



中国中铁

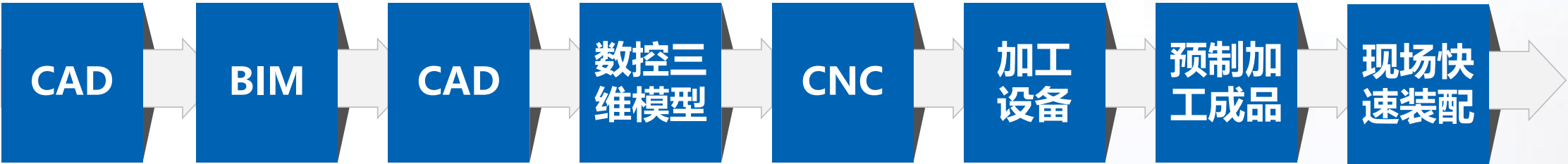
勇于跨越 追求卓越

# 基于BIM的预制装配技术研究与应

中铁建工集团建筑安装有限公司

李解

- 随着BIM技术在机电工程行业应用的逐渐深入，数字化建造应用逐渐加强，“工厂化预制+现场快速装配”已成为发展趋势，对模型精度（LOD）的要求越来越高，传统Revit模型在完成设计、详图阶段后，已不满足**制造**阶段的需要。传统BIM预制加工数据流转如图所示：



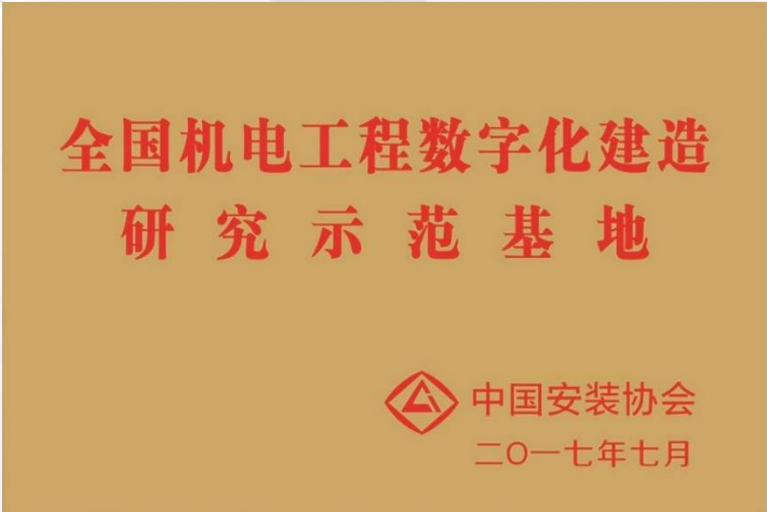
|                                 | 设计 | 详图 | 制造 | 安装 | 运维 |
|---------------------------------|----|----|----|----|----|
| Revit                           | √  | √  |    | √  | √  |
| Fabrication/AutoCAD+Fabrication | √  | √  | √  | √  |    |
| Revit+Fabrication               | √  | √  | √  | √  | √  |

- 数字化建造技术三大要素：**数字化加工基地及设备、数据库、软件平台**



公司自2012年起，积极开展“基于BIM的机电工程数字化建造”研究与应用，2016年成立基地。

中铁建工安装恒鼎数字化加工基地于2017年6月16日，顺利通过了中国安装协会专家领导的考察，被正式评为“全国机电工程数字化建造研究示范基地”，并于2017年7月26日正式挂牌成立。



|      | 第一阶段   | 第二阶段    | 第三阶段     |
|------|--------|---------|----------|
| 加工方式 | 工厂集中加工 | 工厂+现场加工 | 工厂+移动式加工 |
| 加工设备 | 设备改造   | 设备升级    | 设备研发     |
| 应用范围 | 小型机房   | 大型机房    | 大型工厂     |





- 创建与数字化加工设备匹配的共享预制加工数据库，该共享预制加工数据库主要包含：风管、水管、桥架、设备、支吊架等，并根据水暖电系统进行区分，预制加工数据库基于厂商信息和规范要求，满足制造精度要求。



Fabrication预制加工数据库



Revit预制加工数据库



企业预制加工数据库



Imperial Content V3.04

C:\Users\Public\Documents\Autodesk\F... \V3.04



Metric Content V7.04

C:\Users\Public\Documents\Autodesk\F... \V7.04



Revit MEP Imperial Content V2.0

C:\Users\Public\Documents\Autodesk\Fa... \V2.0



Revit MEP Metric Content V2.0

C:\Users\Public\Documents\Autodesk\Fa... \V2.0



中国中铁

恒鼎数字化加工基地 V1.0

C:\Users\Public\Doc... \恒鼎数字化加工基地

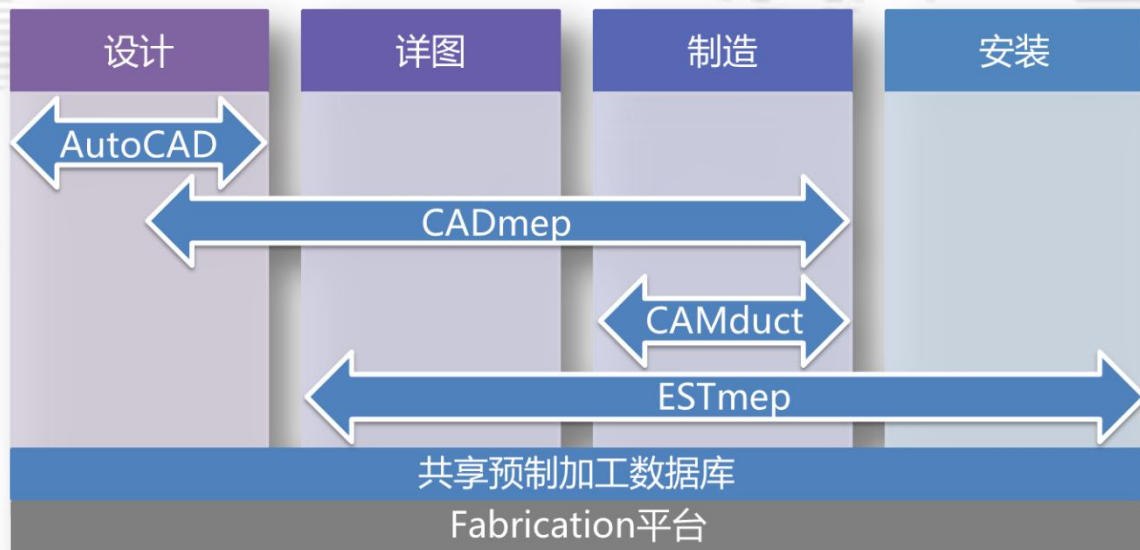


中国中铁

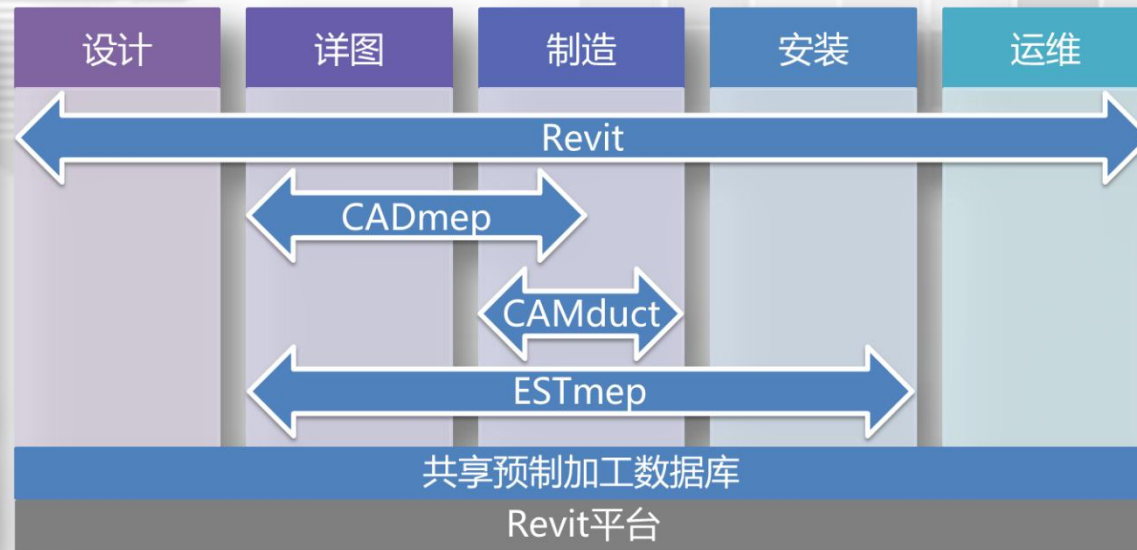
联翔数字化加工基地 V1.0

C:\Users\Public\Doc... \联翔数字化加工基地





基于Fabrication平台的机电工程数字化建造



基于Revit平台的机电工程数字化建造



传统BIM预制加工数据流转



01 沈阳华晨宝马项目简介

02 项目重难点分析

03 BIM实施方案与人员架构

04 软硬件配置

05 BIM创新技术应用

06 BIM综合应用

07 BIM应用成果总结

08 人才培养团队建设



中国中铁

01

## 沈阳华晨宝马项目简介





- 华晨宝马汽车有限公司产品升级项目：包括涂装车间，车身库，连廊，车身车间。项目总建筑面积为22.1万平方米，其中涂装车间为亚洲最大涂装车间。
- 合同工期：2020/04/01-2021/11/30
- 创优目标：鲁班奖



**2020年10月20日完成**

车身库机电安装完成

**2021年02月28日完成**

涂装车间及连廊机电  
安装完成

**2021年06月15日**

联合调试完成

**2021年11月30日**

竣工交验



**2020年08月10日**

开工建设

**2020年10月25日完成**

临时采暖完成

**2021年04月01日完成**

单机调试完成

本工程2020年04月01日开工建设，2021年11月30日竣工交验，合同工期20个月，阶段性工期节点目标如上。



中国中铁

02

## 项目重难点分析



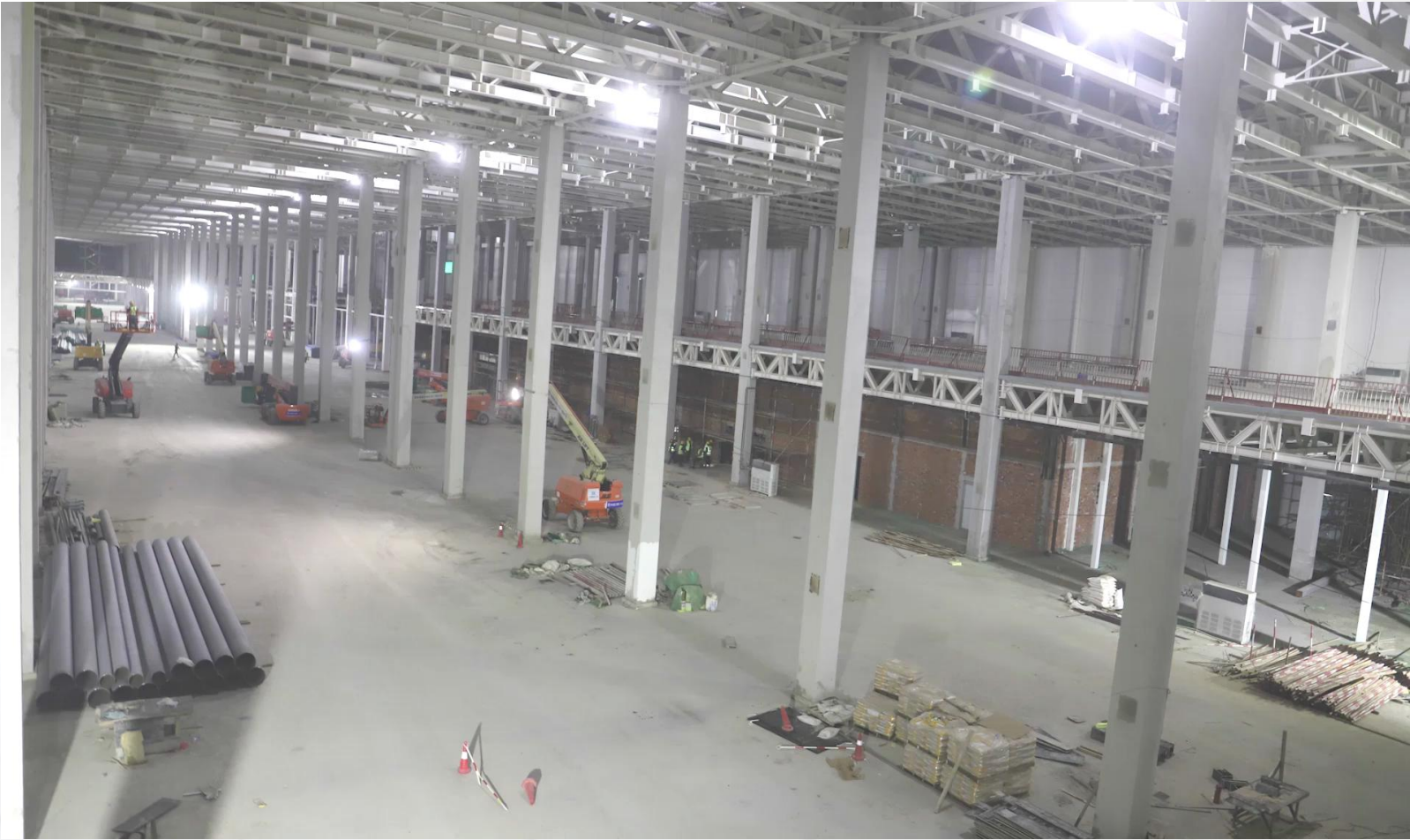
| 序号 | 难点                        | 应对措施                                                                                                                                                                                                        |
|----|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | 场地狭小、立体交叉作业多；现场施工组织及部署难度大 | <p>1、合理进行场地布置对于各单位场地的占用进行严格的审批和规划。</p> <p>2、细化施工部署，对于各分包的穿插时间以及施工进度进行严格的管控，减少互相影响。</p> <p>3、各工序的施工顺序确保最优，每周对各分包召开协调会，过程中及时调整。</p> <p>4、提前申请外场用地避免场地受限制约进度。</p> <p>5、严控作业面移交质量和时间。加强各单位成品保护。</p> <p>场外预制</p> |







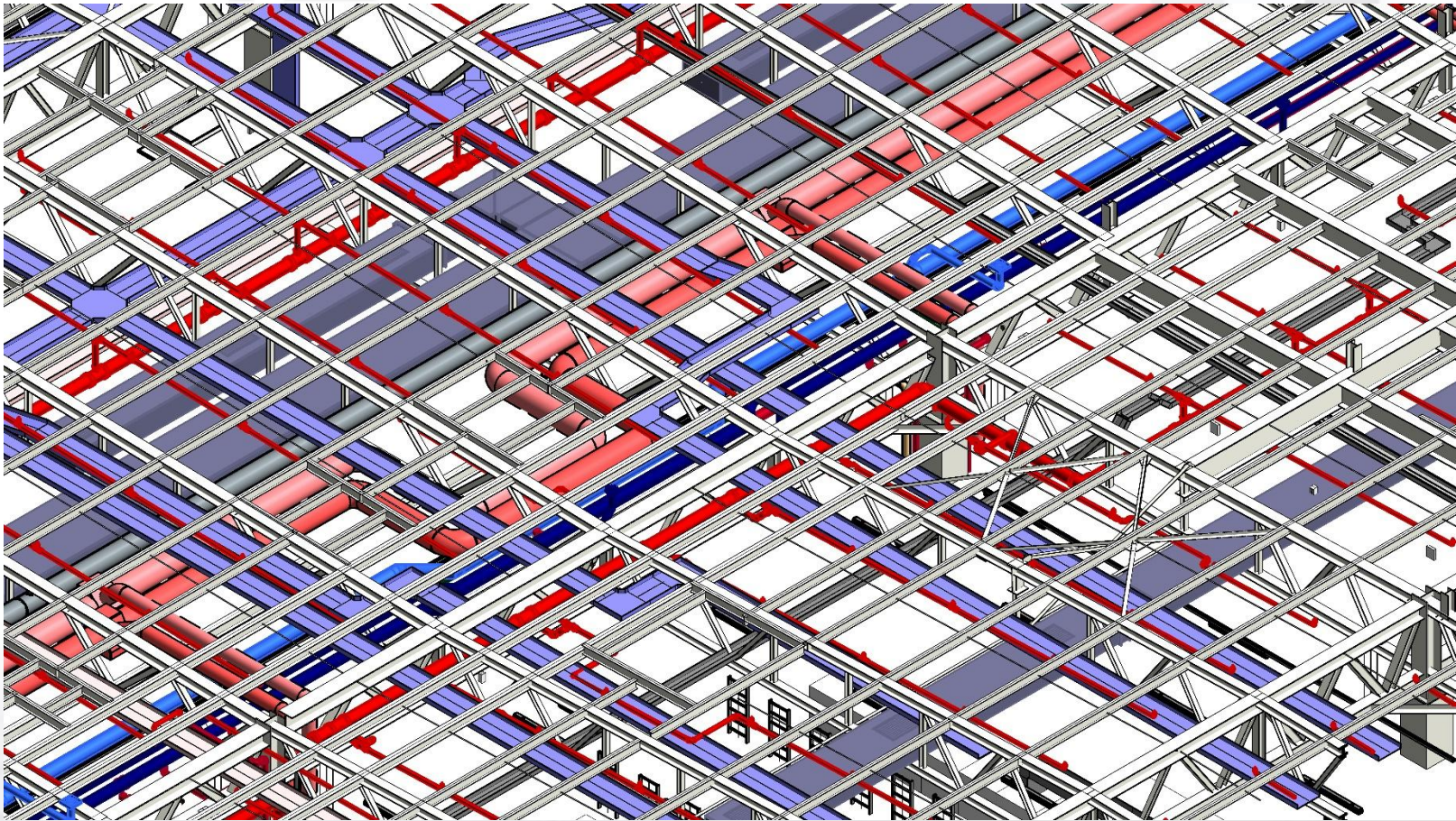
| 序号 | 难点        | 应对措施                                                                                                                |
|----|-----------|---------------------------------------------------------------------------------------------------------------------|
| 2  | 高大空间施工效率低 | <p>1、平行施工：不同专业在不同施工区域同时进行施工作业，避免在同一施工区域的交叉作业；</p> <p>2、合理选用施工机械，有效提高施工效率；</p> <p>3、采用工厂化预制加工，高空快速装配，尽量减少高空作业时间。</p> |







| 序号 | 难点                                            | 应对措施                                                                                                                                                         |
|----|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3  | 机电材料包含辅梁、电气系统桥架、消火栓及喷淋系统管道排烟系统风管，等种类繁多，现场加工混乱 | <div>1、将大部分人工加工转移至数字化加工基地进行自动化生产，将预制构件运输至现场进行拼装；</div> <div>2、现场加工部分通过采用便携式全位置自动焊机、便携式合缝机等设备进行加工；</div> <div>3、利用Revit、Fabrication系列软件和BIM管理系统进行控制和优化。</div> |







中国中铁

| 序号 | 难点           | 应对措施                                                         |
|----|--------------|--------------------------------------------------------------|
| 4  | 工期紧张，工序、工艺复杂 | 1、利用广联达BIM5D，Oracle Primavera P6 EPPM、Synchro等平台软件进行施工进度模拟控制 |

