▶ リファレンスドキュメントにアクセスする
- ▶ 情報に基づいた意思決定を行う





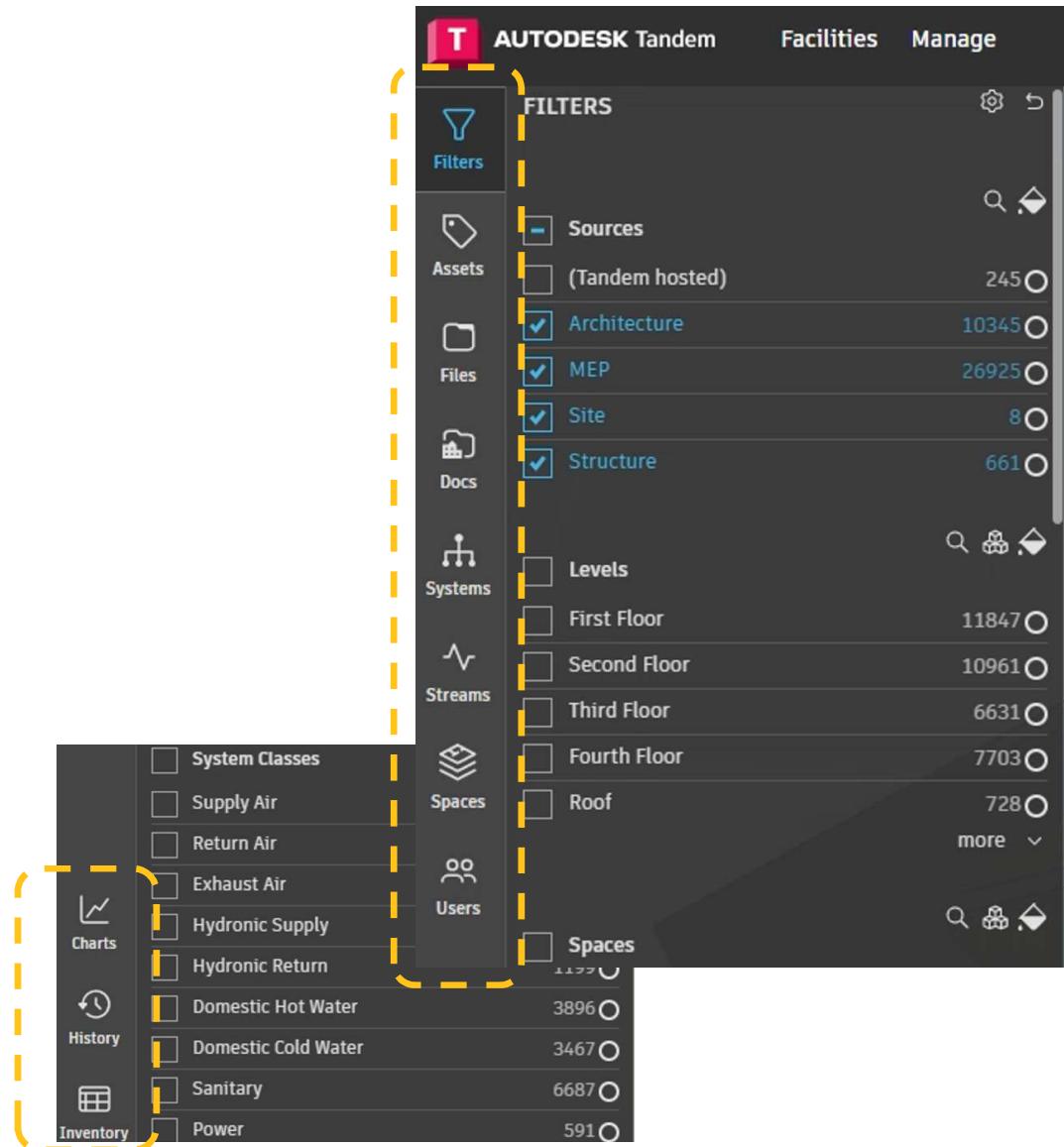
Autodesk Tandem プロダクト



Autodesk Tandem

プロダクトの機能

- フィルター、インベントリ
- ビュー
- フロア プラン
- スペース
- アセットのデータの追加、変更履歴
- ヒートマップ
- MEP システムのデータ
- ダッシュボード



DEMO:
Filters/Inventory

The image shows a 3D architectural model of a building complex. The main building is a long, low-profile structure with a grid of windows and a flat roof. To its right is a taller, more vertical tower-like structure. The building is situated on a plot with several green lawns and paved walkways. The overall style is contemporary and minimalist.

FILTERS

Sources

- (Tandem hosted) 245
- Architecture 10345
- MEP 26925
- Site 8
- Structure 661

Levels

- First Floor 11847
- Second Floor 10961
- Third Floor 6631
- Fourth Floor 7703
- Roof 728
- more ▾

Spaces

- ADA TOILET E-127 181
- ADA TOILET E-229 181
- ADA TOILET E-328 187
- ADA TOILET E-431 115
- ADA TOILET W-218 179
- more ▾

System Classes

- Supply Air 1950
- Return Air 895
- Exhaust Air 947
- Hydronic Supply 1333
- Hydronic Return 1199
- Domestic Hot Water 3896
- Domestic Cold Water 3467
- Sanitary 6687
- Power 591

Autodesk Tandem Facilities Manage | LTU East Residence Home Autodesk - TK

AUTODESK Tandem Facilities Manage | LTU East Residence

Home Autodesk - TK

Filters

Assets

Files

Docs

Systems

Streams

Spaces

Users

Charts

History

Inventory

DEMO: Views

Basic Wall : X - CORRUGATED METAL 3/4, AIR 1 1/2, RIGID 3 / GYP SHEATHING 5/8, MS 6 / PLY 3/4, RIGID 1 1/2

AUTODESK Tandem Facilities Manage | LTU East Residence

Home Autodesk - TK

Filters Assets Files Docs Systems Spaces Users Charts History Inventory

DEMO: Floorplans

The image shows a detailed 3D architectural rendering of a modern residential complex. The main building is a long, low-profile structure with a light-colored facade featuring many windows and a prominent glass-enclosed entrance area. A smaller, dark-colored rectangular extension is attached to the right side. The building is set on a site with green lawns and paved walkways. In the background, there are other buildings and trees under a clear sky. The overall style is clean and contemporary.

Basic Roof : R - TPO , COVER BD 1/2 / RIGID 5

AUTODESK Tandem Facilities Manage | Autodesk Toronto Default     Autodesk - TK 

 Filters
 Assets
 Files
 Docs
 Systems
 Streams
 Spaces
 Users
 Charts
 History
 Inventory

DEMO: Spaces



The image shows a 3D architectural rendering of a modern skyscraper and a smaller, older red brick building adjacent to it. The skyscraper has a glass facade and a dark base. The smaller building is red with a prominent dome and multiple gables. They are situated on a grey platform with some small structures like a bus stop. The background is white.

T AUTODESK Tandem Facilities Manage | LTU East Residence

Home Autodesk - TK

Filters

Assets

Files

Docs

Systems

Streams

Spaces

Users

Charts

History

Inventory

DEMO: Asset Data

The interface displays a 3D architectural rendering of a modern multi-story building complex. The buildings feature a mix of light-colored panels and large windows. The site includes several green lawns and paved walkways. The top right corner of the screen shows the text "DEMO: Asset Data". The left sidebar contains various navigation icons and labels: Filters, Assets, Files, Docs, Systems, Streams, Spaces, Users, Charts, History, and Inventory. The top right corner also features a cube icon labeled "FRONT", "RIGHT", "W", and "S".