| BMW Brilliance Automotive Ltd Products Upgrading Project (Tiexi)-Paint Shop and CBS MEP Project Master Schedule |                                                                             |                                                     |                   |             |             |      |    |    |    |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------|-------------------|-------------|-------------|------|----|----|----|
| Activity ID                                                                                                     | Activity Name                                                               | 作业名称                                                | Original Duration | Start       | Finish      | 2020 |    |    |    |
|                                                                                                                 |                                                                             |                                                     |                   |             |             | Q1   | Q2 | Q3 | Q4 |
|                                                                                                                 |                                                                             |                                                     |                   |             |             | Q1   | Q2 | Q3 | Q4 |
|                                                                                                                 |                                                                             |                                                     |                   |             |             | Q1   | Q2 | Q3 | Q4 |
| <b>Paint Shop and CBS MEP Project Master Schedule</b>                                                           |                                                                             |                                                     | 688               | 2020-04-01  | 2021-11-30  |      |    |    |    |
| <b>Paint Shop &amp; Conveyor bridge</b>                                                                         |                                                                             |                                                     | 394               | 2020-04-01  | 2021-04-30  |      |    |    |    |
| <b>CSA Reference Milestone (土建参考节点时间)</b>                                                                       |                                                                             |                                                     | 77                | 2020-08-30  | 2020-11-15  |      |    |    |    |
| BMW-PS-1080                                                                                                     | Steel Structure Installation                                                | 钢结构安装                                               | 0                 |             | 2020-08-30* |      |    |    |    |
| BMW-PS-1100                                                                                                     | Platform +18.0m Platform Complete                                           | +18.0m 平台完成                                         | 0                 |             | 2020-09-30* |      |    |    |    |
| BMW-PS-1120                                                                                                     | Platform +8.0m                                                              | +8.0m 平台完成                                          | 0                 |             | 2020-09-30* |      |    |    |    |
| BMW-PS-1170                                                                                                     | Roof Works Complete                                                         | 屋面工作完成                                              | 0                 |             | 2020-10-15* |      |    |    |    |
| BMW-PS-1180                                                                                                     | Building Shell Closed                                                       | 建筑物封闭                                               | 0                 |             | 2020-11-15* |      |    |    |    |
| <b>MEP Installation (机电安装)</b>                                                                                  |                                                                             |                                                     | 394               | 2020-04-01  | 2021-04-30  |      |    |    |    |
| BMW-PM-1460                                                                                                     | Project Start                                                               | 项目开始                                                | 0                 | 2020-04-01* |             |      |    |    |    |
| BMW-PM-1080                                                                                                     | MEP Auxiliary Beam start                                                    | 机电辅梁开始                                              | 0                 | 2020-07-31* |             |      |    |    |    |
| BMW-PM-1500                                                                                                     | Temporary Heating Complete                                                  | 厂房内临时采暖完成                                           | 0                 |             | 2020-10-31* |      |    |    |    |
| BMW-PM-1730                                                                                                     | Area 1(60-55.U01.L-02, 51.L-4B/U1.L-02) MEP Complete(include pipe pressure) | 区域1(60-55.U01.L-02, 51.L-4B/U1.L-02)机电系统完成 (包含管道打压) | 0                 |             | 2020-11-30* |      |    |    |    |
| BMW-PM-1740                                                                                                     | Area 2(60-40.U04-P)MEP Complete(include pipe pressure)                      | 区域2(60-40.U04-P)机电系统完成 (包含管道打压)                     | 0                 |             | 2020-12-31* |      |    |    |    |
| BMW-PM-1750                                                                                                     | Area 3(60-40.U02-04) MEP Complete(include pipe pressure)                    | 区域3(60-40.U02-04) 机电系统完成 (包含管道打压)                   | 0                 |             | 2021-01-31* |      |    |    |    |
| BMW-PM-1510                                                                                                     | Plumbing Complete                                                           | 给水系统完成                                              | 0                 |             | 2021-02-28* |      |    |    |    |
| BMW-PM-1180                                                                                                     | Fire Fighting & sprinkler system Complete                                   | 消火栓及喷淋系统完成                                          | 0                 |             | 2021-02-28* |      |    |    |    |
| BMW-PM-1210                                                                                                     | Energy System Complete(Hot Water & Compressed Air)                          | 动力系统完成 (热水及压缩空气)                                    | 0                 |             | 2021-02-28* |      |    |    |    |
| BMW-BM-1220                                                                                                     | IT & Security & BAS Work Scope Complete                                     | IT、安防等施工范围完成                                        | 0                 |             | 2021-02-28* |      |    |    |    |
| BMW-PM-1190                                                                                                     | Electrical Complete(include fire alarm)                                     | 电气系统安装完成 (包含消防电)                                    | 0                 |             | 2021-03-31* |      |    |    |    |
| BMW-PM-1520                                                                                                     | HVAC Complete(including smoke exhaust and air supplement system)            | 暖通空调系统安装完成 (包含排烟及补风系统)                              | 0                 |             | 2021-03-31* |      |    |    |    |
| BMW-PM-1230                                                                                                     | BAS Complete                                                                | 楼宇自动化系统完成                                           | 0                 |             | 2021-03-31* |      |    |    |    |
| BMW-PM-1490                                                                                                     | GPS System Power on                                                         | GPS系统通电                                             | 0                 |             | 2021-04-15* |      |    |    |    |
| BMW-PM-1830                                                                                                     | EPS System Power on                                                         | EPS系统通电                                             | 0                 |             | 2021-04-15* |      |    |    |    |
| BMW-PM-1760                                                                                                     | Office & Auxiliary Building MEP System Complete                             | 办公室及辅助房机电系统完成                                       | 0                 |             | 2021-04-30* |      |    |    |    |
| BMW-PM-1820                                                                                                     | Hang Wall Complete                                                          | 挡烟垂壁完成                                              | 0                 |             | 2021-04-30* |      |    |    |    |
| <b>CBS</b>                                                                                                      |                                                                             |                                                     | 122               | 2020-07-01  | 2020-10-31  |      |    |    |    |
| <b>CSA Reference Milestone (土建参考节点时间)</b>                                                                       |                                                                             |                                                     | 32                | 2020-07-15  | 2020-08-15  |      |    |    |    |
| BMW-PS-1280                                                                                                     | Steel Structure Complete                                                    | 钢结构完成                                               | 0                 |             | 2020-07-15* |      |    |    |    |
| BMW-PS-1290                                                                                                     | Roof Works Complete                                                         | 屋面工作完成                                              | 0                 |             | 2020-08-15* |      |    |    |    |
| <b>MEP Installation (机电安装)</b>                                                                                  |                                                                             |                                                     | 122               | 2020-07-01  | 2020-10-31  |      |    |    |    |
| BMW-PM-1570                                                                                                     | MEP Auxiliary Beam Install start                                            | 机电辅梁安装开始                                            | 0                 | 2020-07-01* |             |      |    |    |    |
| BMW-PM-1810                                                                                                     | Temporary Heating Complete                                                  | 厂房内临时采暖完成                                           | 0                 |             | 2020-10-31* |      |    |    |    |
| <b>区域1 (涂装车间)</b>                                                                                               |                                                                             |                                                     | 0                 | 2020-09-01  | 2020-09-01  |      |    |    |    |
| BMW-PM-1770                                                                                                     | Hydrant & sprinkler system complete                                         | 消火栓及喷淋系统完成                                          | 0                 |             | 2020-09-01* |      |    |    |    |
| BMW-PM-1780                                                                                                     | Electrical Complete(include fire alarm)                                     | 电气系统完成 (包含消防电)                                      | 0                 |             | 2020-09-01* |      |    |    |    |
| BMW-PM-1790                                                                                                     | IT & Security Complete                                                      | IT路由及安防系统完成                                         | 0                 |             | 2020-09-01* |      |    |    |    |
| BMW-PM-1800                                                                                                     | BAS Complete                                                                | 楼宇自动化系统完成                                           | 0                 |             | 2020-09-01* |      |    |    |    |
| <b>区域2 (涂装废水处理站)</b>                                                                                            |                                                                             |                                                     | 0                 | 2020-10-20  | 2020-10-20  |      |    |    |    |
| BMW-PM-1660                                                                                                     | Hydrant & sprinkler system complete                                         | 消火栓及喷淋系统完成                                          | 0                 |             | 2020-10-20* |      |    |    |    |

■ Actual Work    
 ■ Critical Remaining Work    
 ▼ Summary  
■ Remaining Work    
 ◆ Milestone

Page 1 of 2      
 [天：除特殊说明外，均指日历天。本进度计划中按天计算时间的，开始当天计入，期限最后一天的



中国中铁

03

## BIM实施方案与人员架构



- 管理模式:

- 为规范项目施工阶段建筑信息模型技术应用行为，实现应用过程的统一性、规范性、可持续性，提升应用的水平和协同工作质量。推动试点项目BIM应用落地，积累项目应用经验，助力促进集团基于BIM的数字化管理转型与升级，推动项目及企业综合治理的精益化管理。主要研究包括BIM管理规范及BIM技术标准，明晰参与单位职责内容，明确BIM成果标准，并将其作为项目应用BIM技术的纲领性文件，项目所有参与方共同遵循导则中的规范和标准开展BIM工作。研究在施工阶段项目各参与方BIM实施的成果要求，分析达成这些成果所必须的过程要求。

- 实施办法:

- 研究工作统一模板，针对BIM工作过程中涉及到的组织机构、工作计划流程、实施标准及成果、软硬件配置、周报管理、月报管理、成果交付说明、审核报告及BIM成果验收单等内容，进行规定。主要包含：建模管理办法、模型更新及维护管理办法、模型交付管理、模型数据收集管理、碰撞检测及深化设计管理、基于 BIM 技术的施工进度计划编制管理、基于 BIM 技术的施工进度控制管理、BIM 技术的施工现场平面管理、BIM 技术的专项施工方案模拟及优化管理、基于 BIM 技术的3维/4 维技术交底管理、基于 BIM 技术的竣工及验收管理、基于 BIM 技术的施工安全管理、基于 BIM 技术的施工物料管理、基于 BIM 技术的成本管理。





1. BIM实施方案
2. 构件分类分级规则
3. 族命名标准
4. 系统缩写与颜色规范
5. LOD\_BBA
6. 项目执行计划-DC
7. 项目执行计划-LDI
8. 任务信息交付计划
9. 数字空间明细表
10. BBA\_3D模型命名规则
11. 模型质量审核表
12. 项目样板审核表
13. 设施编码系统

TEMP\_BEP-DC  
STD 00100  
项目执行计划

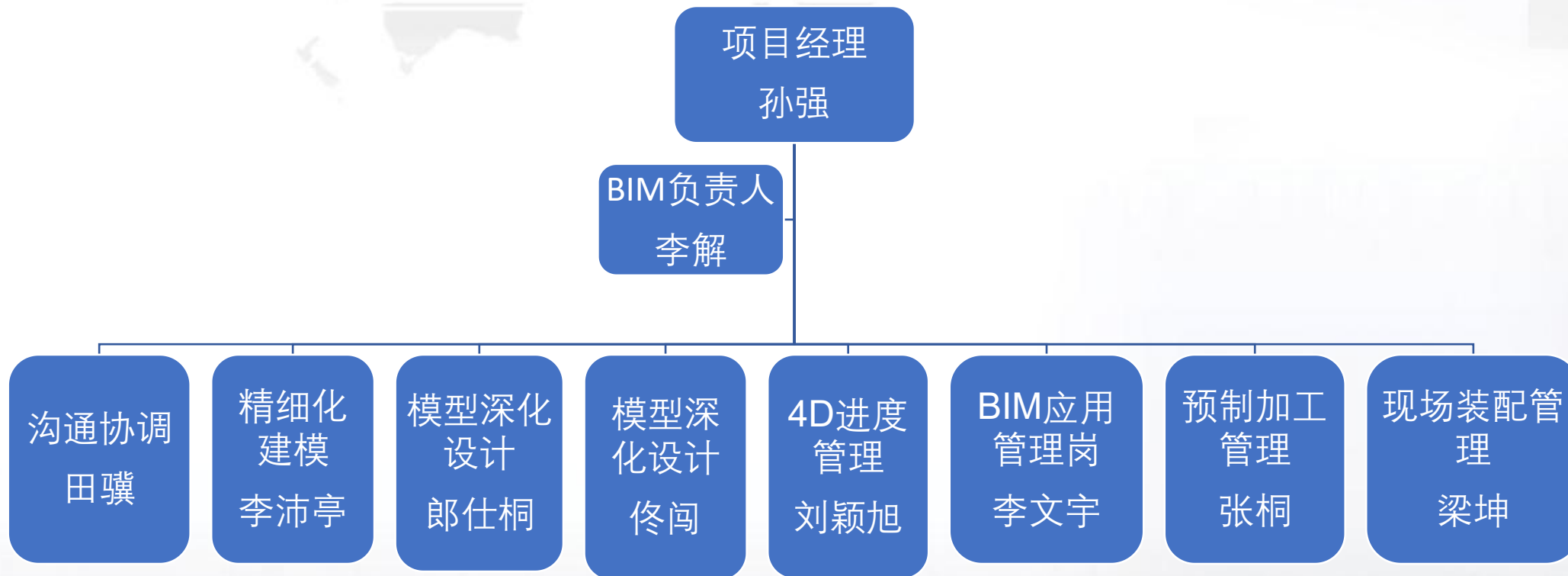
TEMP\_BEP-DC  
项目执行计划  
(BEP)

Family Naming Standard  
STD 00100  
族命名标准

Family Naming Standard  
族命名标准

| System Document<br>建筑、机电、环境、车辆设备设施及运行管理标准 |                                 |                                               | System abbreviation and color<br>specification<br>系统缩写与颜色规范 |                      | For reference only<br>仅供参考      |
|-------------------------------------------|---------------------------------|-----------------------------------------------|-------------------------------------------------------------|----------------------|---------------------------------|
| NO.<br>序号                                 | System Name<br>系统名称             | Corresponding<br>REVIT component<br>对应REVIT组件 | System code<br>系统代号                                         | Color swatch<br>色卡编号 | REVIT values of color<br>颜色RGB值 |
| 1                                         | Compressed Air<br>压缩空气          | pressure system<br>压力系统                       | CA                                                          |                      | 130,130,130                     |
| 2                                         | Steam Compressed Air<br>蒸汽压缩空气  | pressure system<br>压力系统                       | OCA                                                         |                      | 130,130,130                     |
| 3                                         | Water<br>水                      | pressure system<br>压力系统                       | W                                                           |                      | 255,255,255                     |
| 4                                         | Compressed Natural Gas<br>压缩天然气 | pressure system<br>压力系统                       | CNG                                                         |                      | 244,148,67                      |
| 5                                         | Oil<br>油                        | pressure system<br>压力系统                       | VO                                                          |                      | 255,255,255                     |
| 6                                         | Water Emulsion<br>水乳剂           | pressure system<br>压力系统                       | WET                                                         |                      | 191,191,191                     |
| 7                                         | Steam<br>蒸汽                     | pressure system<br>压力系统                       | SA                                                          |                      | 220,220,220                     |
| 8                                         | Hydrogen<br>氢气                  | pressure system<br>压力系统                       | HO                                                          |                      | 255,255,255                     |
| 9                                         | Hydrogen<br>氢气                  | pressure system<br>压力系统                       | HO                                                          |                      | 255,255,255                     |
| 10                                        | Hydrogen<br>氢气                  | pressure system<br>压力系统                       | HO                                                          |                      | 255,255,255                     |
| 11                                        | Hydrogen<br>氢气                  | pressure system<br>压力系统                       | HO                                                          |                      | 255,255,255                     |
| 12                                        | Hydrogen<br>氢气                  | pressure system<br>压力系统                       | HO                                                          |                      | 255,255,255                     |
| 13                                        | Hydrogen<br>氢气                  | pressure system<br>压力系统                       | HO                                                          |                      | 255,255,255                     |

| BIM System Construction Standard |                        |             |              |              |              |              |              |              |              |
|----------------------------------|------------------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| NO.                              | System Name            | System Code | System Color | System Color | System Color | System Color | System Color | System Color | System Color |
| 1                                | Compressed Air         | CA          |              |              |              |              |              |              |              |
| 2                                | Steam Compressed Air   | OCA         |              |              |              |              |              |              |              |
| 3                                | Water                  | W           |              |              |              |              |              |              |              |
| 4                                | Compressed Natural Gas | CNG         |              |              |              |              |              |              |              |
| 5                                | Oil                    | VO          |              |              |              |              |              |              |              |
| 6                                | Water Emulsion         | WET         |              |              |              |              |              |              |              |
| 7                                | Steam                  | SA          |              |              |              |              |              |              |              |
| 8                                | Hydrogen               | HO          |              |              |              |              |              |              |              |
| 9                                | Hydrogen               | HO          |              |              |              |              |              |              |              |
| 10                               | Hydrogen               | HO          |              |              |              |              |              |              |              |
| 11                               | Hydrogen               | HO          |              |              |              |              |              |              |              |
| 12                               | Hydrogen               | HO          |              |              |              |              |              |              |              |
| 13                               | Hydrogen               | HO          |              |              |              |              |              |              |              |





中国中铁

04

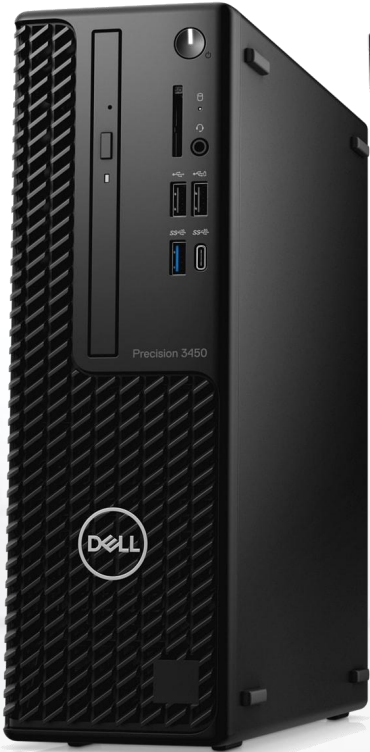
## 软硬件配置

| 建模类软件            |                      |                                                                                      |
|------------------|----------------------|--------------------------------------------------------------------------------------|
| 软件名称             | 用途                   | 图标                                                                                   |
| Revit            | 模型、节点<br>深化          |     |
| Navisworks       | 模型轻量化<br>整合、碰撞<br>检测 |     |
| Tekla structures | 钢结构模型<br>深化          |    |
| Lumion           | 效果输出、<br>虚拟漫游        |     |
| 橄榄山快模            | 预留洞口                 |   |
| 建模大师             | 机电应用，<br>效率提升        |  |
| 品茗CCBIM          | 移动端模型<br>查看，校审       |   |

| 平台/数字化加工软件                  |       |                                                                                       |
|-----------------------------|-------|---------------------------------------------------------------------------------------|
| 软件名称                        | 用途    | 图标                                                                                    |
| 广联达BIM5D                    | 智慧工地  |    |
| BIMS                        | 管理平台  |    |
| Oracle Primavera P6<br>EPPM | 进度计划  |    |
| Synchro                     | 进度模拟  |    |
| Fabrication                 | 简化预制  |    |
| Lantek                      | 数字化加工 |  |



| 序号 | 设备配置                                                                                                                   | 数量 |
|----|------------------------------------------------------------------------------------------------------------------------|----|
| 1  | Dell Precision 7750 Intel(R) Core(TM) i9-10885H/Ram-32 GB/Nvidia Quadro RTX3000( 6 GB/GDDR6)                           | 1台 |
| 2  | Dell Precision 7710 Intel Core i7-6920HQ/Ram-32G/ Nvidia Quadro M3000M( 4 GB/GDDR5)                                    | 2台 |
| 3  | BIM台式机Intel(R) Core(TM) i9-10850K/Ram-64GB/Nvidia GeForce RTX3070( 8 GB/GDDR6 )                                        | 2台 |
| 4  | DELL R740 2U机架服务器/1*英特尔 至强 铂金 8268 2.9G, 24C/48T, 10.4GT/s, 35.75M 缓存, Turbo, HT (205W) DDR4-2933/32G*4; 3200MHz DDR 4 | 1台 |





3D打印机



VR/AR设备



桥架生产线



螺旋风管机



防火一体板生产线



悬臂式自动焊机





中国中铁

05

## BIM创新技术应用



# 三大应用 亮点

1

Synchro+P6进度控制

2

BIM+机电辅梁预制装配

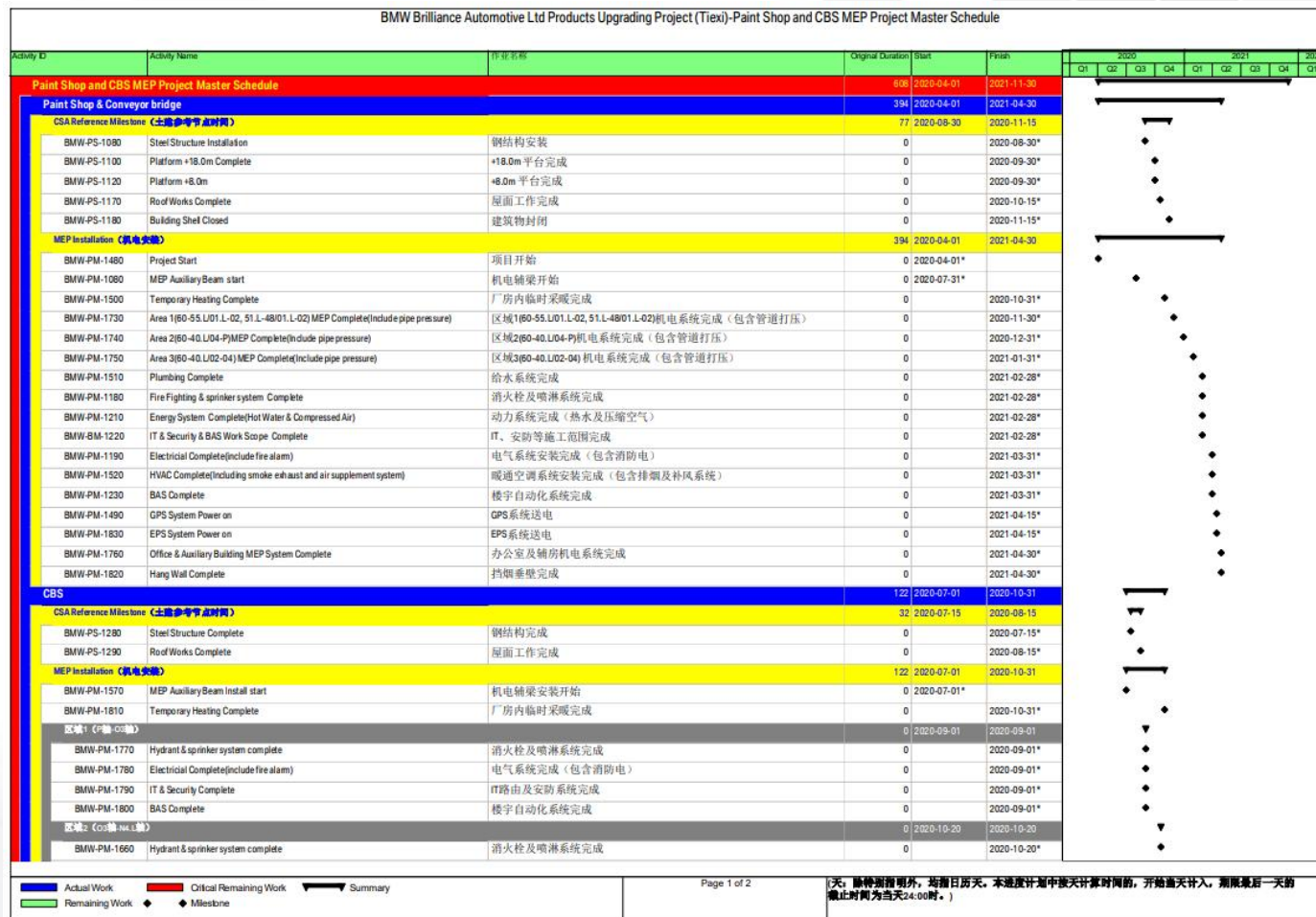
3

BIM+机电管线预制装配



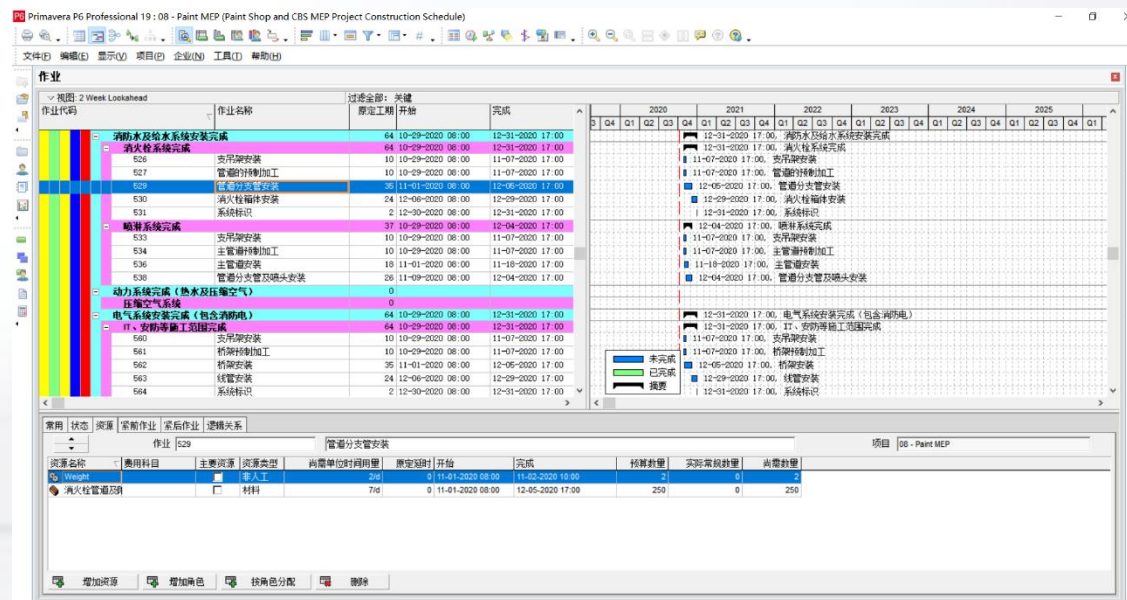
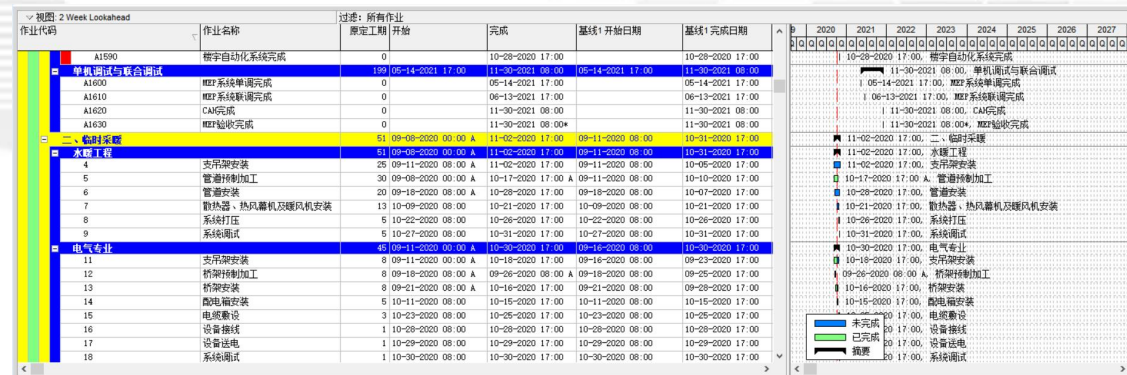