T AUTODESK Tandem Facilities Manage | Autodesk Toronto 

Default (Demo)    Autodesk - TK 

Filters

Assets

Files

Docs

Systems

Streams

Spaces

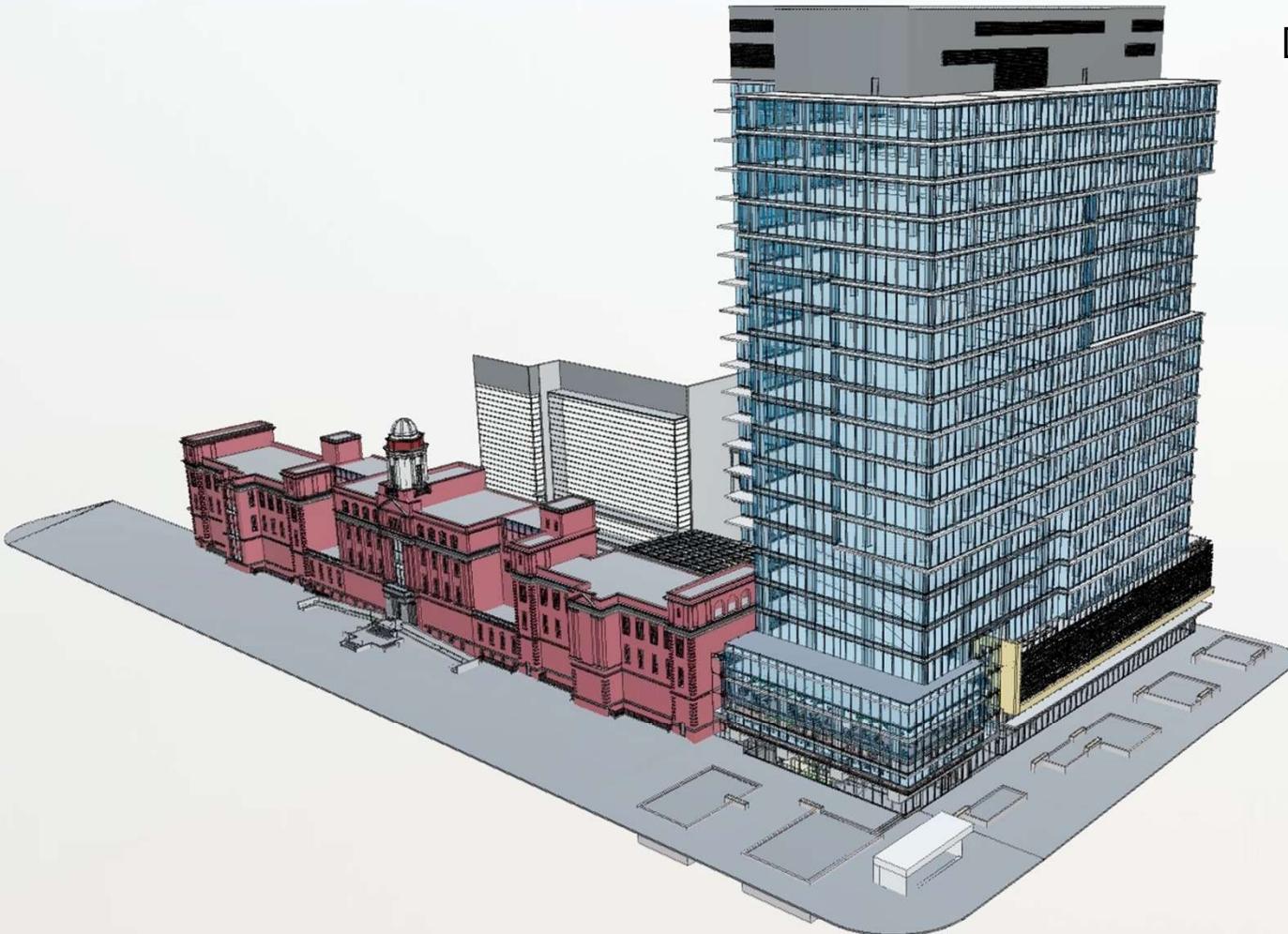
Users

Charts

History

Inventory

DEMO: Heatmaps



T AUTODESK Tandem Facilities Manage | LTU East Residence Home 

Filters

Assets

Files

Docs

Systems

Streams

Spaces

Users

Charts

History

Inventory

DEMO: Systems



The image shows a 3D architectural rendering of a modern building complex. The main building is a long, low-profile structure with a light-colored facade featuring many windows. A smaller, rectangular extension is attached to one end. The roof is flat and appears to have a green or reflective surface. To the right, there is another building with a similar design but a different color scheme, featuring vertical cladding and large glass windows. The buildings are situated on a site with several green lawns and brown paved paths. The overall style is clean and modern, typical of contemporary institutional architecture.

FRONT **RIGHT** **S** **E**

AUTODESK Tandem Facilities Manage ← Back to Snowdon Towers

Asset Tracking Autodesk - TK

Sources (8) Levels Spaces X Revit Categories (13) Classifications (12) Assembly Code X Revit Types X Parameters

CLASSIFICATION REAL ESTATE CORE

TAGGED ASSETS 2127

PARAMETER COMPLETENESS

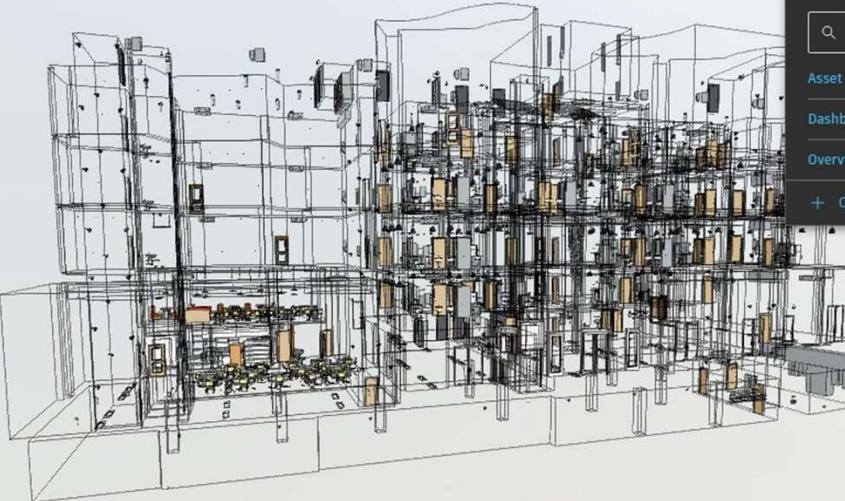
| Parameter | % Complete | Complete | Incomplete |
|----------------------|------------|----------|------------|
| Commissioning Date | 10% | 203 | 1924 |
| Name | 49% | 1041 | 1086 |
| Identifiers | 0% | 0 | 2127 |
| Maintenance Interval | 3% | 57 | 2070 |
| Initial Cost | 100% | 2127 | 0 |
| IP Address | 19% | 407 | 1720 |

Complete In progress Not started

PARAMETER BY CLASSIFICATION

| Parameter | % Complete | Complete | Incomplete |
|-------------------------|------------|----------|------------|
| Architectural Asset B10 | | | |
| Asset Tag | 0% | 0 | 257 |
| Commissioning Date | 0% | 0 | 257 |
| Identifiers | 0% | 0 | 257 |
| Initial Cost | 100% | 257 | 0 |
| Installation Date | 51% | 132 | 125 |
| IP Address | 51% | 132 | 125 |
| MAC Address | 51% | 132 | 125 |