- Oracle Primavera P6 EPPM 荟萃了P3软件20年的项目管理精髓和经验,采用最新的IT技术,在大型关系数据库Oracle和MS SQL Server上构架起企业级的、包涵现代项目管理知识体系的、具有高度灵活性和开放性的、以计划---协同---跟踪---控制---积累为主线的企业级工程项目管理软件,是项目管理理论演变为实用技术的经典之作。





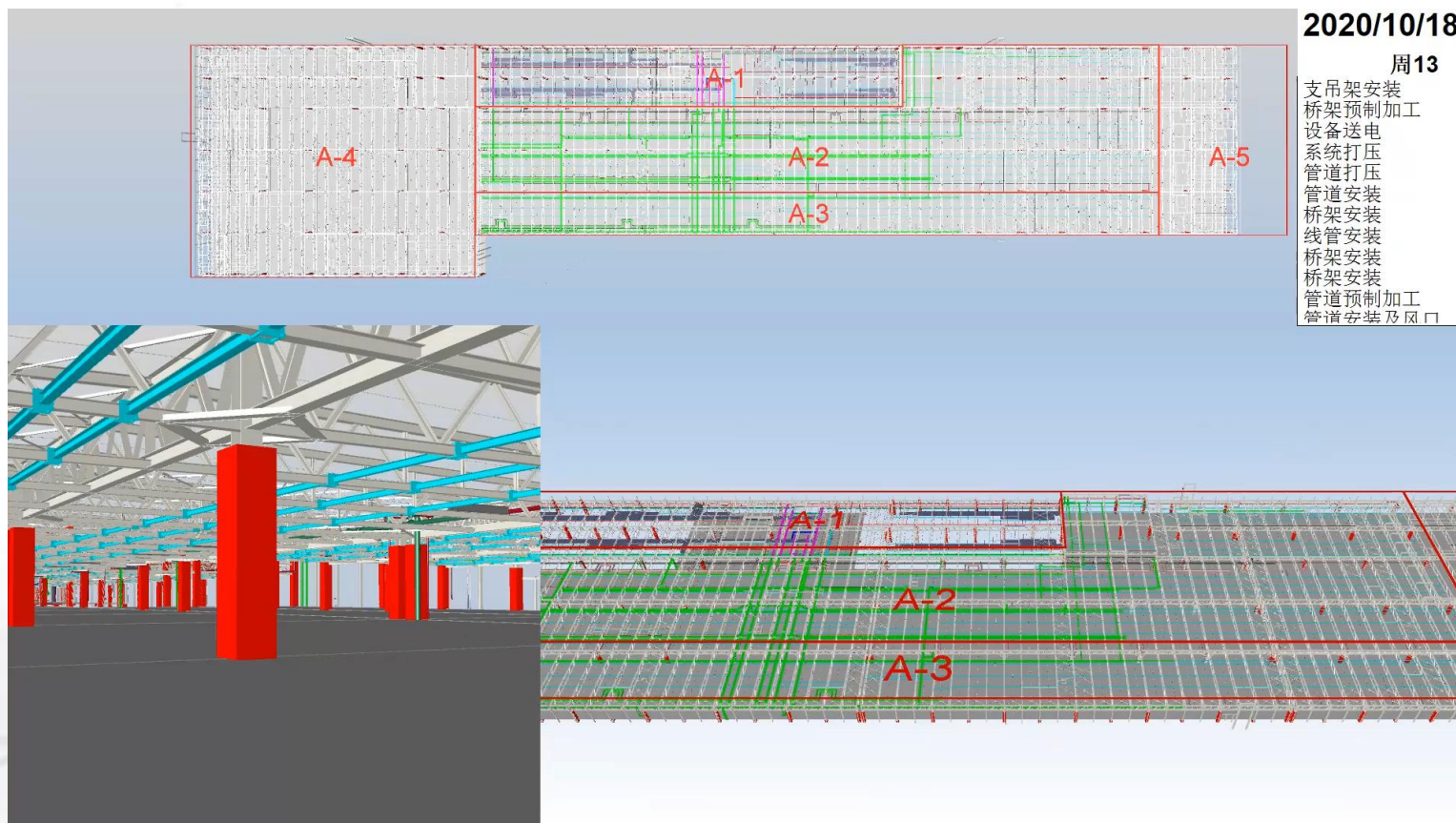
- 根据业主招标文件里程碑节点及土建单位各区域内相关作业的完成时间设置里程碑及紧前作业
- 施工作业按机电施工工序进行紧前作业、紧后作业的逻辑搭接，保证进度计划逻辑的合理性
- 根据现场实际情况及相关节点要求安排各作业工序工期，保证进度计划工期的合理性
- 按各作业浮时过程中监控进度计划实现的风险，及早识别可能延期的作业并采取纠正措施
- 通过各作业权重，分析当前和未来的资源使用情况，以作出准确的预测和决策



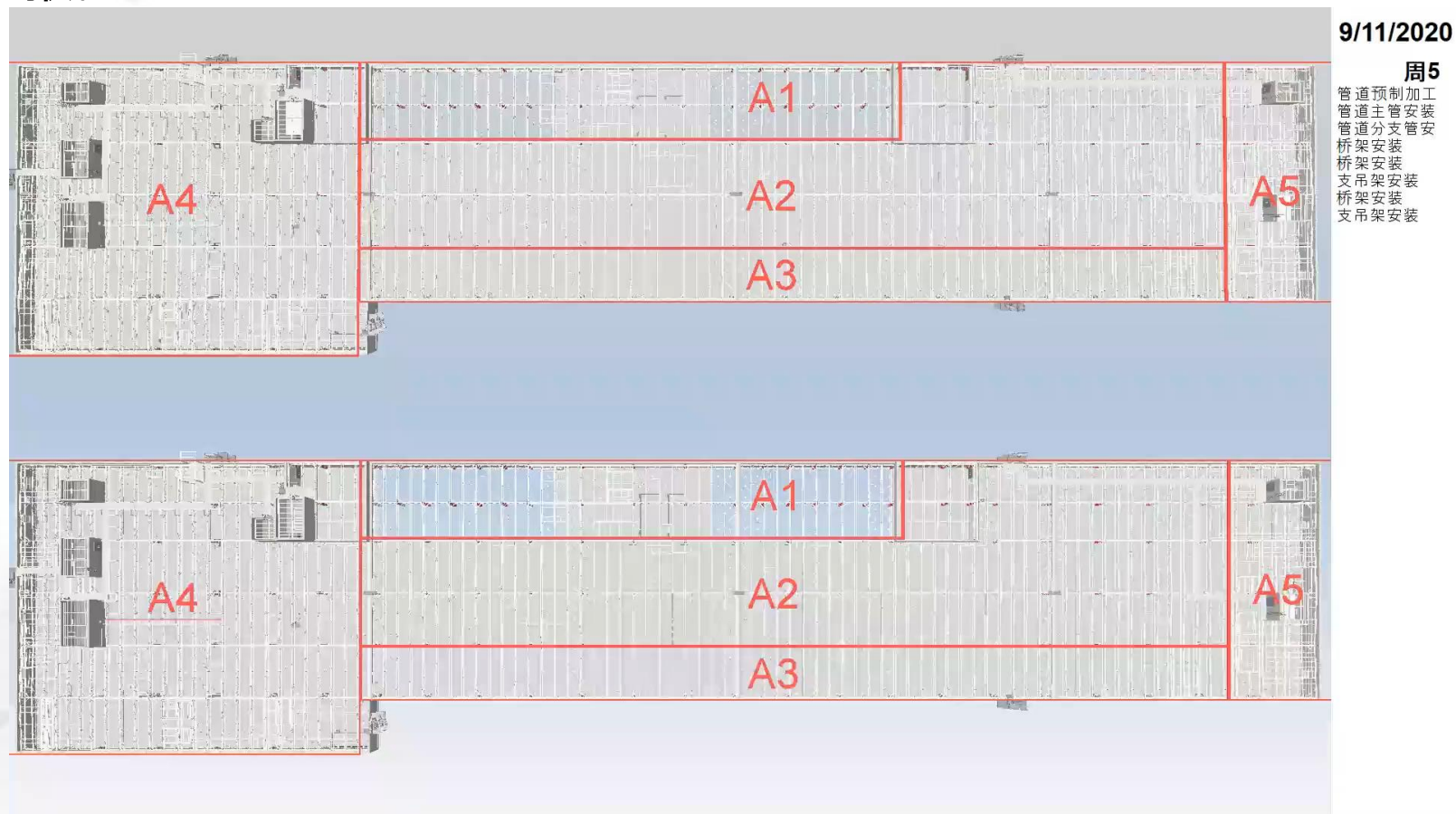




- **施工4D模拟：**将施工进度计划与BIM模型结合，利用模型协调、展示施工活动的先后顺序以及计划进度安排。模拟使用Synchro软件，模拟内容不限于施工土方挖方、场地，围挡，物料存储，交通物流，重型施工设备，塔机，脚手架等，具体内容需与业主或管理公司协调确定。模拟需每周更新一次，并在每周的进度周例会上通过Synchro软件进行展示和汇报。



- 实际与预期进度模拟对比：** BIM与施工进度计划管理的结合，模型、进度实时更新，利用模型对施工活动有组织的施工模拟，将施工进度可视化，并和现场实际施工进度进行比对，以便在早期发现进度计划之外的偏差，采取措施解决发现的问题，在每周的进度周例会上通过Synchro软件进行展示和汇报。







- 进度偏差分析
- (1) 消火栓及喷淋系统管道、电气及弱电系统桥架、动力热水及排烟管道均比进度计划提前;
- (2) 电气线管滞后5146米, 弱电线管滞后11908米;

| 序号<br>Number | 作业内容<br>Job content                | 偏差量<br>Deviation value | 偏差原因<br>Deviation causes                                                                                                                                                                                                       | 赶工措施<br>The crush measures                                                                                  |
|--------------|------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 1            | 消火栓及喷淋管道<br>Hydrant and spray pipe | 1841m                  | -                                                                                                                                                                                                                              | -                                                                                                           |
| 2            | 电气桥架<br>Electric bridge            | 2267m                  | -                                                                                                                                                                                                                              | -                                                                                                           |
| 3            | 电气线管<br>Electric line pipe         | -5146m                 | (1) 区域1、区域3柱子已移交, 其他区域柱子暂未移交;<br>The pillars of region 1 and region 3 have been handed over, while the pillars of other regions have not been handed over yet;<br>(2) 线管施工速度慢;<br>The construction speed of line pipe is slow; | (1) 增加施工人员10人, 已经到场;<br>10 additional construction personnel have been present;<br>(2) 夜间施工;<br>Night work; |
| 4            | 弱电桥架<br>Weak current bridge        | 179m                   | -                                                                                                                                                                                                                              | -                                                                                                           |
| 5            | 弱电线管<br>Weak wire and tube         | -11908m                | (1) 区域1、区域3柱子已移交, 其他区域柱子暂未移交;<br>The pillars of region 1 and region 3 have been handed over, while the pillars of other regions have not been handed over yet;<br>(2) 线管施工速度慢;<br>The construction speed of line pipe is slow; | (1) 增加施工人员10人, 已经到场;<br>10 additional construction personnel have been present;<br>(2) 夜间施工;<br>Night work; |
| 6            | 排烟管道<br>Exhaust pipes              | 54m2                   | -                                                                                                                                                                                                                              | -                                                                                                           |
| 7            | 动力热水管道<br>Power hot water piping   | 1085m                  | -                                                                                                                                                                                                                              | -                                                                                                           |



## 5.2 BIM+机电辅梁预制装配



中国中铁

- 原方案辅梁连接方式位于主梁下弦，导致辅梁上弦不齐，造成机电管线安装困难。
- 新方案辅梁上弦对齐，通过连接件将主梁两侧辅梁固定，上弦标高一致，方便管线安装。



原方案



新方案





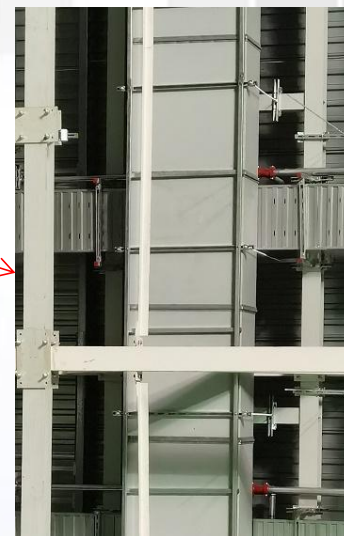
## 5.2 BIM+机电辅梁预制装配



中国中铁

- 原方案将辅梁安装于屋顶下弦，通过将支吊架生根于辅梁后，通过槽钢连接吊杆，槽钢之间通过横担，完成风管吊装，此方案辅梁用量过多，支吊架成本过高，且安全性较差。
- 新方案通过BIM优化风管管线路由，将辅梁至于钢结构梁上弦，辅梁与辅梁之间加装横担，大大减少了辅梁用量，节省了支吊架成本，且风管安装牢固。

原方案



新方案







## 5.2 BIM+机电辅梁预制装配

- 原方案辅梁安装方式同风管辅梁，支吊架生根于辅梁生成横担，将喷淋主管固定于横担之上，辅梁成本高，支吊架成本过高，且安全性较差。
- 新方案新方案通过BIM优化喷淋管线路由，主管之间加装管道连接件，节省了支吊架成本及辅梁用量。



新方案



新方案



原方案





## 5.2 BIM+机电辅梁预制装配



中国中铁

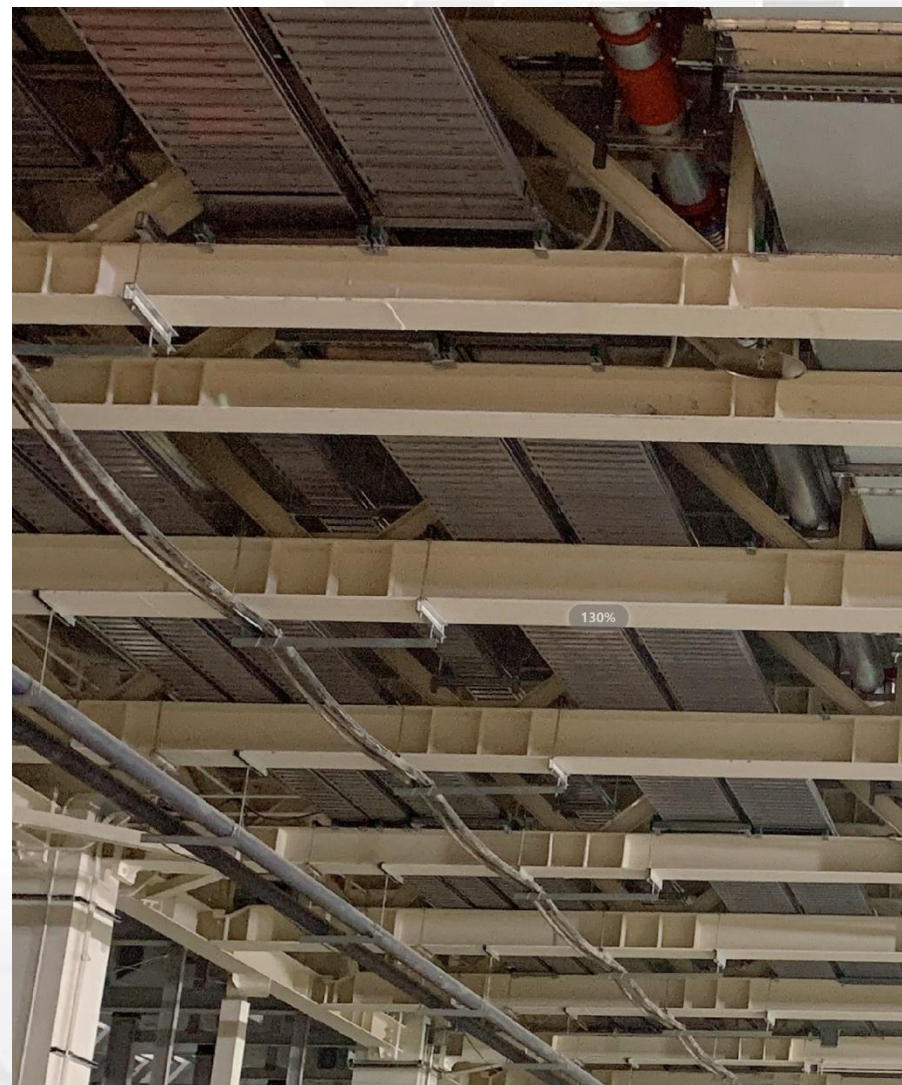
- 通过添加桥架肋板，加固桥架强度，减少机电辅梁用量。



原方案



原方案



新方案

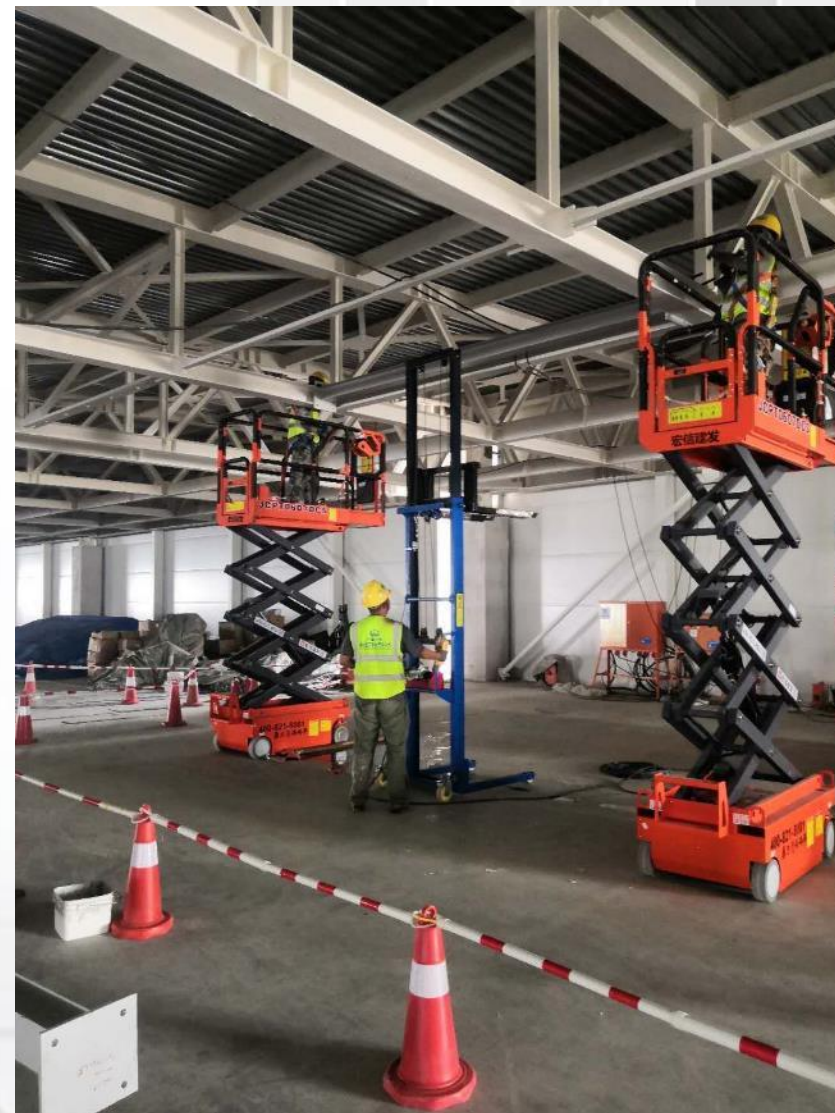
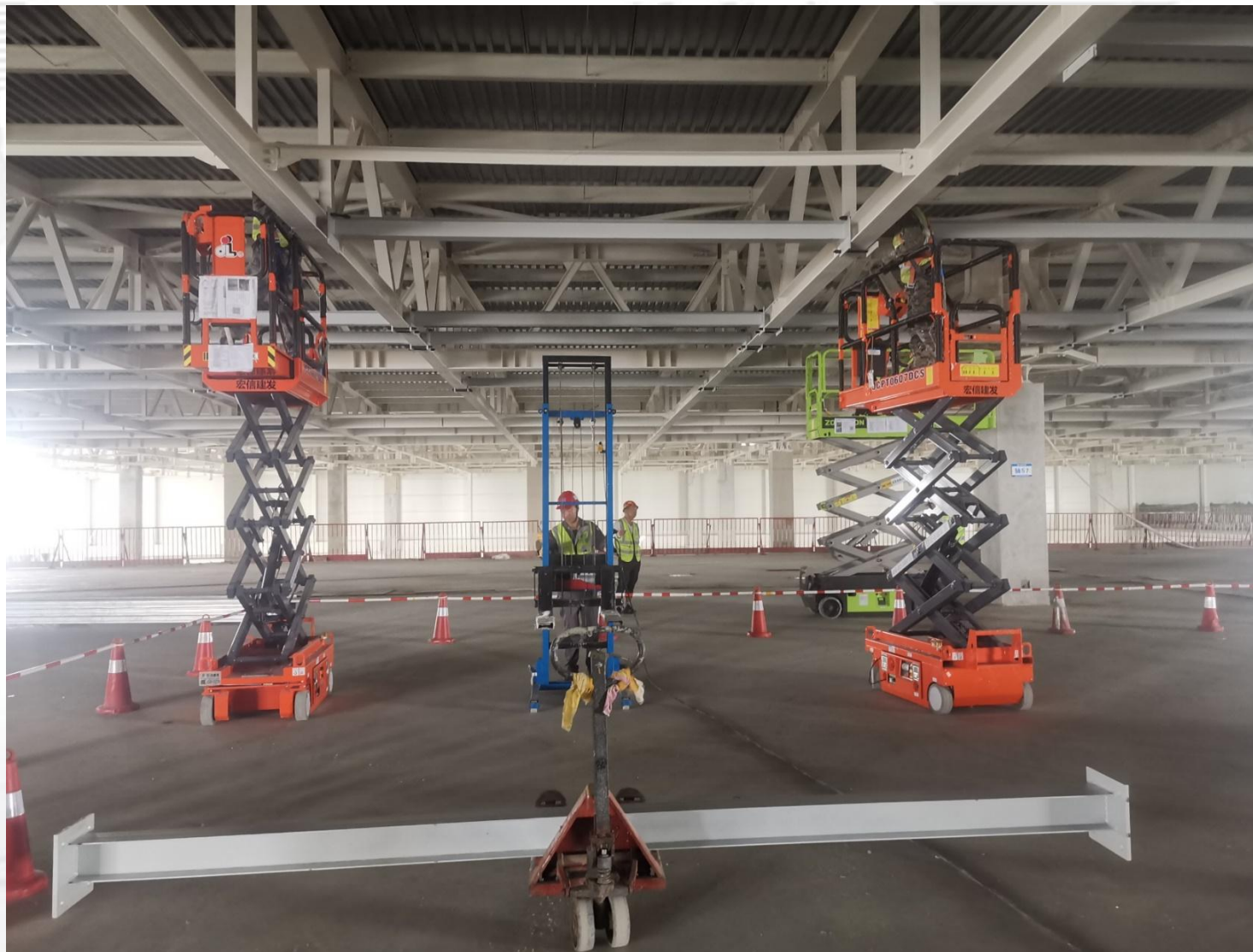




## 5.2 BIM+机电辅梁预制装配



中国中铁







## 5.2 BIM+机电辅梁预制装配-成品支架



中国中铁

- 预制加工构件运输至施工现场，成品保护。







### 5.3 BIM+机电管线预制装配

- 涂装车间施工自2020年10月份开始，2020年12月23日沈阳爆发新冠疫情，持续至2021年1月底，期间项目部克服了疫情影响，在施工人员大量流失的情况下，通过采用“工厂化预制+现场快速装配”保证现场施工。
- (1) 辅梁2102根
- (2) 电气系统桥架17554m
- (3) 弱电系统桥架12000m
- (4) 消火栓及喷淋系统管道66970m
- (5) 动力热水系统管道3393m
- (6) 压缩空气系统管道1290m
- (7) 排烟系统风管29000平





## 5.3 BIM+机电管线预制装配

- 共享预制加工数据库
- 主要包含：风管、水管、桥架、设备、支吊架等，并根据水暖电系统进行区分，预制加工数据库基于厂商信息和规范要求，满足制造精度需求。
- 所有预制加工构件ITM是解锁的，可以根据数字化加工设备的实际情况，对预制加工数据库进行创建和修改，比如材料、规格和连机器等相关信息，以满足生产需求，可创建企业、工厂或材料品牌预制加工数据库，方便实用。



Fabrication预制加工数据库



Revit预制加工数据库



企业预制加工数据库



Imperial Content V3.04

C:\Users\Public\Documents\Autodesk\F... \V3.04



Metric Content V7.04

C:\Users\Public\Documents\Autodesk\F... \V7.04



Revit MEP Imperial Content V2.0

C:\Users\Public\Documents\Autodesk\Fa... \V2.0



Revit MEP Metric Content V2.0

C:\Users\Public\Documents\Autodesk\Fa... \V2.0



恒鼎数字化加工基地 V1.0

C:\Users\Public\Doc... \恒鼎数字化加工基地



联翔数字化加工基地 V1.0

C:\Users\Public\Doc... \联翔数字化加工基地

Date Driven  
数据驱动



现场拼装



竣工模型



建筑结构模型



机电模型



幕墙、装修等  
机电相关模型



机电预制  
加工模型



工厂预制加工

DDIC数字化建造技术  
BIM+建造=智造



装车运输







### 5.3 BIM+机电管线预制装配

- 机电管线预制装配技术，实现“工厂化预制+现场快速装配”，有效地保证了施工的工期、提高了现场文明施工规范施工、降低了现场劳务施工作业强度、改善了现场施工劳务作业的环境、提高了现场文明施工程度。
- 机电管线预制装配技术主要原理是运用BIM技术，根据设计提供的施工图纸将原机房机电管线进行重新优化排布，设备位置合理化布置，管段提前由工厂预制化加工，运输至现场进行快速装配，以达到控制成本的同时大幅提升施工质量和管理水平，全程跟踪、及时纠偏、快速装配、绿色施工的目的。
- 通过抓好四大核心：一套数据Data、两组模型Model、三种图纸Blueprint、四类精度Precision，在深化设计、采购、预制加工、装车运输、现场装配五个阶段上，有效减少噪声污染、施工中的垃圾和机械伤害，同时避免进场材料因施工安排调整带来的长期堆放、多次的倒运和加工空间紧张等问题，实现场外预制、现场装配新型施工模式。





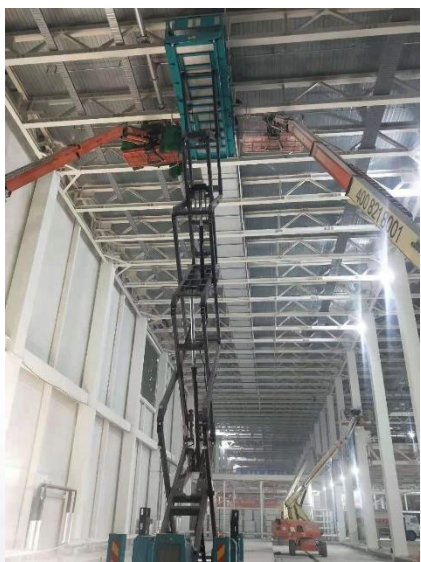
• 机电管线预制装配管理与技术流程

| 施工阶段<br>DMBP管理 | 深化设计    | 采购     | 加工     | 运输 | 装配     |
|----------------|---------|--------|--------|----|--------|
| P              | BIM模型精度 | 成品构件精度 | 预制加工精度 |    | 现场装配精度 |
| B              | 深化设计图纸  |        | 预制加工图纸 |    | 现场装配图纸 |
| M              | 深化设计模型  |        | 预制加工模型 |    |        |
| D              | 一套BIM数据 |        |        |    |        |



### 5.3 BIM+机电管线预制装配-设备选型方案

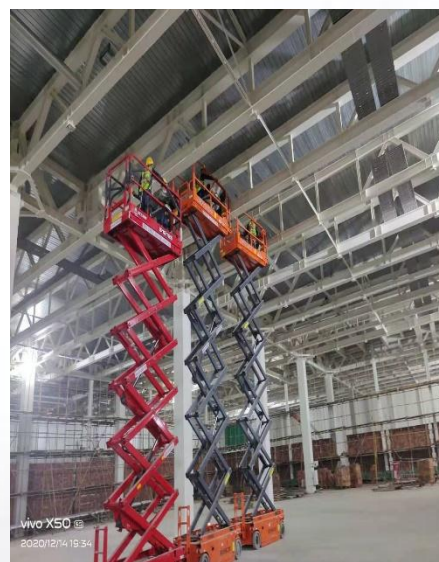
厂房结构较为复杂，现场为多层厂房，镂空区域较多，现场存在大量26米、24米、18米、10米、8米、的高空作业，投入机械多样化，施工难度较大、施工交叉比较多；针对以上问题我司提前策划施工方案，根据工艺的移交区域有针对性的组织施工，针对不同的专业特点使用不同的机械，并提前在市场上寻找比较稀缺的机械设备，以保证各个区域的施工顺利进行。



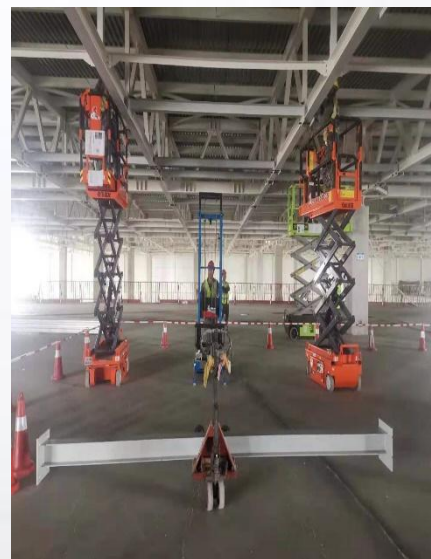
18米升降平台，风管安装



24米直臂车安装桥架



12米剪刀车安装消防管道



6米剪刀车安装辅梁



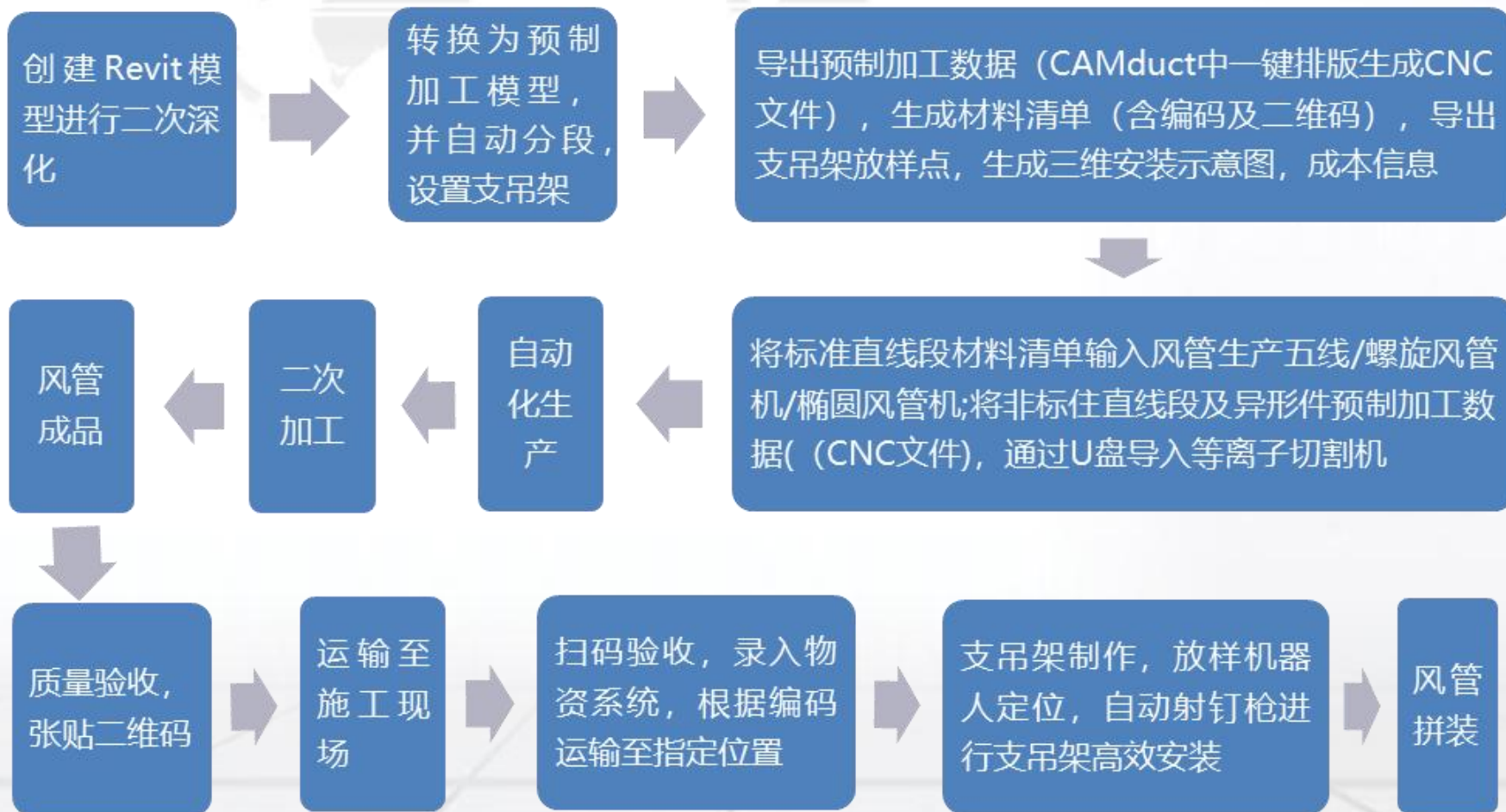


## 5.3 BIM+机电管线预制装配



中国中铁

### • BIM+风管预制装配-实施流程





### 5.3.1 BIM+机电管线预制装配-防排烟风管

- 传统防火风管的制作，是在传统铁皮风管加工完成后，通过人工在风管外侧逐层拼装防火材料后投入使用，人工成本高，操作繁琐，生产效率低，质量不易把控，安全隐患大，每平方米造价450元，施工成本高，面对本项目的施工环境，更为困难。市场上缺少防火风管板材一体成型的全自动生产线。

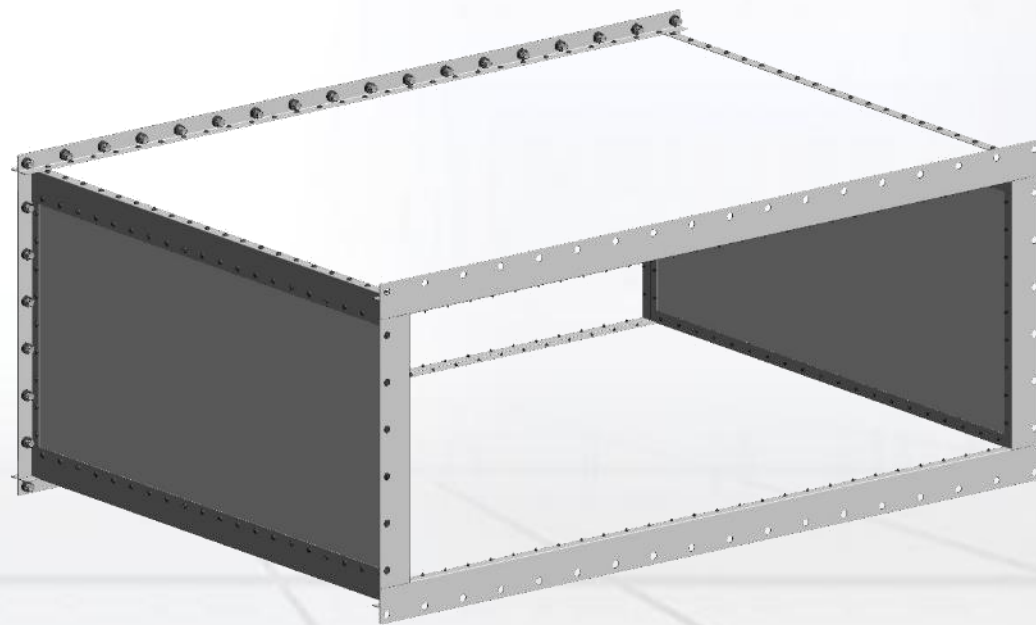


| 名称       | 图片                                                                                    | 产品介绍                                                                                           | 应用前景                                                                                              |
|----------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 角钢法兰风管   |    | 最早使用的风管之一，采用镀锌薄钢板制作，强度高，可满足高低压风系统的使用，可现场加工，运输成本低，调整方便。                                         | 属于传统产品，其优缺点早已被广大的用户认可，由于其强度和结构的特殊性仍不可被完全取代，具有广泛的用途和使用场所                                           |
| 共板法兰风管   |    | 生产机械化 自动化程度高，风管自成法兰，生产安装快捷，满足现代化工程需要。                                                          | 经济效益显著，在中低压风系统使用中已经替代了传统的角钢法兰，节约了大量钢材和人工成本，随着工艺的不断完善使其能达到防火要求，将在防排烟风系统应用中逐步替代角钢法兰风管               |
| 复合风管     |    | 近年来的风管类型，多以离心玻纤、挤塑、酚醛为芯材，内外复铝箔布或彩涂板用防火粘结剂经机械一次性复合；再经切割、开槽、粘结加固等工艺而制成，根据风管断面尺寸，风压大小在采用适当的加固措施。  | 风靡一时的风管产品，目前仍在大面积使用，因其风管质量轻，易安装，不需要二次保温等特点，随着科学技术不断发展和工艺的不断完善将会得到更广泛的应用                           |
| 自撑式防火风管  |   | 一体化防火板由镀锌薄钢板、岩棉板、火克板机械复合而成，结合强度高，耐火隔热性能好，外观美观颜色可选，采用P型法兰，T型插槽，高效预制成品制造，满足新规GB51251-2017标准。     | 随着新规GB51251-2017标准的逐步推行，传统防火包覆风管现场施工周期长，工艺复杂，现场施工材料、空间的浪费，环境的污染以不能满足现代化装配式建筑工程需要，传统施工必将会被成品制造逐步替代 |
| 双面彩钢防火风管 |  | 双彩一体化防火板由彩涂板、岩棉板、火克板、彩涂板机械复合而成，结合强度高，耐火隔热性能好，外观美观颜色可选，采用P型法兰，T型插槽，高效预制成品制造，满足新规GB51251-2017标准。 | 新产品，客户了解程度较低，随着新规GB51251-2018标准的逐步推行，现代化装配式建筑工程的需要，双面彩钢防火风管将在电子、食品、医疗、喷涂等对环境要求高的场所得到广泛的应用         |



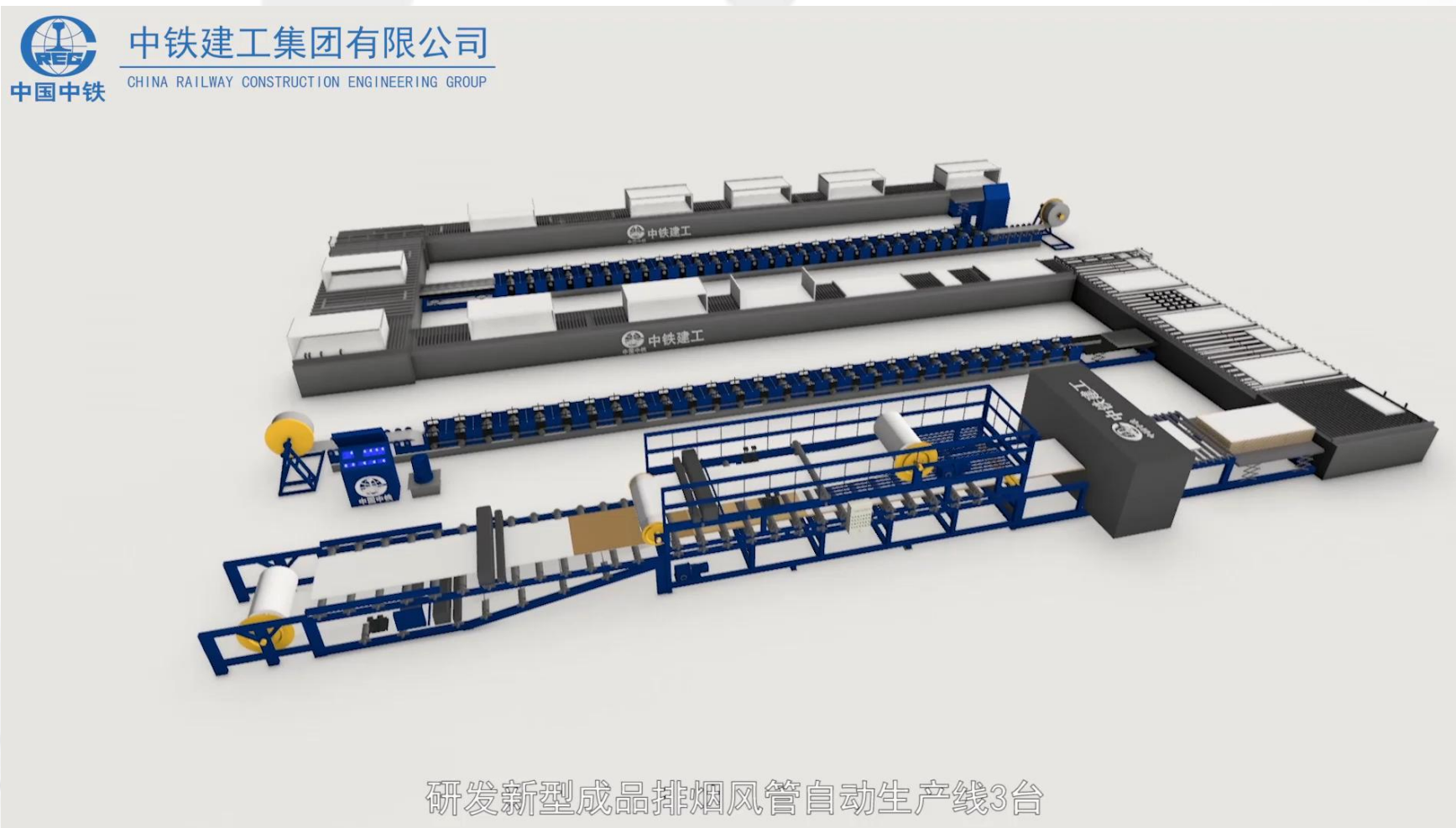
### 5.3.1 BIM+机电管线预制装配-新型防排烟风管

- 新型防排烟风管包括防火一体板材、防排烟风管“斤”型转角、防排烟风管“F”型法兰等，耐火性好、结构强度高、使用寿命长，安装简便、安装安全性高、漏风风险小、风损少。
- 新型防火一体板实现了工厂自动化生产一体成型，其由内侧金属板、防火隔热层、无机耐火层、外侧金属板、板材强度加强肋构成，耐火性好、结构强度高、加工效率高、拼装简便、使用寿命长的特点。
- “斤”型转角和“F”型法兰分别由“斤”型转角成型机和“F”型法兰成型机加工一体成型，其加工效率高，降低漏风风险、减少风损。
- 成本由每平米450元，降低至每平米260元。