Complete In progress Not started



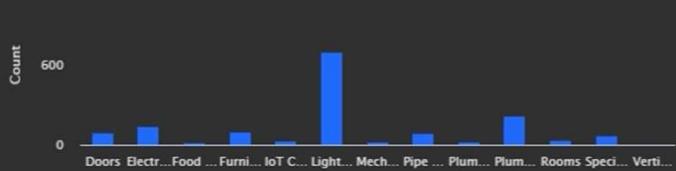
CLASSIFICATION STATUS



100.0%
MODEL ELEMENT
CLASSIFIED

Assets Spaces Streams

CLASSIFICATION BY REVIT CATEGORY

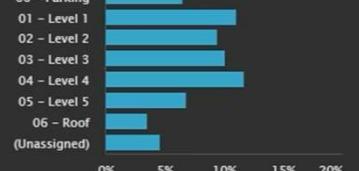


Count

Unclassified Classified Percent Classified

Doors Electr... Food ... Furni... IoT C... Light... Mech... Pipe ... Plum... Plum... Rooms Speci... Verti...

TAGGED ASSETS BY LEVEL



Percent Classified

00 - Parking 01 - Level 1 02 - Level 2 03 - Level 3 04 - Level 4 05 - Level 5 06 - Roof (Unassigned)

0% 5% 10% 15% 20% % of total tagged assets

Assets Spaces Streams

NAME STATUS MODEL NUMBER STATUS ASSET TAG STATUS INSTALLATION DATE STATUS

<https://tandem-stg.autodesk.com/pages/data-validation/um:adsk.dtt:TxbsSs66Tx-VCa7hR9A0NA/0s7uwrWHQAC6VJxVvEl-vg>

Autodesk Tandem の使用を開始する

Getting Started with Autodesk Tandem



It takes just two minutes to sign up for an account—and it's free.

[Sign up for free](#)



Stay in touch with the digital twin journey through updates and webinars.

[Subscribe now](#)

- 時間制限なし
- ユーザー制限なし
- 施設制限なし
- 最大 1,000 個のタグ付きアセット
- 最大 200 ストリーム

- Webinar への招待
- Tandemに関する最新情報



Autodesk Tandem

Build Smart. Operate Smarter. Tandem is a digital twin cloud-based technology solution by Autodesk.

- Tandemに関する最新情報
- Webinar への招待
- デジタルツイン情報

intandem.autodesk.com/contact-us/

linkedin.com/autodesktandem/



Tandem API

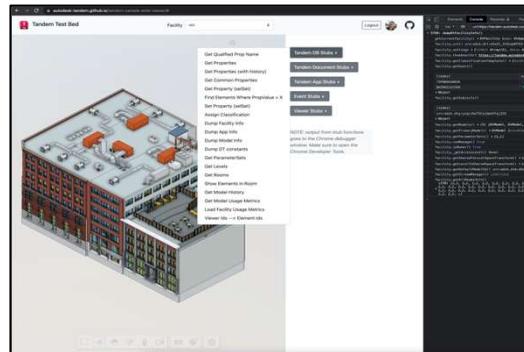


Autodesk Tandem プラットフォーム ロードマップ

現在

REST API

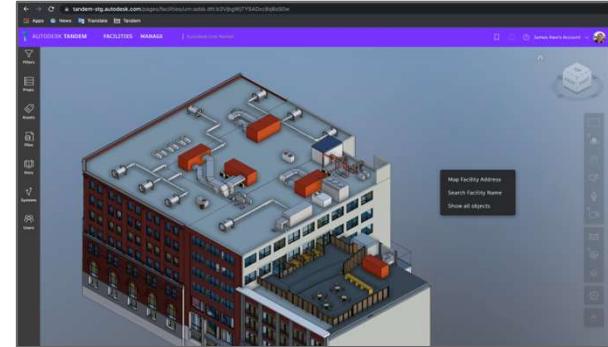
JavaScript SDK



- ・デジタルツインビジネスロジックを備えた高レベルAPI
 - ・クライアント側に埋め込んでカスタムデジタルツインアプリを作成可能
 - ・Node.jsのサーバー側で使用可能

将来

Tandem Extensions



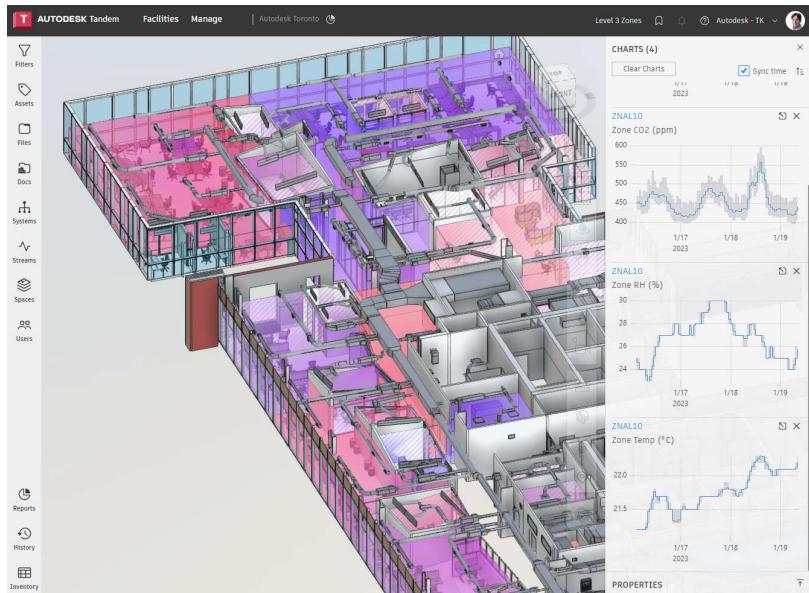
- CMMS/IWMS ソリューションとの垂直統合を可能にする
 - Tandem データのカスタムデータ分析をサポート

** BETA Nov. 2023まで **

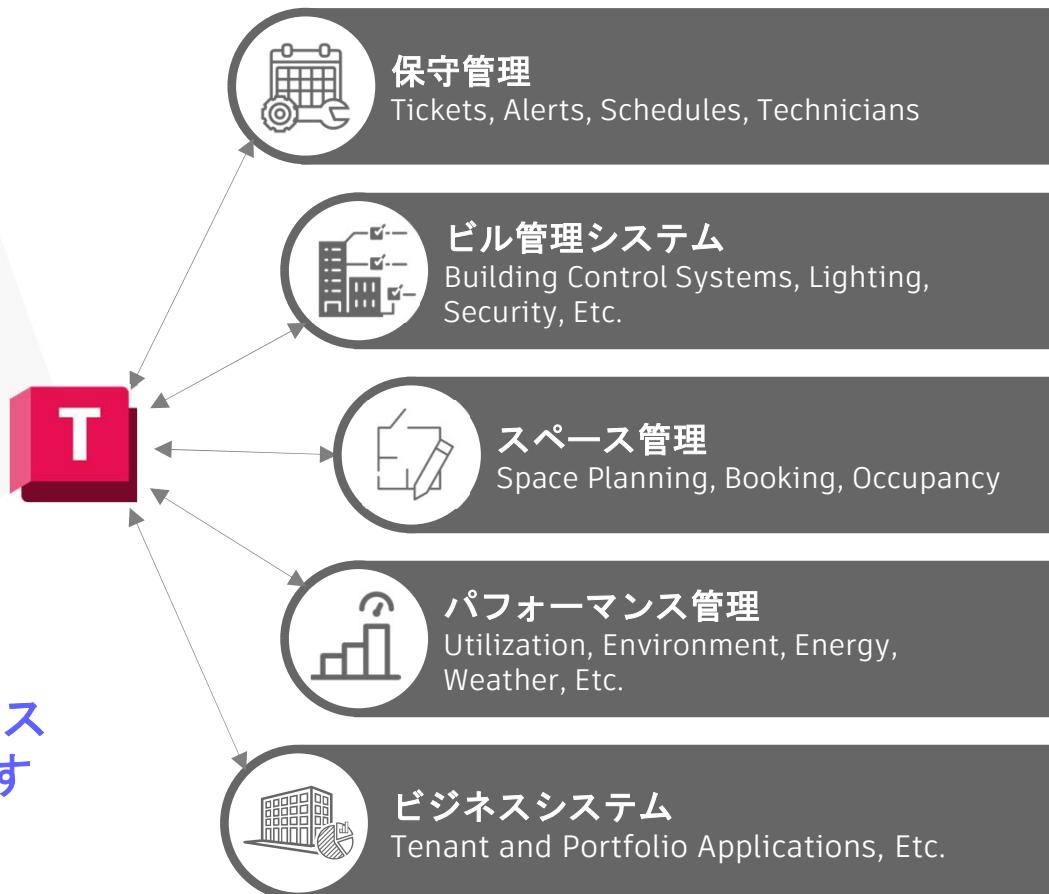
** 無期限のベータ版ですが、現在も利用可 **

** 利用不可 **

IT と OT データをTandemに接続



Autodesk Tandem には、多くの運用システムに接続してデータを双方向に共有する機能が必要です



APS ビューアとの関連?