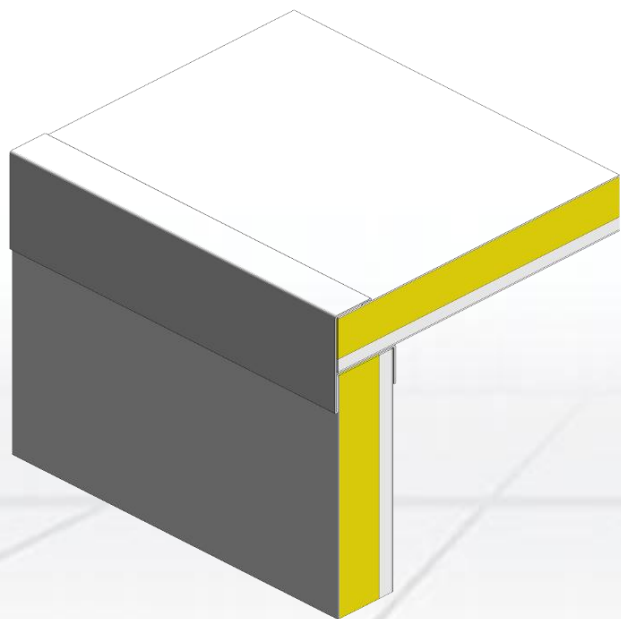
- 研发新型防火一体板一体成型机成功解决上述问题，具有成本低、耗材少、操作简便、自动化生产、加工质量高、生产效率高、能耗低、洁净的特点，每班生产1800平方米。



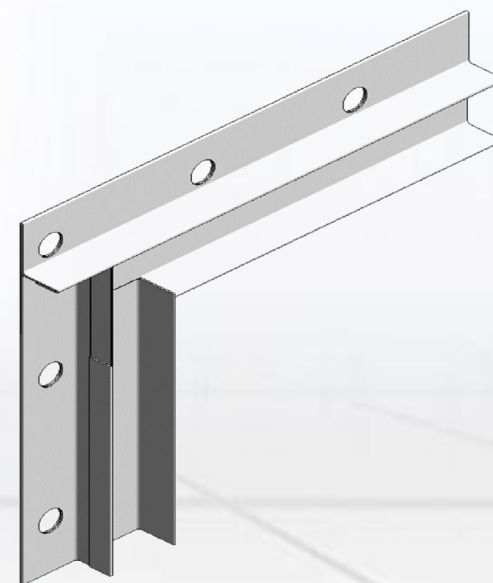


### 5.3.1 BIM+机电管线预制装配-防排烟风管

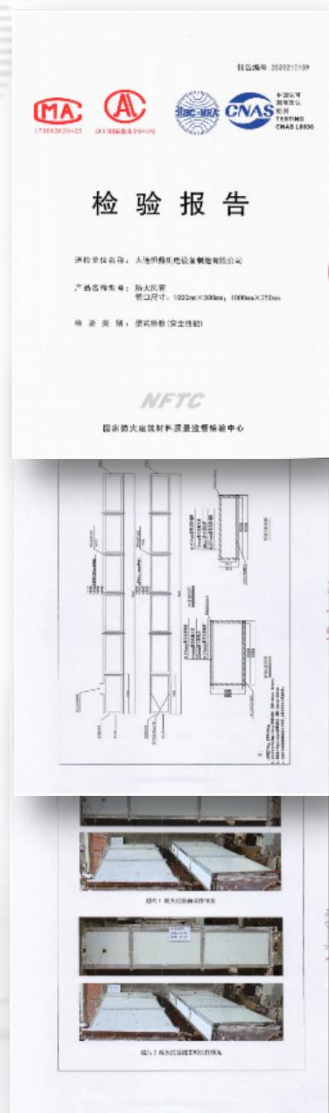
- 新型防排烟风管“斤”型转角自动生产线，实现了一体化成型，加工效率高，安装方便，使用寿命长，强度高，能够很好固定防火一体板材，同时一体成型，减小漏风风险、减少风损，成品剖面形似汉字“斤”，并且两处开口垂直相交，每班生产2400米。



- 新型防排烟风管“F”型法兰自动生产线，实现了一体化成型，加工效率高，安装方便，使用寿命长，强度高，能够很好固定防火一体板材，同时一体成型，减小漏风风险、减少风损，成品剖面形似英文字母“F”，并且两处开口垂直相交，每班生产2400米。

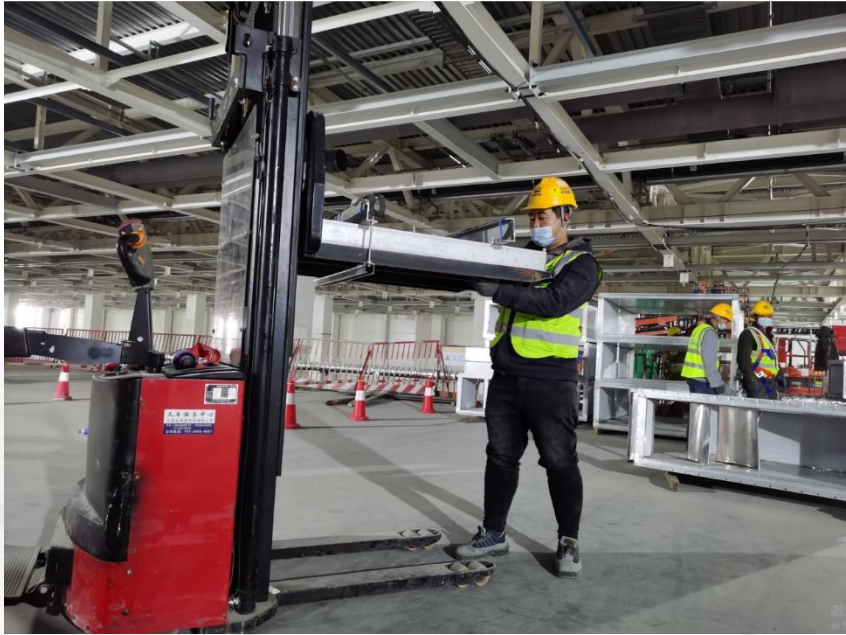


## 5.3.1 BIM+机电管线预制装配-新型防排烟风管





### 5.3.1 机电管线预制装配技术-新型防排烟风管拼装及现场快速装配

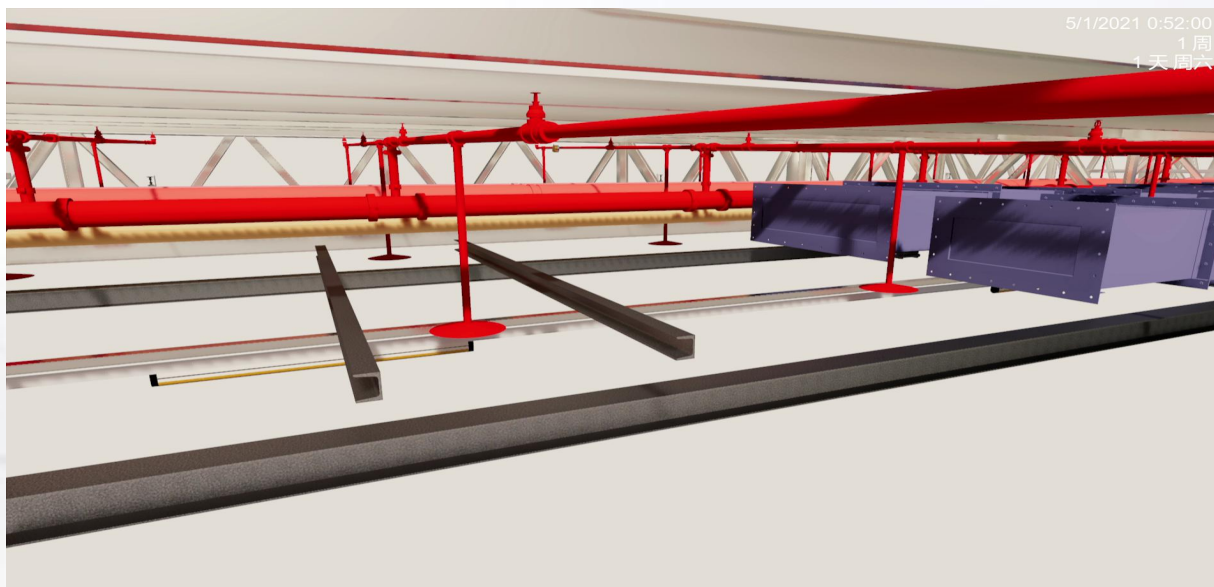




- 采用这样的结构，将风管放置在横梁上以后，只需要移动行走轮就可以实现风管的推送，简单便捷容易操作。本实用新型可以先将多个风管预组装成具有一定长度和宽度的风管组，然后将风管组推送到指定位置，在进行风管组之间的组装。所述行走轮采用截面为凸字形的圆台结构，防止其从工字梁上滑落，保证了安全。



风管  
安装  
轨道  
运输  
平台





### 5.3.2 机电管线预制装配技术-管道工厂化预制

- 工厂预制加工
- 对本项目的工艺管道在工厂进行预制加工，提高加工质量和生产效率。







- 以3F为例

| A           | B       | C          | D          | E      | F   |
|-------------|---------|------------|------------|--------|-----|
| 喷淋跨越桁架管道距离表 |         |            |            |        |     |
| 项序          | 轴线位置    | 喷淋管道距离 (m) | 喷淋管道个数 (个) | 系数 (列) | 合计  |
| 1           | 66L-68L | 8          | 2          | 6      | 12  |
| 2           | 66L-68L | 8.5        | 1          | 6      | 6   |
| 3           | 62L-66L | 10         | 6          | 6      | 36  |
| 4           | 60L-62L | 9          | 4          | 6      | 24  |
| 5           | 55L-60L | 9          | 8          | 5      | 40  |
| 6           | 54L-55L | 11         | 2          | 5      | 10  |
| 7           | 51L-54L | 9          | 3          | 5      | 15  |
| 8           | 51L     | 8          | 1          | 5      | 5   |
| 9           | 38L-51L | 9          | 21         | 5      | 105 |
| 8m段         |         | 17         |            |        |     |
| 8.5m段       |         | 6          |            |        |     |
| 9m段         |         | 184        |            |        |     |
| 10m段        |         | 36         |            |        |     |
| 11m段        |         | 10         |            |        |     |

- 通过对奇数下弦之间的喷淋主管进行预制加工，通过一种用于桁架上的管道安装结构进行固定，可以代替机电辅梁，降低成本和施工难度，同时减少成品支架用量。





- 配合大型工厂屋顶的桁架结构，将承载件放置于下弦梁上，通过下弦梁承载管道的重量，提高对管道重量的承载能力，保证了管道安装结构的稳定性；配合吊装组件进一步提高对管道重量的承载能力。并且通过在承载件上设置锁紧孔与限位件配合，能够对承载件的位置进行限定，也便于对承载件进行调节。







### 5.3.2 机电管线预制装配技术-喷淋主管快速装配



中国中铁





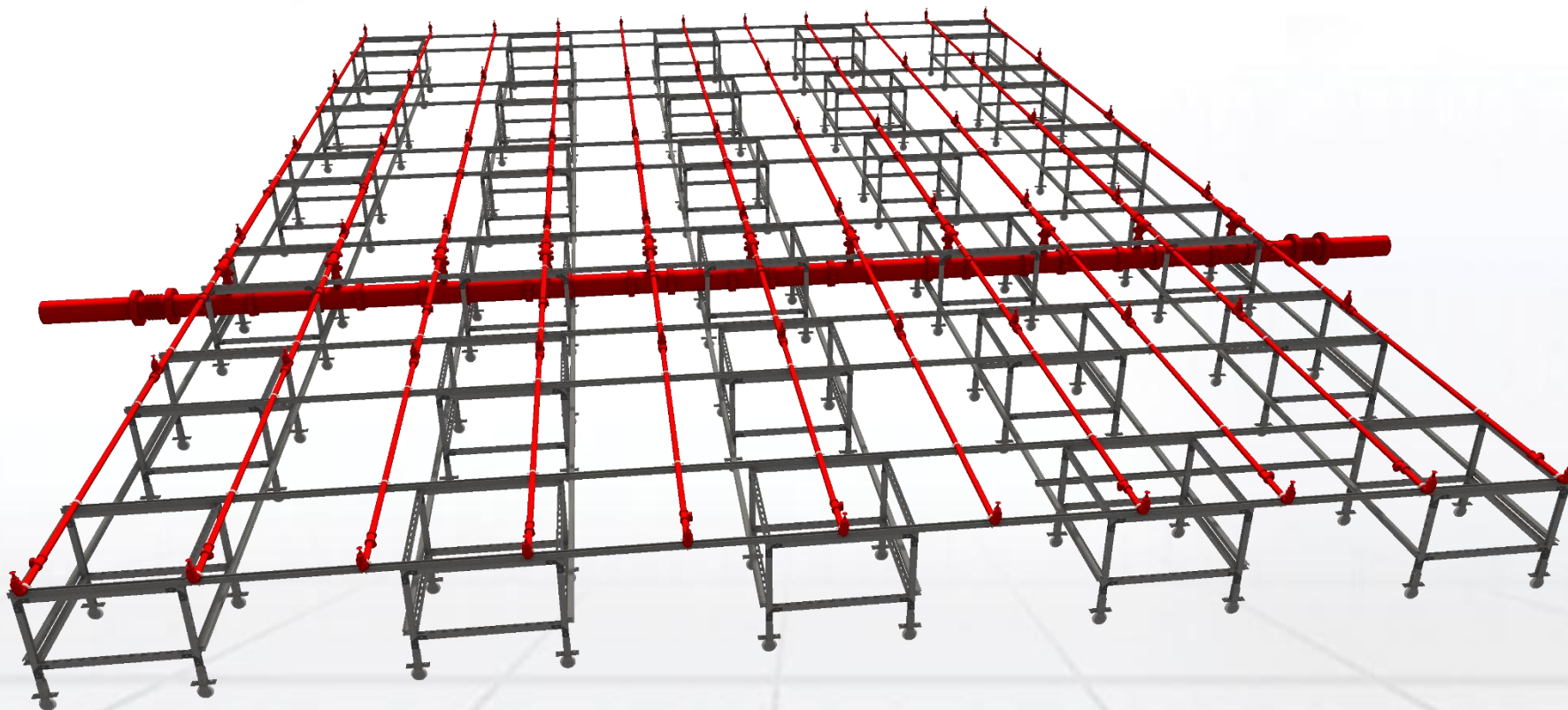


### 5.3.2 机电管线预制装配技术-喷淋支管预制

- 现场预制加工，针对喷淋支管，在现场进行批量预制。



结构类型复杂，现场桁架间距短多为4.5米至3米桁架比较密集，不利于机电管线安装，管线施工难度大。针对这些复杂情况，项目采取了不同区域采用不同的施工方案，有针对性的展开施工。