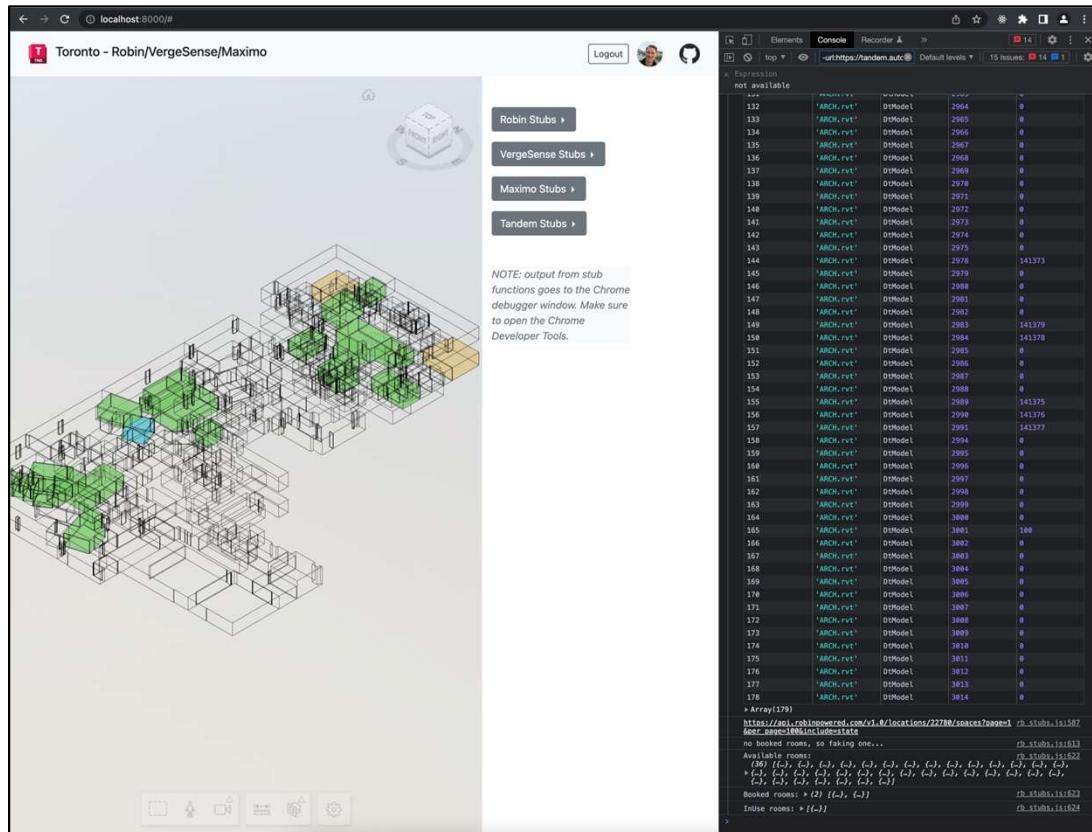
- APS Viewer (別名 “Forge Viewer”, “LMV”)をすでにご存知の場合...
- インターアクションはほとんど同じ。ただし、常にマルチモデルを想定してください
- データ層が全く違う
 - Tandem DB サーバーと直接通信します
 - ユーザー定義のプロパティ (別名「パラメータ」) を許可します
 - ソースファイルからの増分更新 (Revit、IFC、Navisworksなど)
 - データ変更の詳細な履歴
- 改良されたデータレイヤーにより、多くのユースケースに最適です
- 新しい WebGPU の実装により、大規模なモデルの処理が大幅に高速化されます。



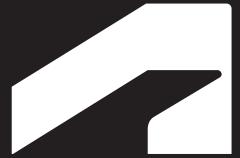
Tandem Data - REST API

- REST APIは、Tandemサーバーとの通信に使用され、必要なCRUD操作を提供する低レベルAPIです。
 - Tandem DBサーバーへのインターフェース
 - 効率的かつ強力
 - Tandem UI で使用
- 一般的な使用例
 - 分類/classificationsの割り当て
 - 要素のプロパティの読み取り/書き込み
 - ドキュメントの読み取り/追加
 - プッシュ/プルストリームデータ

プロトタイプのインテグレーション



- システム インテグレーションのプロトタイプを作成
 - ロビン（ルーム予約）
 - VergeSense（占有センサー）
 - Maximo（保守管理）
 - Tandem を介してこれらのシステムを視覚化し、対話する機能を実証します。
 - ハンドオーバープロセス中にこれらのシステムにデータを追加/初期化する機能を実証します。



Tandem API

デベロッパリソース

For Now ...





GitHub ページのドキュメント

Autodesk Tandem APIs (BETA)

Tandem digital twins represent a hub of information about your facility and they establish the existence and location of assets within that facility. That foundation is critical, but any good digital twin will include integrations with other systems and will support programmatic management of the asset data. Therefore, API access to the Tandem data model is essential. Over time, we plan to offer comprehensive APIs in several contexts to help developers customize and extend the foundational capabilities that the Tandem product provides.

Autodesk Tandem Platform Roadmap

The REST API stage includes:

- ReadWrite access to the Asset Information Model
- Append/Query access to Operational Event History, e.g., time-series data

The Next stage includes:

- Higher-level API with the digital twin business logic
- Embeddable on the client-side to create a custom digital twin app
- Usable on the server-side in Node.js

The Later stage includes:

- Enable vertical integrations with CMMS/BWMS solutions
- Support custom data analytics on Tandem data

Sample code for each API context exists on GitHub: [Tandem API Samples](#)

The main read/write functions will not be very interesting until you learn how to setup a Facility, create user-defined Parameters, and map those parameters to assets using Classifications in a Facility Template. To learn how to do that and to get started with the product, visit: [intandem.autodesk.com](#)

REST API - Autodesk Tandem Model Service API (BETA)

The REST API is the first context that will be officially supported. It is the base level API that communicates with the Tandem data server and manages `create/read/write/delete` of property data for assets. These asset properties are also called "parameters" in the Tandem client app, and

Qualified Properties

The `/attrs` and `/schema` endpoints are used to retrieve information about the properties that are available within Tandem. Some properties are read-only and come from the design source files (e.g. Revit, IFC). Other properties are defined in Tandem by the user and are read/write.

When reading property values via `/scan` or writing property values via `/mutate`, it is necessary to know information about the property definition. For instance, both endpoints expect properties to be referenced by their internal "fully qualified" names. As an example, here is a call to `/scan` to find all elements with the property `"zzAc"` attached to it.

Internal name must be used to look up the property

Most API users will need to establish a mapping table to move back and forth between the property's internal name and its Display Name. This mapping table can be created using the results of `/attrs` or `/schema`.

Let's start by looking at a property (aka "Parameter") in the Tandem product.

EDIT PARAMETER

| Name | Category | Data Type |
|---------|-------------------|-----------|
| Param A | Test 2 - Concrete | Element |

Description: Placeholder description

<https://autodesk-tandem.github.io/>



GitHub サンプル

- パブリック GitHub: <https://github.com/autodesk-tandem>
 - 現時点では APS パブリック GitHub から分離
 - 最初は API コンテキストごとに 1 つのサンプル
 - サンプルは今後さらに追加される予定です

The screenshot shows the GitHub repository page for 'Autodesk Tandem - Developer Samples'. The repository has 4 repositories, 12 members, and 1 team. It features four popular samples: 'tandem-sample-emb-viewer' (Public, CSS), 'tandem-sample-chrome-ext' (Public, JavaScript), 'tandem-sample-rest' (Public, JavaScript), and 'autodesk-tandem.github.io' (Public). The page also includes sections for 'People' (showing 12 members) and 'Top languages' (JavaScript and CSS).

Coming soon to APS

The screenshot shows a web browser displaying the Autodesk Platform Services Tandem Data developer guide. The URL is [https://developer.autodesk.com/tandem-data/developer-guide/read-properties-scan](#). The page title is "Read Properties - /scan". The content explains the POST scan endpoint for retrieving property data from the backend database. It includes code snippets for JavaScript and C# demonstrating how to define column families and names. Below the code, it notes that some column names within each family are hardcoded. At the bottom, there's a screenshot of the Autodesk Tandem interface showing the "ASSET PROPERTIES" panel for a selected "Test Wall" object.

すべてのドキュメントとサンプルを APS 開発者ポータルに移行中 (11月)



Postman

- REST API で利用可能な Postman コレクション
 - コレクションを介したインタラクティブなテストが可能

The screenshot shows the Postman interface with the 'scan' collection selected. The left sidebar lists various API endpoints under 'AUTODESK TANDEM MODEL SERVICE ...'. The main panel displays the 'scan' collection, which includes an 'AUTHORIZATION' section for Bearer Token and a detailed description of the GET /modeldata/:modelID/scan endpoint. The description explains that this endpoint is used to read elements and their properties from the database using a brute force approach, and recommends using the POST version for more specific queries. It also describes the structure of the returned array of elements and their properties.

The screenshot shows the Postman interface with a test step titled 'OK - Update user-defined property to new value'. The 'Body' tab is selected, showing a JSON payload for a POST request to /modeldata/:modelID/mutate. The payload contains an array of objects with 'keys' and 'values' fields, and a 'desc' field indicating the update was made from Postman. The 'Headers' tab shows a list of 12 headers.

<https://documenter.getpostman.com/view/15787353/UVeFMRdB>

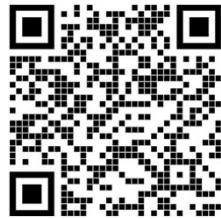


Tandem TestBed (REST)

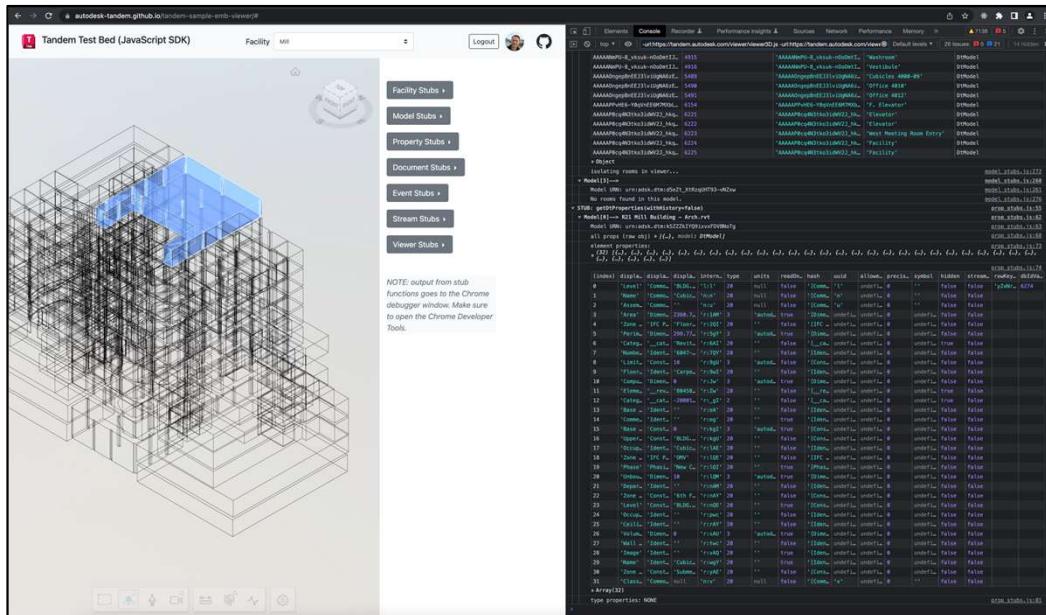
The screenshot shows the Autodesk Tandem TestBed (REST) interface. On the left, there's a map of a facility with several buildings. To the right of the map is a sidebar with navigation links: Facility Stubs, Model Stubs, Property Stubs, Group Stubs, Streams Stubs, Miscellaneous Stubs, Tandem App Stubs, and Diagnostic Stubs. Below the sidebar is a note: "NOTE: output from stub functions goes to the Chrome debugger window. Make sure to open the Chrome Developer Tools." The main area contains a large code editor window displaying REST API requests and responses. The code includes various endpoints like /getFacilities, /getFacilitiesActiveTeam, /getFacilitiesByName, and /getFacilitiesByTeam. It also shows JSON data for facilities such as "Improvements testing AEDS", "IPD & Test facilities", "Tandem Licensing Systems", "Cable test", "Excel AED in", "Improve test update", "Hospital B1 Test", "Hospital A in 22-33-28", "Improve test update", "Facility Monitoring", "Autodesk Yoranga", "Test Building 1", "Signal Butte Water Treatment Plant", "Pacific Center Building A", "MDC Building", "Signal Butte Water Treatment Plant", "School of Medicine and Biomedical", "Yoranga", "Jane M. Gilman Children's Hospital", and "Pacific Center Building A2". The code uses the Tandem API library, as indicated by imports like "import { Tandem } from 'tandem'" and "const tandem = new Tandem();". The developer tools window shows network requests and responses, including headers, status codes, and raw data.