### 5.3.2 机电管线预制装配技术-喷淋支管预制



中国中铁

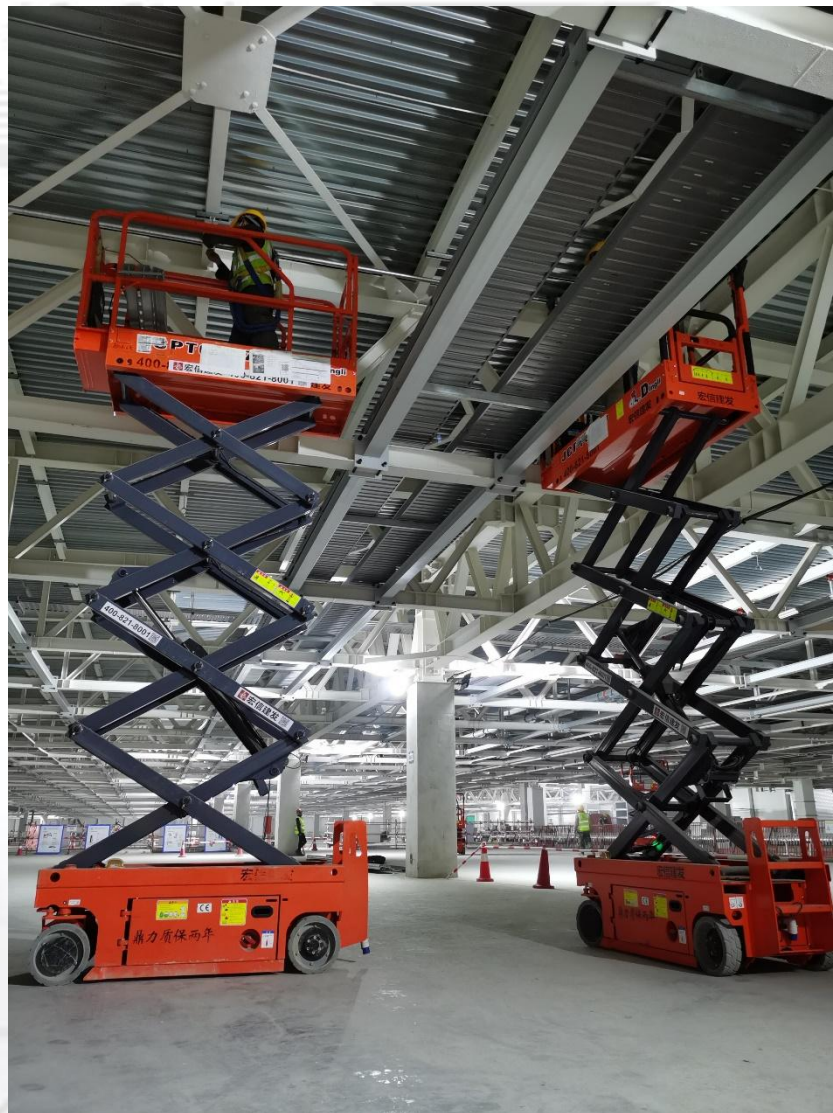
- 集中进行打压



### 5.3.2 机电管线预制装配技术-喷淋支管快速装配



中国中铁





- 喷淋支管的整体提升





### 5.3.3 机电管线预制装配技术-桥架预制加工

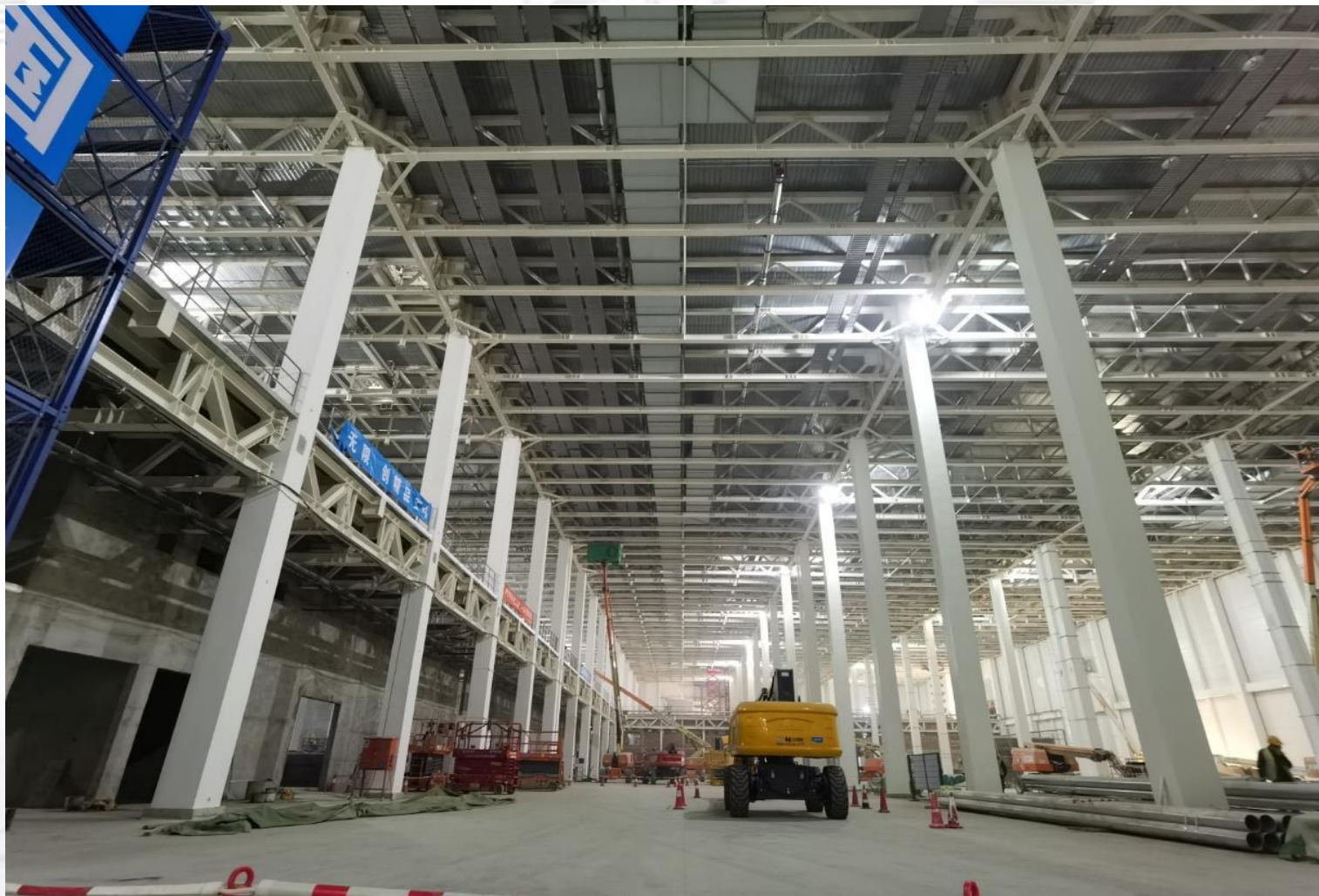


中国中铁





### 5.3.3 机电管线预制装配技术-桥架快速装配





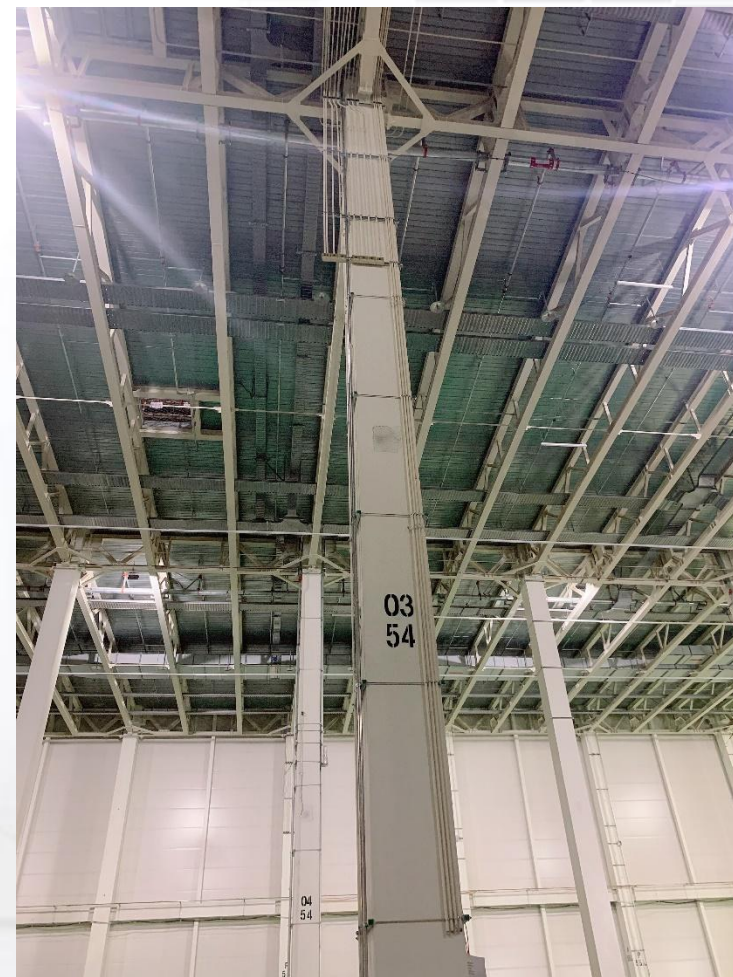
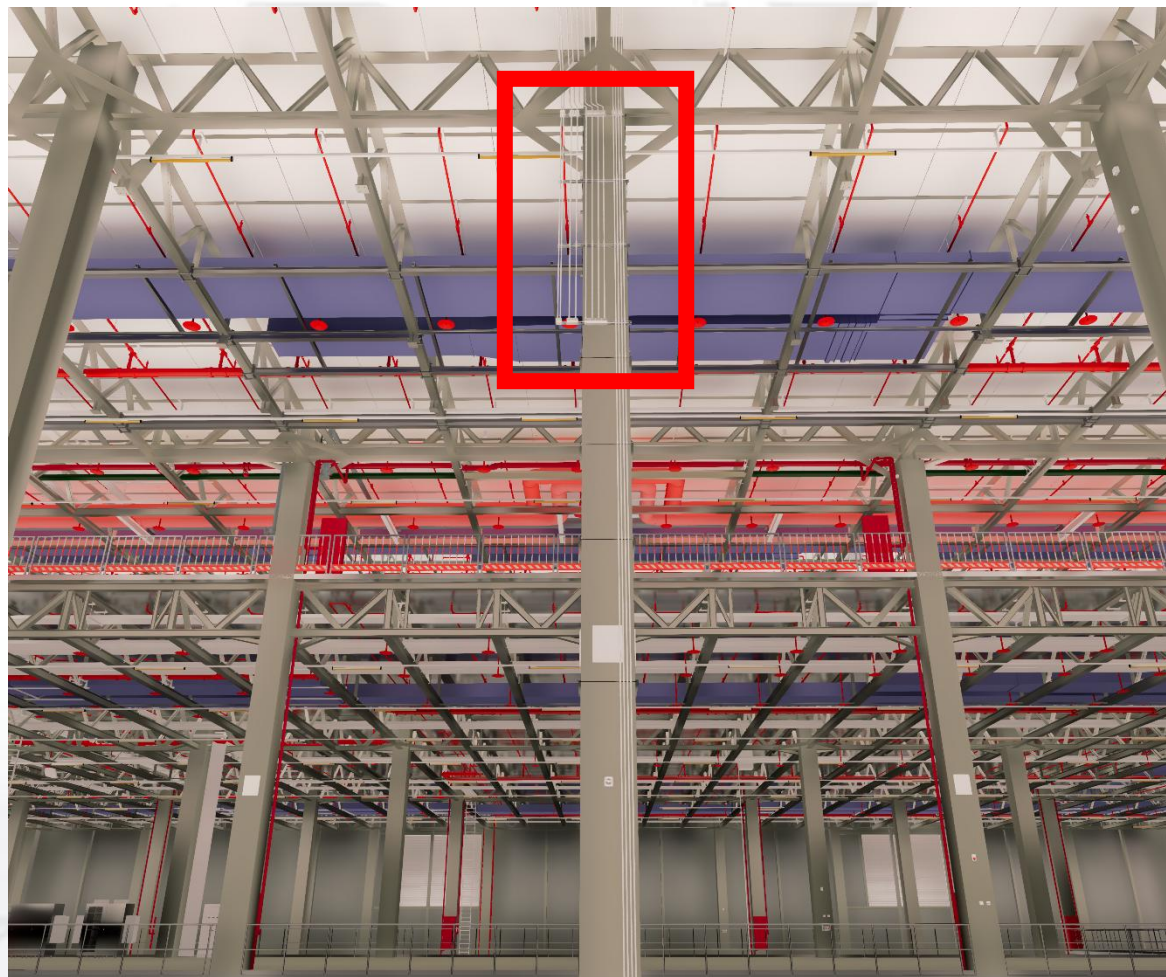


### 5.3.3 机电管线预制装配技术-电气配管



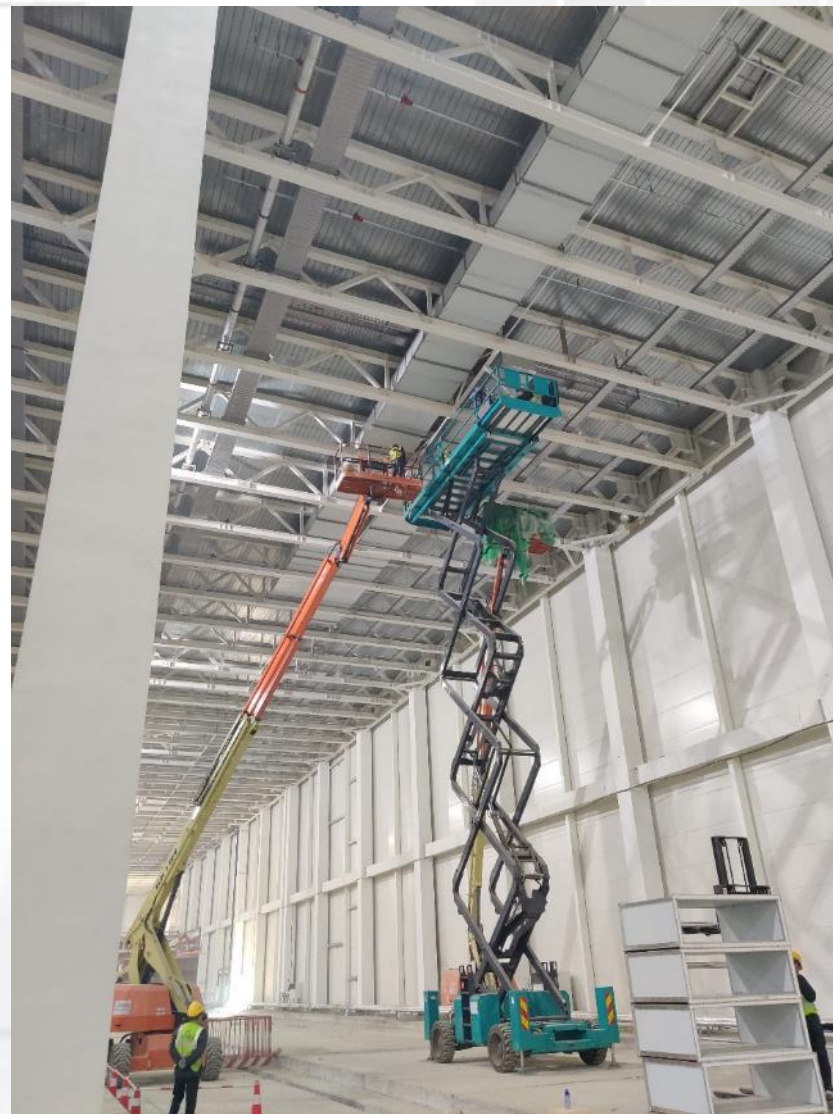
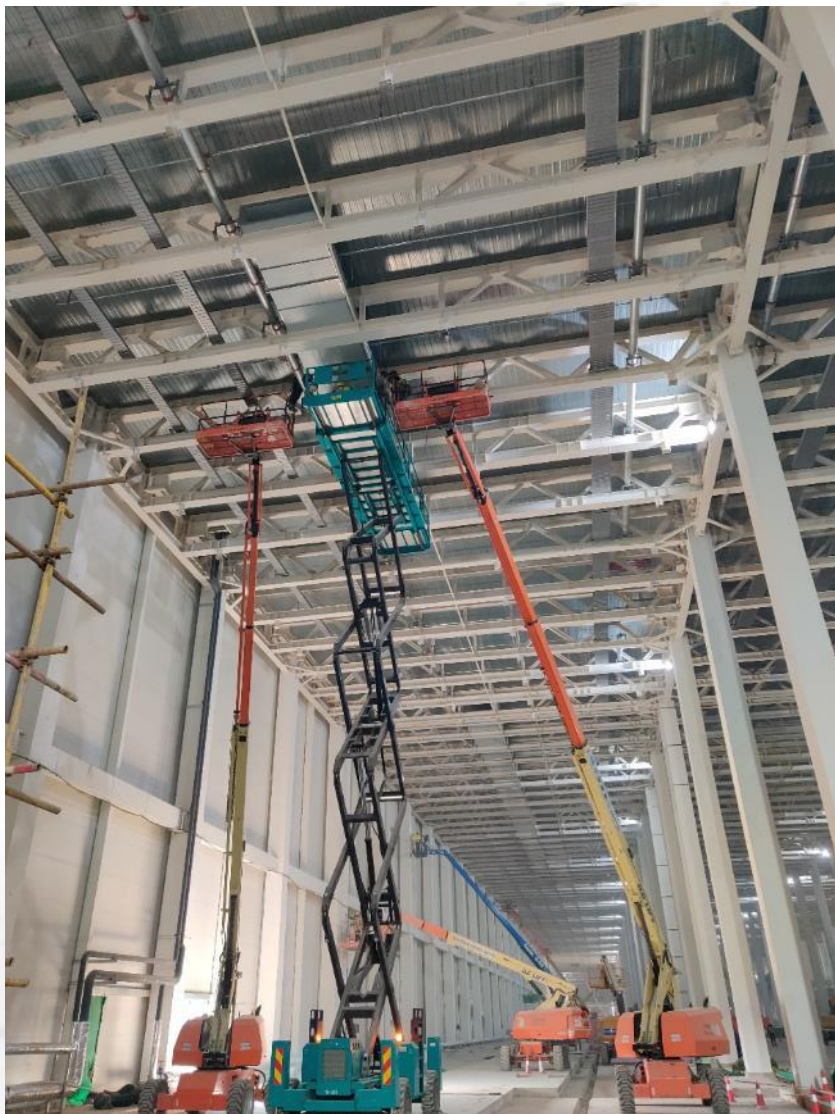
中国中铁

- 高空区域电气配管，在加工区进行批量预制，现场快速装配。





### 5.3 机电管线预制装配技术-现场快速装配

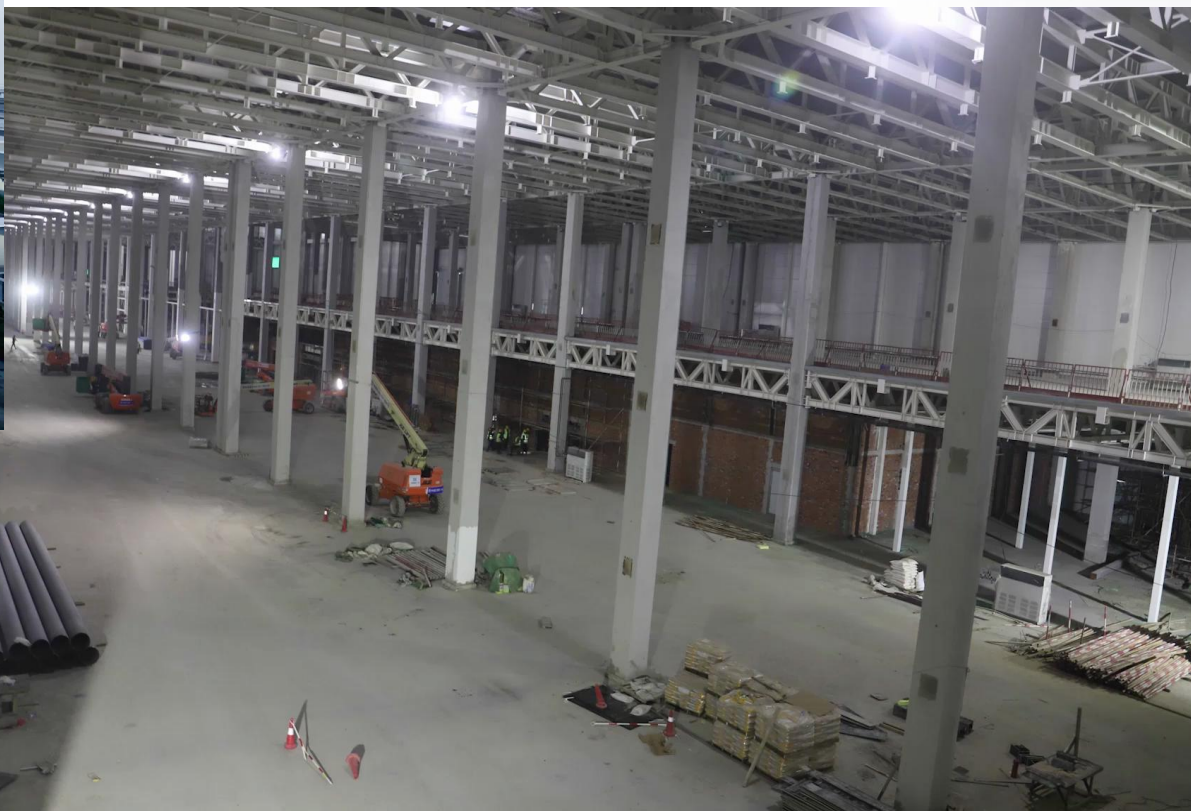




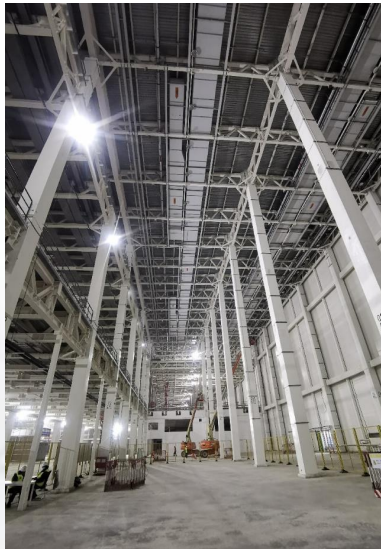
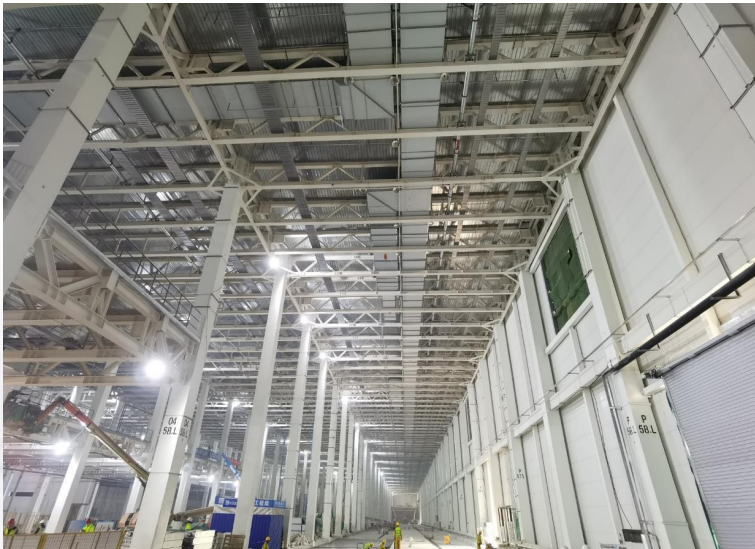
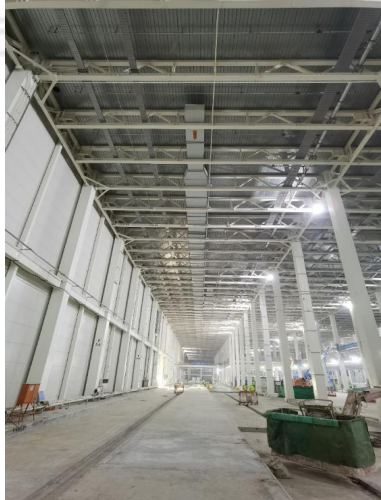
### 5.3 机电管线预制装配技术-现场快速装配



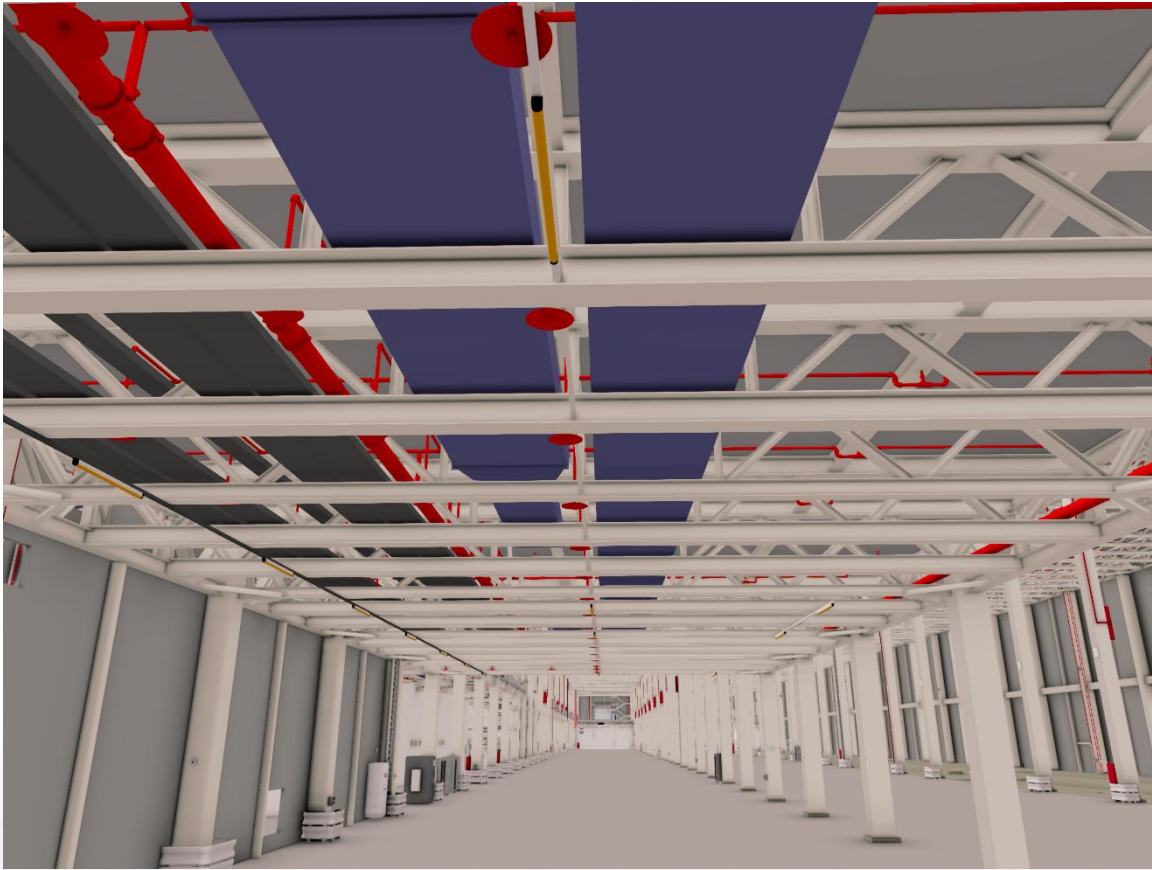
中国中铁















中国中铁

06

## BIM综合应用



## BIM应用基础准备

- 细化实施方案及应用点
- 编制施工BIM模型深化标准
- 建立完善BIM族库

## 结构BIM技术应用

- 结构图纸问题会审报告
- 基于BIM的图纸、模型、问题管理      复杂节点优化设计      复杂节点技术交底
- 中空站台结构BIM优化

## 建筑BIM技术应用

- 建筑专业BIM深化      建筑BIM图纸会审与报告
- 砌筑墙体预留洞深化出图      建筑空间净高分析
- 

## 机电BIM技术应用

- 机电BIM模型深化      机电管线综合标准及出图      机电管线综合优化设计
- 排风土建风道优化      10m层下吊平台优化      机电BIM图纸会审报告
- 机房BIM深化为装配式准备      预留预埋套管的施工      机电现场VR交底

## BIM与智能设备结合应用

- BIM与放线机器人结合应用      悬臂式自动焊机      防火一体板生产线      斤型转角一体化生产线
- BIM与3D打印机结合应用      F型法兰一体化生产线      VR      AR

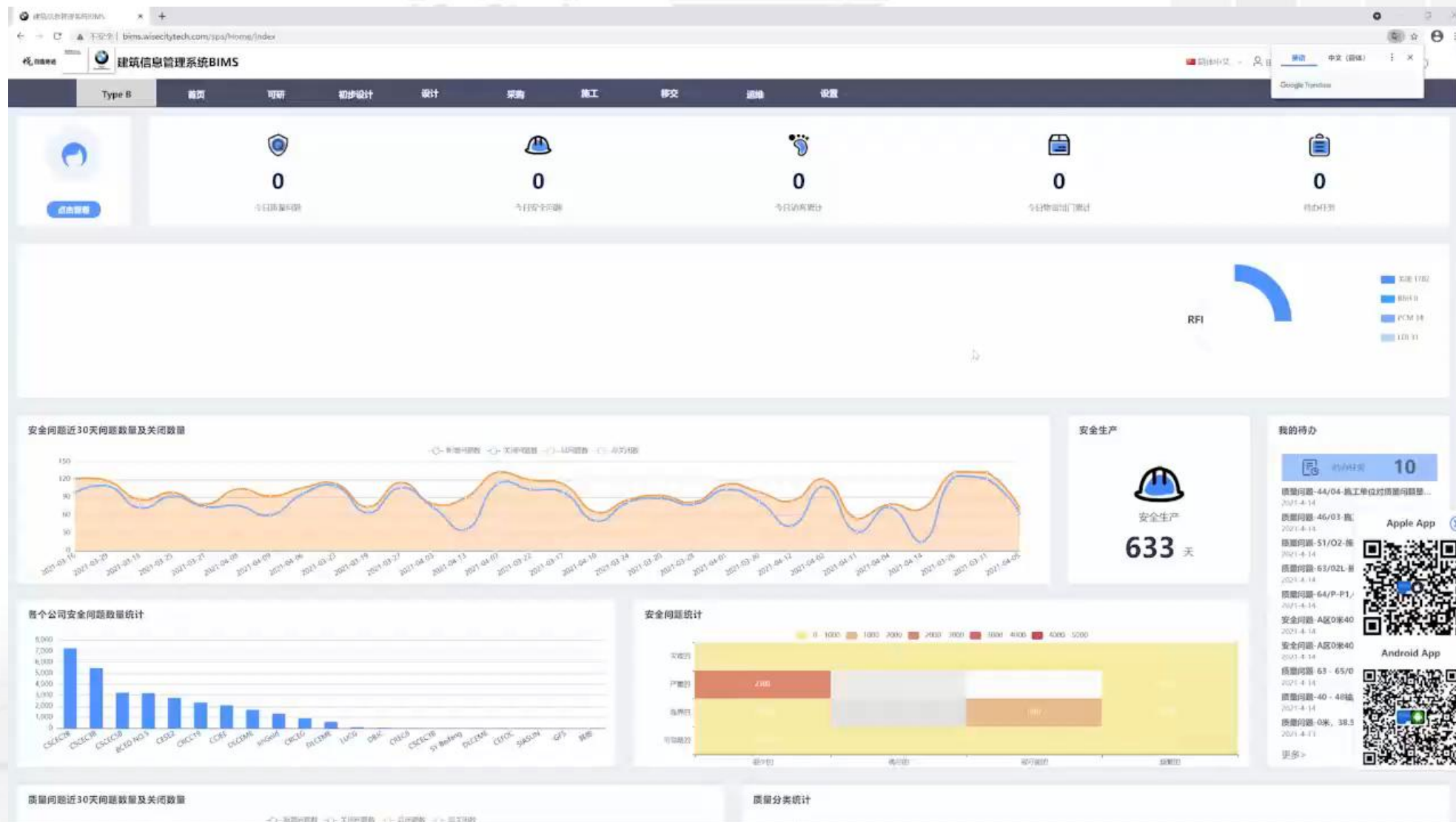
## 通用BIM应用

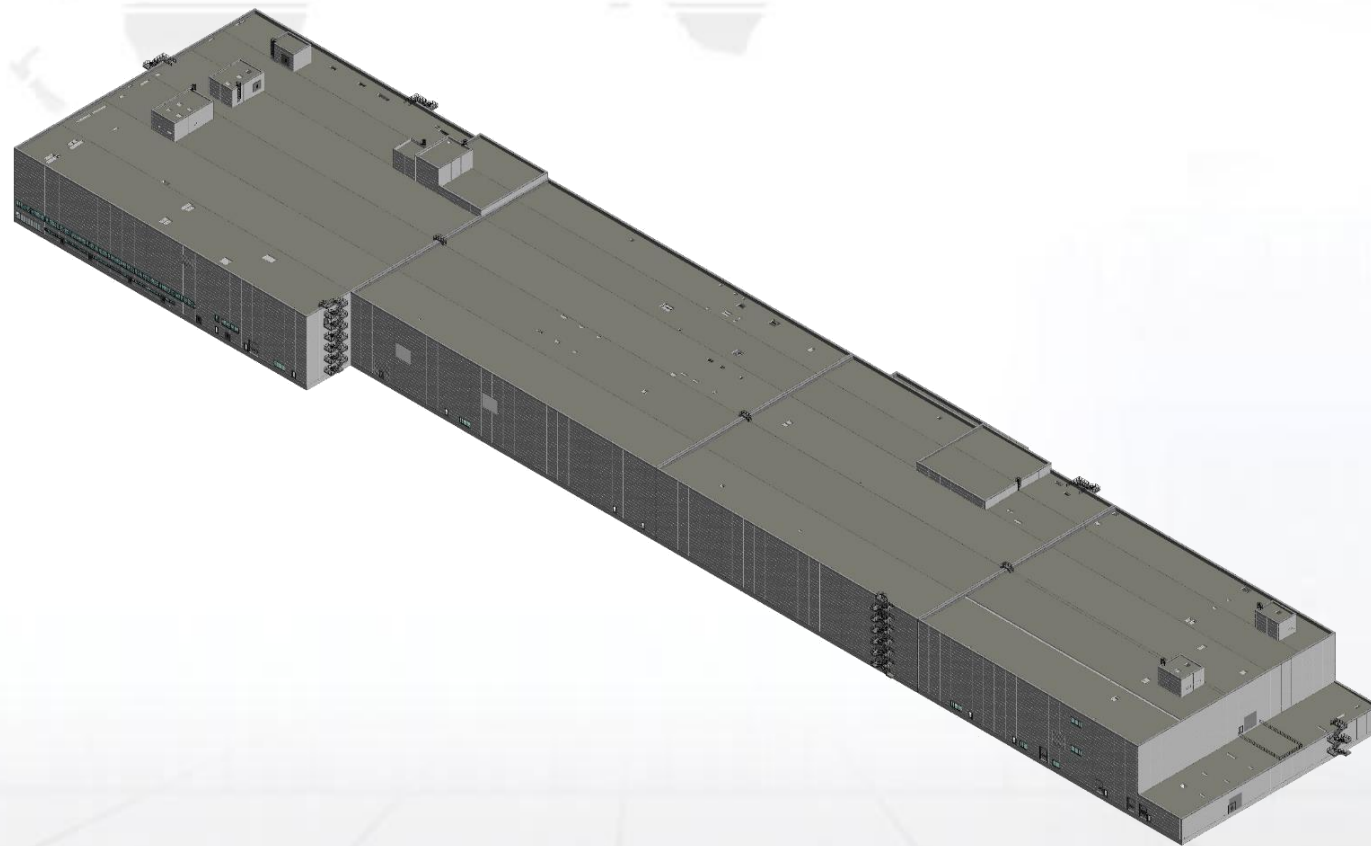
- 站房施工4D进度模拟
- BIM模型辅助算量





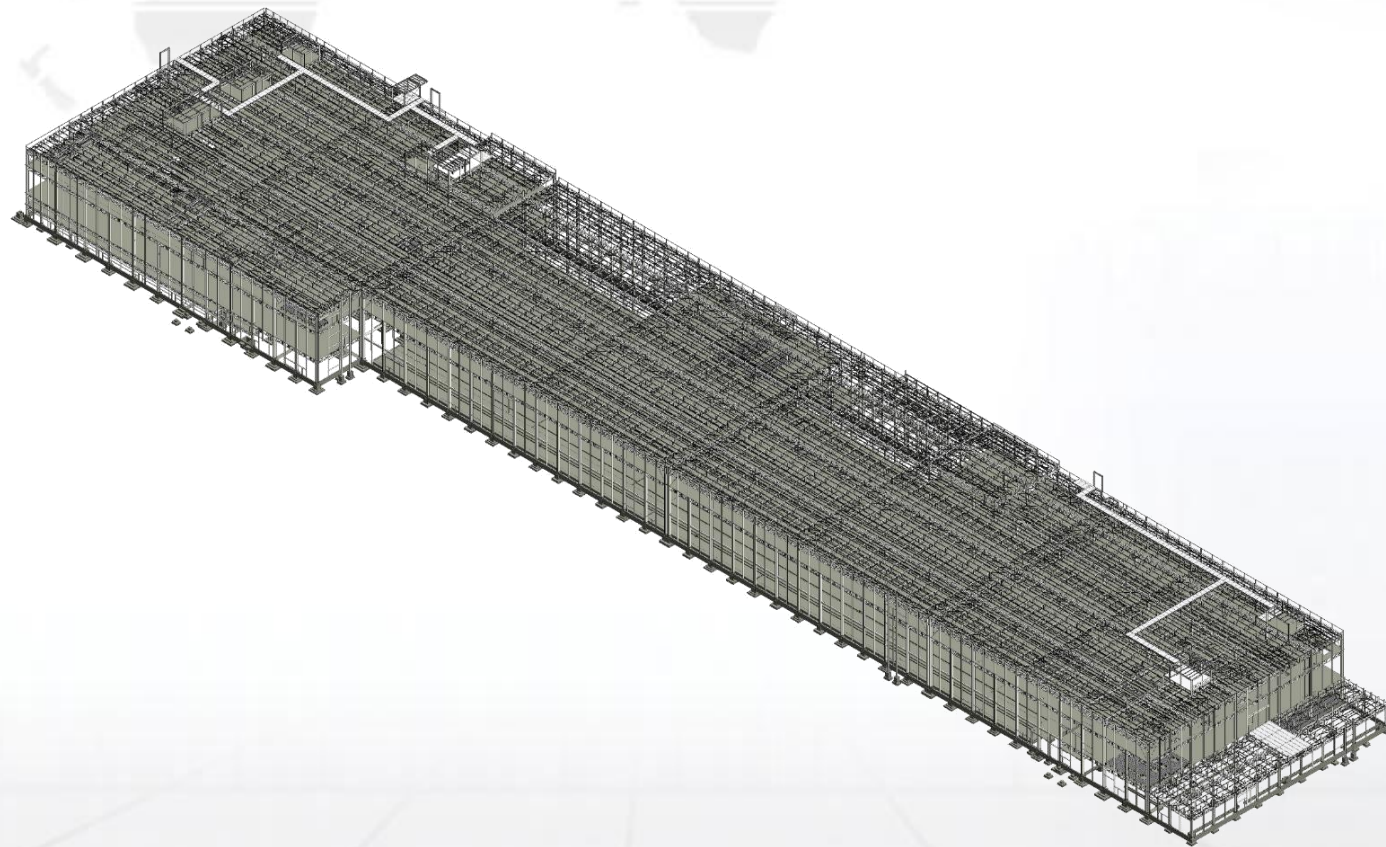
中国中铁



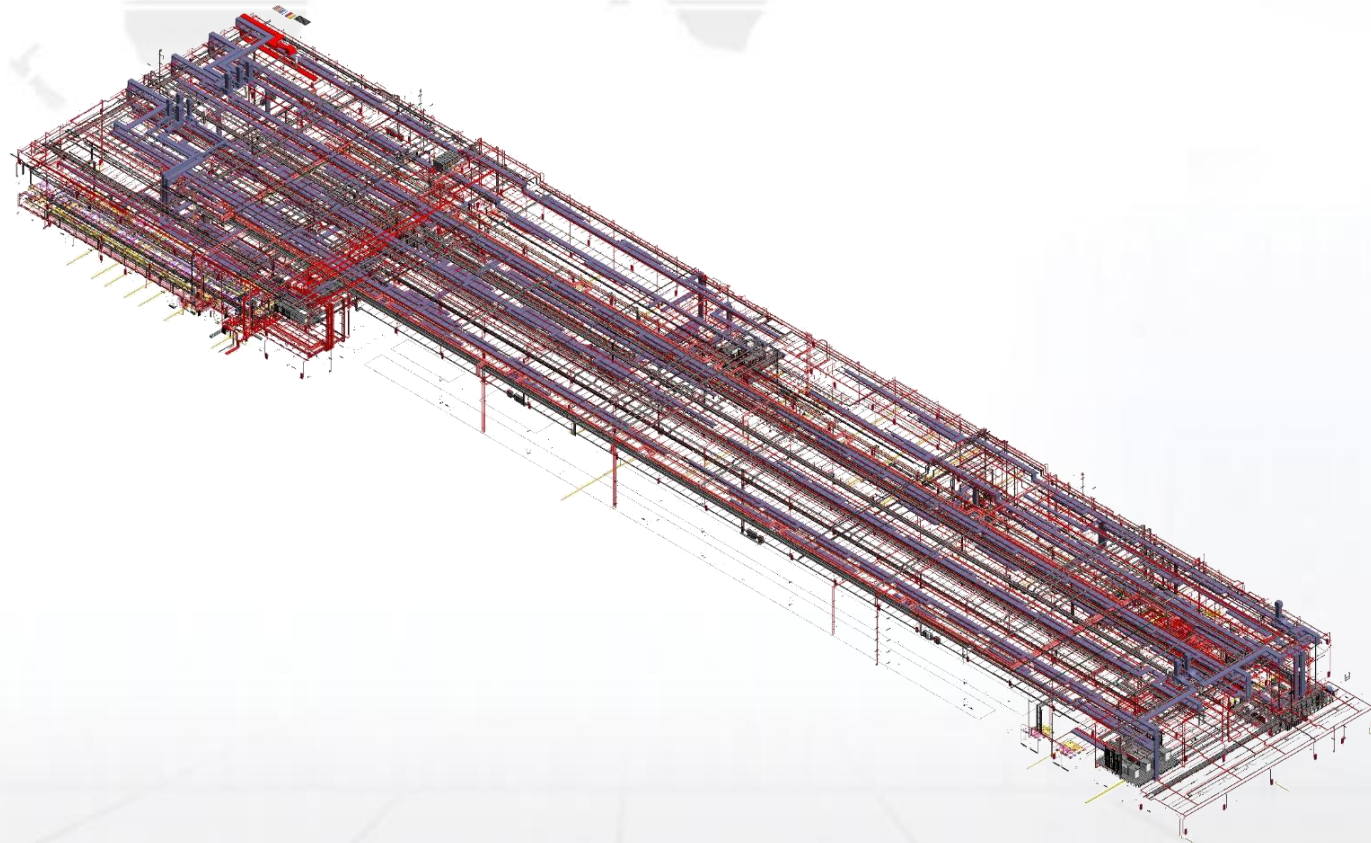


涂装车间建筑BIM模型



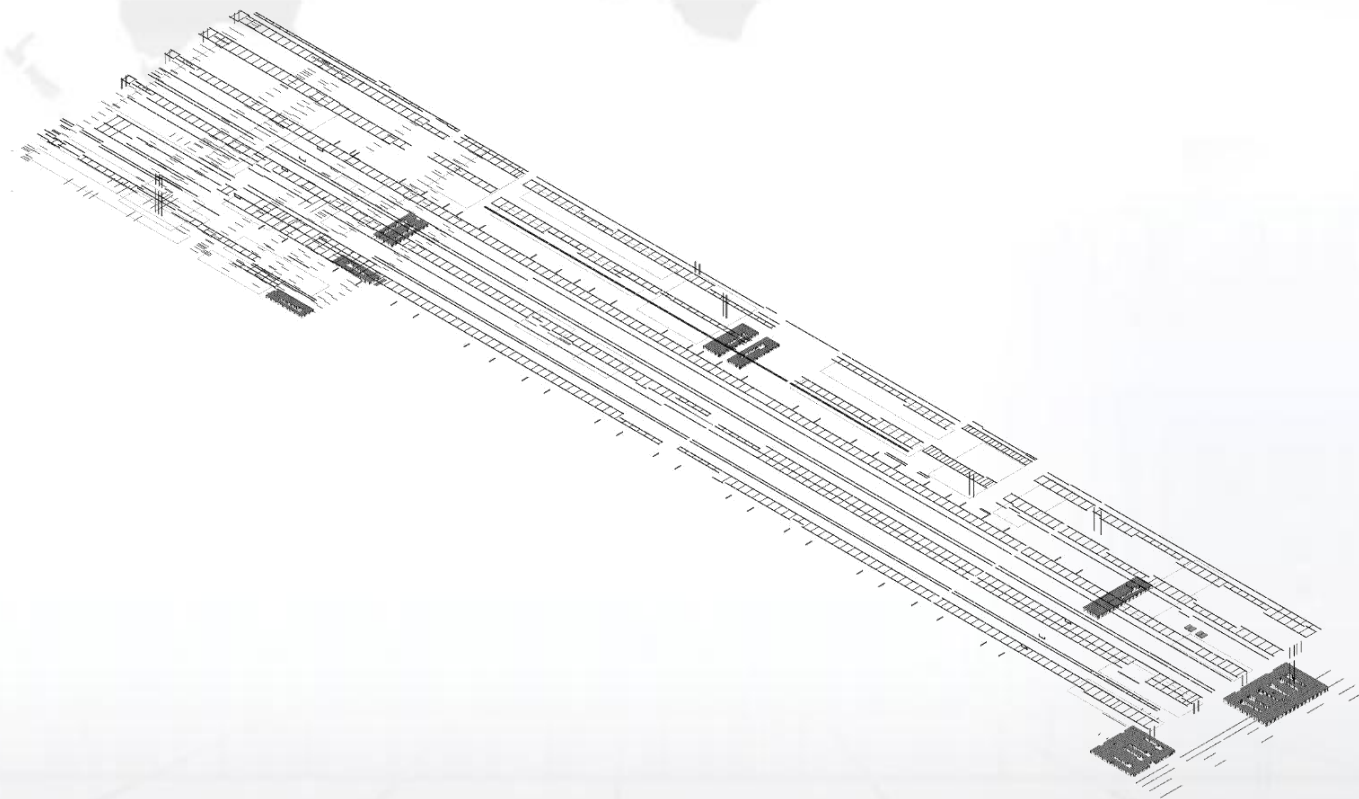


涂装车间结构BIM模型

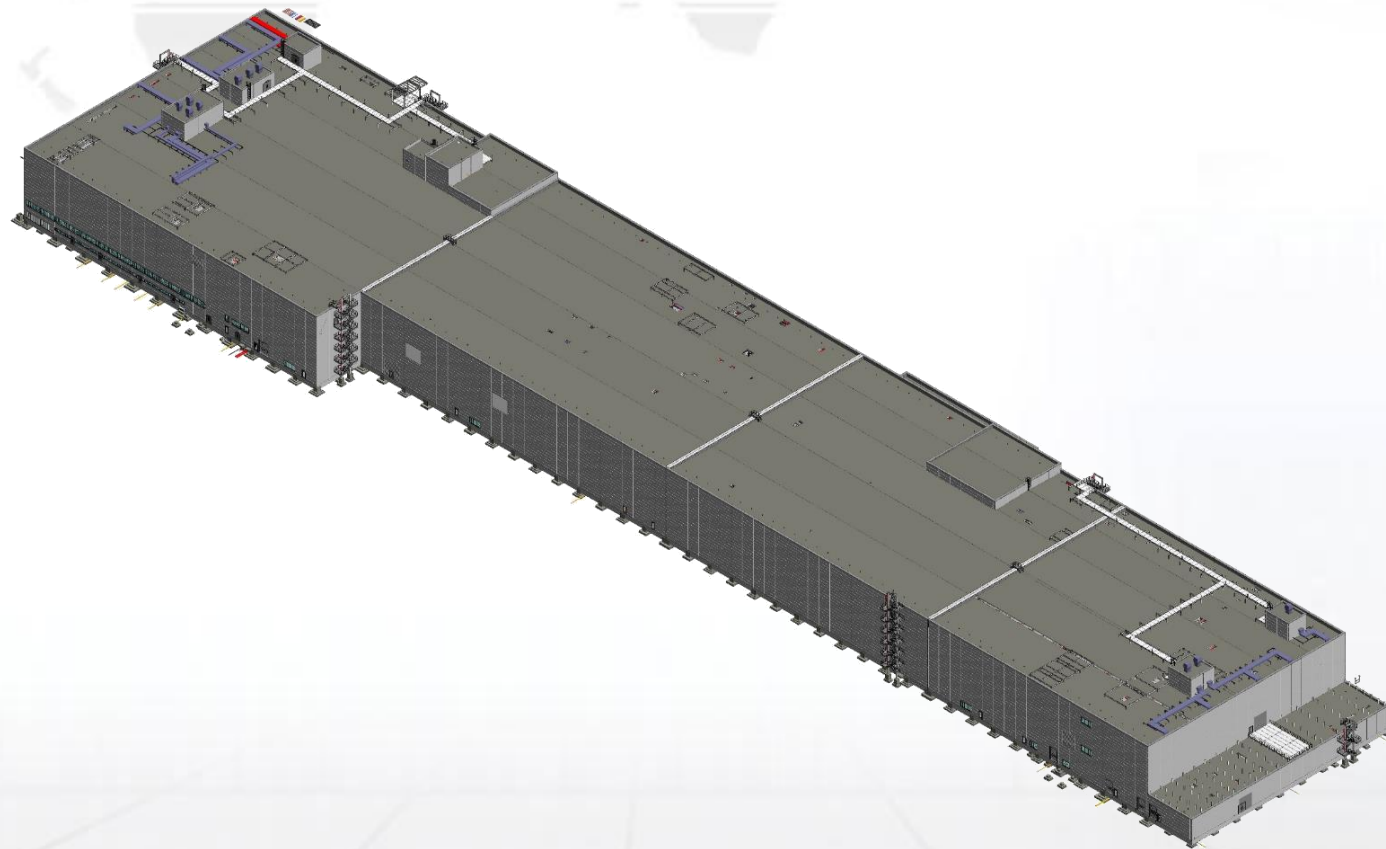


涂装车间机电、消防BIM模型





涂装车间机电辅梁、成品支架、FM支架BIM模型



涂装车间全专业BIM模型



[illegible][illegible]

| Table 1. Continued           |                                 |       |       |                          |
|------------------------------|---------------------------------|-------|-------|--------------------------|
| Model and Parameter<br>估計值名稱 | Regression Coefficient<br>估計值名稱 | Mean  | Stdev | Posterior<br>Probability |
| Model 1                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 2                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 3                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 4                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 5                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 6                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 7                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 8                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 9                      |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 10                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 11                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 12                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 13                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 14                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 15                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 16                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 17                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 18                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 19                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 20                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 21                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 22                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 23                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 24                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 25                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 26                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 27                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 28                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 29                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 30                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 31                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 32                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 33                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 34                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 35                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 36                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 37                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 38                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 39                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 40                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 41                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 42                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 43                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |
| Model 44                     |                                 |       |       |                          |
| Intercept                    | Intercept                       | 0.000 | 0.000 | 100%                     |

| Image |  | Image |  |
|-------|--|-------|--|
| Image |  | Image |  |
| Image |  | Image |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |
|       |  |       |  |

| BOM 0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000 |  |  |  |  |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|