- No ビューアー
- APIの対話型学習ツール
- 独自のプロジェクトにコピーできるコードスタブ
- 何が起こっているかをデバッグおよびリバースエンジニアリングするための良い方法

<https://autodesk-tandem.github.io/tandem-sample-rest-testbed>



Tandem TestBed (JavaScript SDK)

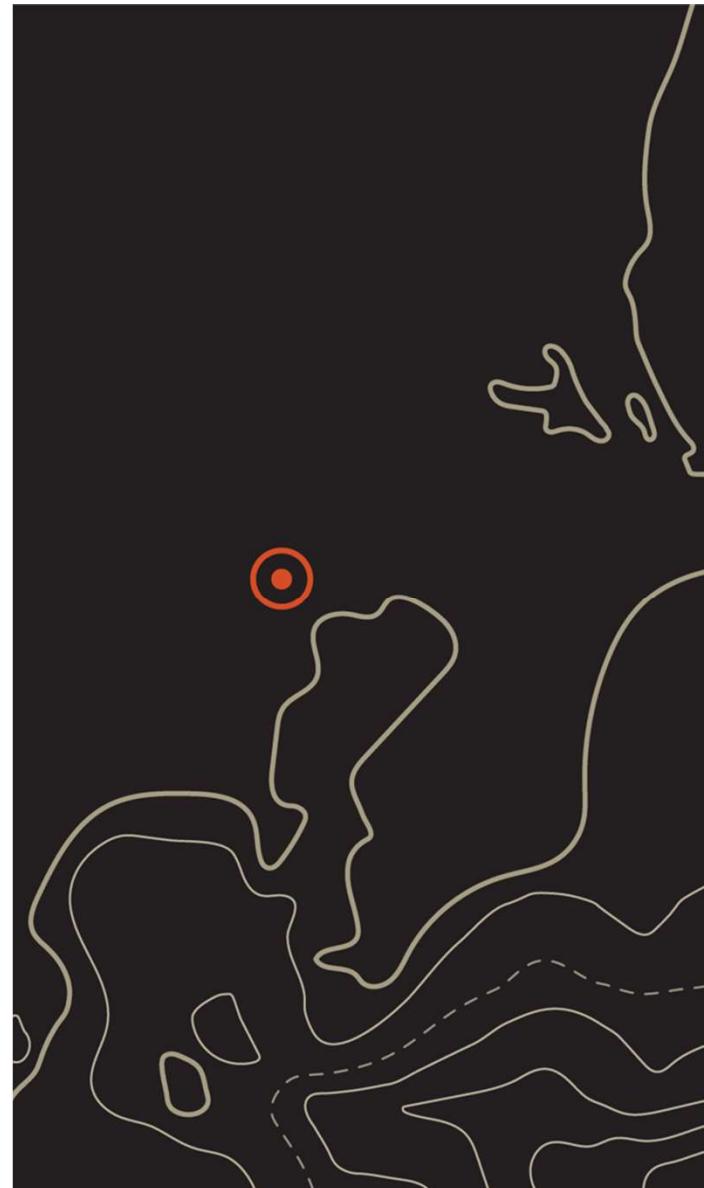


- 「埋め込みビューア」の例
- APS Viewer を知っている人にとっては見覚えのあるものでしょう。
- APIの対話型学習ツール
- 独自のプロジェクトにコピーできるコードスタブ
- 何が起こっているかをデバッグおよびリバースエンジニアリングするための良い方法

<https://autodesk-tandem.github.io/tandem-sample-emb-viewer>

まとめ

- 1 デジタルツインとは
- 2 Autodesk Tandem プロダクトの紹介
- 3 Autodesk Tandem API





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