[illegible][illegible][illegible][illegible]

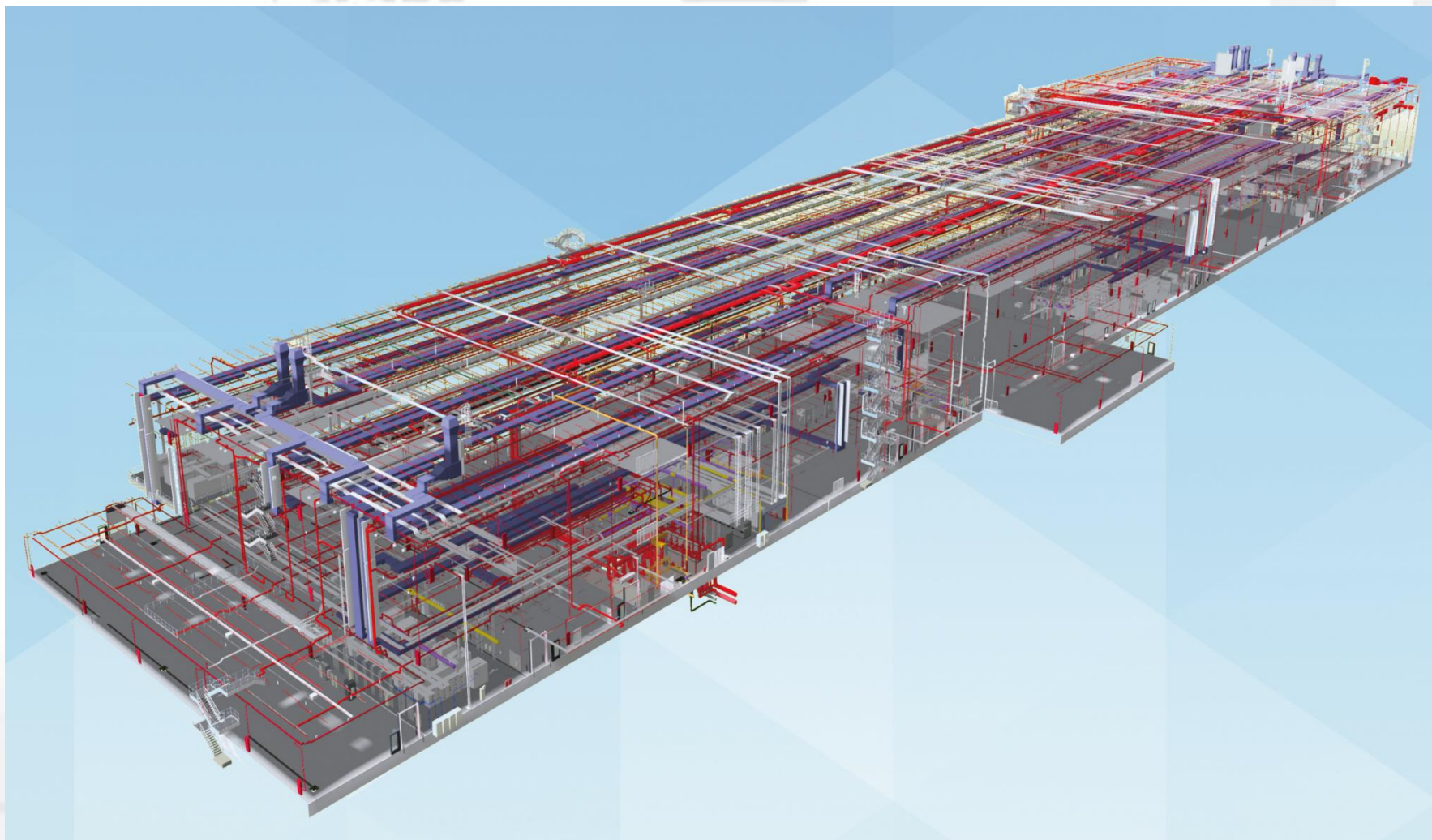
| Decimals<br>小数 | Fraction<br>分数       |
|----------------|----------------------|
| 3              |                      |
| Decimals<br>小数 | Fraction<br>分数       |
| 0.0001         | $\frac{1}{10,000}$   |
| 0.0002         | $\frac{2}{10,000}$   |
| 0.0003         | $\frac{3}{10,000}$   |
| 0.0004         | $\frac{4}{10,000}$   |
| 0.0005         | $\frac{5}{10,000}$   |
| 0.0006         | $\frac{6}{10,000}$   |
| 0.0007         | $\frac{7}{10,000}$   |
| 0.0008         | $\frac{8}{10,000}$   |
| 0.0009         | $\frac{9}{10,000}$   |
| 0.0010         | $\frac{10}{10,000}$  |
| 0.0011         | $\frac{11}{10,000}$  |
| 0.0012         | $\frac{12}{10,000}$  |
| 0.0013         | $\frac{13}{10,000}$  |
| 0.0014         | $\frac{14}{10,000}$  |
| 0.0015         | $\frac{15}{10,000}$  |
| 0.0016         | $\frac{16}{10,000}$  |
| 0.0017         | $\frac{17}{10,000}$  |
| 0.0018         | $\frac{18}{10,000}$  |
| 0.0019         | $\frac{19}{10,000}$  |
| 0.0020         | $\frac{20}{10,000}$  |
| 0.0021         | $\frac{21}{10,000}$  |
| 0.0022         | $\frac{22}{10,000}$  |
| 0.0023         | $\frac{23}{10,000}$  |
| 0.0024         | $\frac{24}{10,000}$  |
| 0.0025         | $\frac{25}{10,000}$  |
| 0.0026         | $\frac{26}{10,000}$  |
| 0.0027         | $\frac{27}{10,000}$  |
| 0.0028         | $\frac{28}{10,000}$  |
| 0.0029         | $\frac{29}{10,000}$  |
| 0.0030         | $\frac{30}{10,000}$  |
| 0.0031         | $\frac{31}{10,000}$  |
| 0.0032         | $\frac{32}{10,000}$  |
| 0.0033         | $\frac{33}{10,000}$  |
| 0.0034         | $\frac{34}{10,000}$  |
| 0.0035         | $\frac{35}{10,000}$  |
| 0.0036         | $\frac{36}{10,000}$  |
| 0.0037         | $\frac{37}{10,000}$  |
| 0.0038         | $\frac{38}{10,000}$  |
| 0.0039         | $\frac{39}{10,000}$  |
| 0.0040         | $\frac{40}{10,000}$  |
| 0.0041         | $\frac{41}{10,000}$  |
| 0.0042         | $\frac{42}{10,000}$  |
| 0.0043         | $\frac{43}{10,000}$  |
| 0.0044         | $\frac{44}{10,000}$  |
| 0.0045         | $\frac{45}{10,000}$  |
| 0.0046         | $\frac{46}{10,000}$  |
| 0.0047         | $\frac{47}{10,000}$  |
| 0.0048         | $\frac{48}{10,000}$  |
| 0.0049         | $\frac{49}{10,000}$  |
| 0.0050         | $\frac{50}{10,000}$  |
| 0.0051         | $\frac{51}{10,000}$  |
| 0.0052         | $\frac{52}{10,000}$  |
| 0.0053         | $\frac{53}{10,000}$  |
| 0.0054         | $\frac{54}{10,000}$  |
| 0.0055         | $\frac{55}{10,000}$  |
| 0.0056         | $\frac{56}{10,000}$  |
| 0.0057         | $\frac{57}{10,000}$  |
| 0.0058         | $\frac{58}{10,000}$  |
| 0.0059         | $\frac{59}{10,000}$  |
| 0.0060         | $\frac{60}{10,000}$  |
| 0.0061         | $\frac{61}{10,000}$  |
| 0.0062         | $\frac{62}{10,000}$  |
| 0.0063         | $\frac{63}{10,000}$  |
| 0.0064         | $\frac{64}{10,000}$  |
| 0.0065         | $\frac{65}{10,000}$  |
| 0.0066         | $\frac{66}{10,000}$  |
| 0.0067         | $\frac{67}{10,000}$  |
| 0.0068         | $\frac{68}{10,000}$  |
| 0.0069         | $\frac{69}{10,000}$  |
| 0.0070         | $\frac{70}{10,000}$  |
| 0.0071         | $\frac{71}{10,000}$  |
| 0.0072         | $\frac{72}{10,000}$  |
| 0.0073         | $\frac{73}{10,000}$  |
| 0.0074         | $\frac{74}{10,000}$  |
| 0.0075         | $\frac{75}{10,000}$  |
| 0.0076         | $\frac{76}{10,000}$  |
| 0.0077         | $\frac{77}{10,000}$  |
| 0.0078         | $\frac{78}{10,000}$  |
| 0.0079         | $\frac{79}{10,000}$  |
| 0.0080         | $\frac{80}{10,000}$  |
| 0.0081         | $\frac{81}{10,000}$  |
| 0.0082         | $\frac{82}{10,000}$  |
| 0.0083         | $\frac{83}{10,000}$  |
| 0.0084         | $\frac{84}{10,000}$  |
| 0.0085         | $\frac{85}{10,000}$  |
| 0.0086         | $\frac{86}{10,000}$  |
| 0.0087         | $\frac{87}{10,000}$  |
| 0.0088         | $\frac{88}{10,000}$  |
| 0.0089         | $\frac{89}{10,000}$  |
| 0.0090         | $\frac{90}{10,000}$  |
| 0.0091         | $\frac{91}{10,000}$  |
| 0.0092         | $\frac{92}{10,000}$  |
| 0.0093         | $\frac{93}{10,000}$  |
| 0.0094         | $\frac{94}{10,000}$  |
| 0.0095         | $\frac{95}{10,000}$  |
| 0.0096         | $\frac{96}{10,000}$  |
| 0.0097         | $\frac{97}{10,000}$  |
| 0.0098         | $\frac{98}{10,000}$  |
| 0.0099         | $\frac{99}{10,000}$  |
| 0.0100         | $\frac{100}{10,000}$ |

[illegible][illegible][illegible][illegible][illegible][illegible]

|    | 分類 | 品名 | 規格                  | 單位 | 數量  | 估價     | 備註                     |
|----|----|----|---------------------|----|-----|--------|------------------------|
| 1  | 電料 | 電線 | 1.5mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 1.5mm <sup>2</sup> 電線  |
| 2  | 電料 | 電線 | 2.5mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 2.5mm <sup>2</sup> 電線  |
| 3  | 電料 | 電線 | 4mm <sup>2</sup>    | 公尺 | 100 | 100.00 | 4mm <sup>2</sup> 電線    |
| 4  | 電料 | 電線 | 6mm <sup>2</sup>    | 公尺 | 100 | 100.00 | 6mm <sup>2</sup> 電線    |
| 5  | 電料 | 電線 | 10mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 10mm <sup>2</sup> 電線   |
| 6  | 電料 | 電線 | 16mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 16mm <sup>2</sup> 電線   |
| 7  | 電料 | 電線 | 25mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 25mm <sup>2</sup> 電線   |
| 8  | 電料 | 電線 | 35mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 35mm <sup>2</sup> 電線   |
| 9  | 電料 | 電線 | 50mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 50mm <sup>2</sup> 電線   |
| 10 | 電料 | 電線 | 70mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 70mm <sup>2</sup> 電線   |
| 11 | 電料 | 電線 | 95mm <sup>2</sup>   | 公尺 | 100 | 100.00 | 95mm <sup>2</sup> 電線   |
| 12 | 電料 | 電線 | 120mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 120mm <sup>2</sup> 電線  |
| 13 | 電料 | 電線 | 150mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 150mm <sup>2</sup> 電線  |
| 14 | 電料 | 電線 | 185mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 185mm <sup>2</sup> 電線  |
| 15 | 電料 | 電線 | 240mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 240mm <sup>2</sup> 電線  |
| 16 | 電料 | 電線 | 300mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 300mm <sup>2</sup> 電線  |
| 17 | 電料 | 電線 | 350mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 350mm <sup>2</sup> 電線  |
| 18 | 電料 | 電線 | 400mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 400mm <sup>2</sup> 電線  |
| 19 | 電料 | 電線 | 450mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 450mm <sup>2</sup> 電線  |
| 20 | 電料 | 電線 | 500mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 500mm <sup>2</sup> 電線  |
| 21 | 電料 | 電線 | 550mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 550mm <sup>2</sup> 電線  |
| 22 | 電料 | 電線 | 600mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 600mm <sup>2</sup> 電線  |
| 23 | 電料 | 電線 | 650mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 650mm <sup>2</sup> 電線  |
| 24 | 電料 | 電線 | 700mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 700mm <sup>2</sup> 電線  |
| 25 | 電料 | 電線 | 750mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 750mm <sup>2</sup> 電線  |
| 26 | 電料 | 電線 | 800mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 800mm <sup>2</sup> 電線  |
| 27 | 電料 | 電線 | 850mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 850mm <sup>2</sup> 電線  |
| 28 | 電料 | 電線 | 900mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 900mm <sup>2</sup> 電線  |
| 29 | 電料 | 電線 | 950mm <sup>2</sup>  | 公尺 | 100 | 100.00 | 950mm <sup>2</sup> 電線  |
| 30 | 電料 | 電線 | 1000mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1000mm <sup>2</sup> 電線 |
| 31 | 電料 | 電線 | 1050mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1050mm <sup>2</sup> 電線 |
| 32 | 電料 | 電線 | 1100mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1100mm <sup>2</sup> 電線 |
| 33 | 電料 | 電線 | 1150mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1150mm <sup>2</sup> 電線 |
| 34 | 電料 | 電線 | 1200mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1200mm <sup>2</sup> 電線 |
| 35 | 電料 | 電線 | 1250mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1250mm <sup>2</sup> 電線 |
| 36 | 電料 | 電線 | 1300mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1300mm <sup>2</sup> 電線 |
| 37 | 電料 | 電線 | 1350mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1350mm <sup>2</sup> 電線 |
| 38 | 電料 | 電線 | 1400mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1400mm <sup>2</sup> 電線 |
| 39 | 電料 | 電線 | 1450mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1450mm <sup>2</sup> 電線 |
| 40 | 電料 | 電線 | 1500mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1500mm <sup>2</sup> 電線 |
| 41 | 電料 | 電線 | 1550mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1550mm <sup>2</sup> 電線 |
| 42 | 電料 | 電線 | 1600mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1600mm <sup>2</sup> 電線 |
| 43 | 電料 | 電線 | 1650mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1650mm <sup>2</sup> 電線 |
| 44 | 電料 | 電線 | 1700mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1700mm <sup>2</sup> 電線 |
| 45 | 電料 | 電線 | 1750mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1750mm <sup>2</sup> 電線 |
| 46 | 電料 | 電線 | 1800mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1800mm <sup>2</sup> 電線 |
| 47 | 電料 | 電線 | 1850mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1850mm <sup>2</sup> 電線 |
| 48 | 電料 | 電線 | 1900mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1900mm <sup>2</sup> 電線 |
| 49 | 電料 | 電線 | 1950mm <sup>2</sup> | 公尺 | 100 | 100.00 | 1950mm <sup>2</sup> 電線 |
| 50 | 電料 | 電線 | 2000mm <sup>2</sup> | 公尺 | 100 | 100.00 | 2000mm <sup>2</sup> 電線 |

[illegible][illegible]

| Bacteria                        |         | Page 155<br>15/10/19 |
|---------------------------------|---------|----------------------|
|                                 |         | 3                    |
|                                 |         |                      |
| Bacteria                        |         | Page 160<br>16/10/19 |
| <i>Escherichia coli</i>         | 大肠杆菌    | 3                    |
| <i>Staphylococcus aureus</i>    | 金黄色葡萄球菌 | 3                    |
| <i>Streptococcus pneumoniae</i> | 肺炎链球菌   | 3                    |
| <i>Salmonella enteritidis</i>   | 肠炎沙门氏菌  | 3                    |
| <i>Shigella flexneri</i>        | 志贺氏菌    | 3                    |
| <i>Legionella pneumophila</i>   | 军团菌肺炎   | 3                    |
| <i>Escherichia coli</i>         | 大肠杆菌    | 3                    |
| <i>Staphylococcus aureus</i>    | 金黄色葡萄球菌 | 3                    |
| <i>Streptococcus pneumoniae</i> | 肺炎链球菌   | 3                    |
| <i>Salmonella enteritidis</i>   | 肠炎沙门氏菌  | 4                    |
| <i>Shigella flexneri</i>        | 志贺氏菌    | 4                    |
| <i>Legionella pneumophila</i>   | 军团菌肺炎   | 4                    |
| <i>Escherichia coli</i>         | 大肠杆菌    | 3                    |



预制加工BIM模型



| 单体(Name) | 碰撞类型(Type of Clash)          |                         | 5月12日                    |      |                      |      | 5月19日                    |      |                      |      |
|----------|------------------------------|-------------------------|--------------------------|------|----------------------|------|--------------------------|------|----------------------|------|
|          |                              |                         | 全部碰撞个数<br>(Clash Number) | 核对   | 有效碰撞个数(Clash Number) |      | 全部碰撞个数<br>(Clash Number) | 核对   | 有效碰撞个数(Clash Number) |      |
|          |                              |                         |                          |      | 各项数量                 | 汇总   |                          |      | 各项数量                 | 汇总   |
| 0610     | 管线/桥架/风管<br>VS<br>钢结构        | DN100以上管线VS钢结构          |                          |      |                      | /    |                          |      |                      | /    |
|          |                              | 所有管线VS钢结构               | 475                      | 357  | 381                  | 667  | 643                      | 322  | 451                  | 817  |
|          |                              | 桥架VS钢结构                 | 152                      | 272  | 109                  |      | 257                      | 234  | 189                  |      |
|          |                              | 风管VS钢结构                 | 177                      | 177  | 177                  |      | 177                      | 172  | 177                  |      |
|          | 管线/桥架/风管<br>相互碰撞             | DN100以上所有管线VS桥架风管       |                          |      |                      | /    |                          |      |                      | /    |
|          |                              | 所有管线VS风管                | 845                      | 893  | 835                  | 1512 | 845                      | 527  | 835                  | 1512 |
|          |                              | 所有管线VS桥架                | 598                      | 633  | 563                  |      | 598                      | 344  | 563                  |      |
|          |                              | 风管VS桥架                  | 138                      | 162  | 114                  |      | 138                      | 24   | 114                  |      |
|          | 管线/桥架/风管<br>自身碰撞             | 管线VS管线                  | 2242                     | 2386 | 2168                 | 2179 | 1156                     | 1235 | 699                  | 1140 |
|          |                              | 风管VS风管                  | 921                      | 1858 |                      |      | 1025                     | 1041 | 320                  |      |
|          |                              | 桥架VS桥架                  | 16                       | 232  | 11                   |      | 269                      | 275  | 121                  |      |
|          | 管线/桥架/风管<br>VS<br>土建基础/墙体/楼板 | DN100以上所有管线VS土建基础/墙体/楼板 |                          |      |                      | /    |                          |      |                      | /    |
|          |                              | 所有管线VS土建基础/墙体/楼板        |                          |      |                      | 0    |                          |      |                      | 0    |
|          |                              | 风管VS土建基础/墙体/楼板          |                          |      |                      |      |                          |      |                      |      |
|          |                              | 桥架VS土建基础/墙体/楼板          |                          |      |                      |      |                          |      |                      |      |
|          | 支吊架、辅梁<br>VS<br>所有MEP        | 支吊架 VS 所有MEP            |                          |      |                      | 0    |                          |      |                      | 0    |
|          |                              | 辅梁 VS 所有MEP             |                          |      |                      |      |                          |      |                      |      |
|          | 设备<br>VS<br>所有MEP            | 设备 VS 所有MEP             |                          |      |                      | 0    |                          |      |                      | 0    |
|          | 门窗<br>VS<br>所有MEP            | 门窗 VS 所有MEP             |                          |      |                      | 0    |                          |      |                      | 0    |



涂装车间三临场地BIM模型





涂装车间三临场地BIM模型



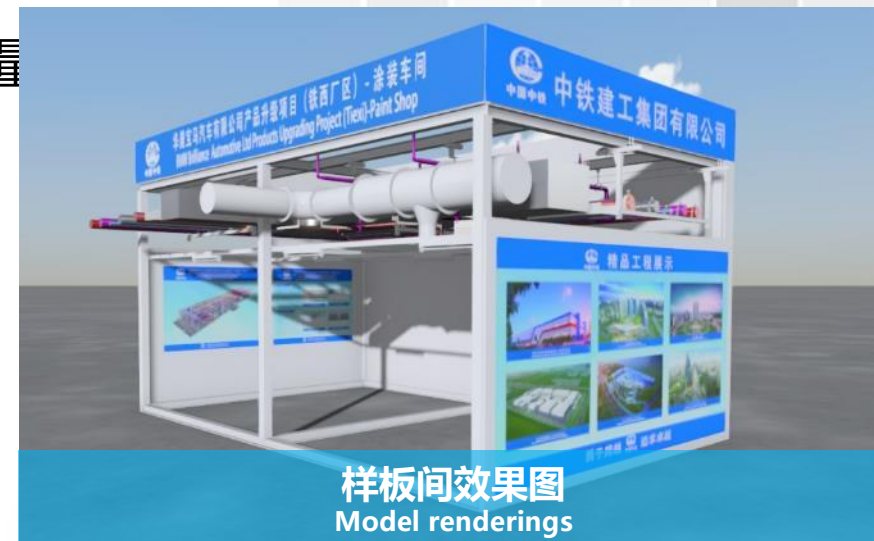


涂装车间三临场地BIM模型





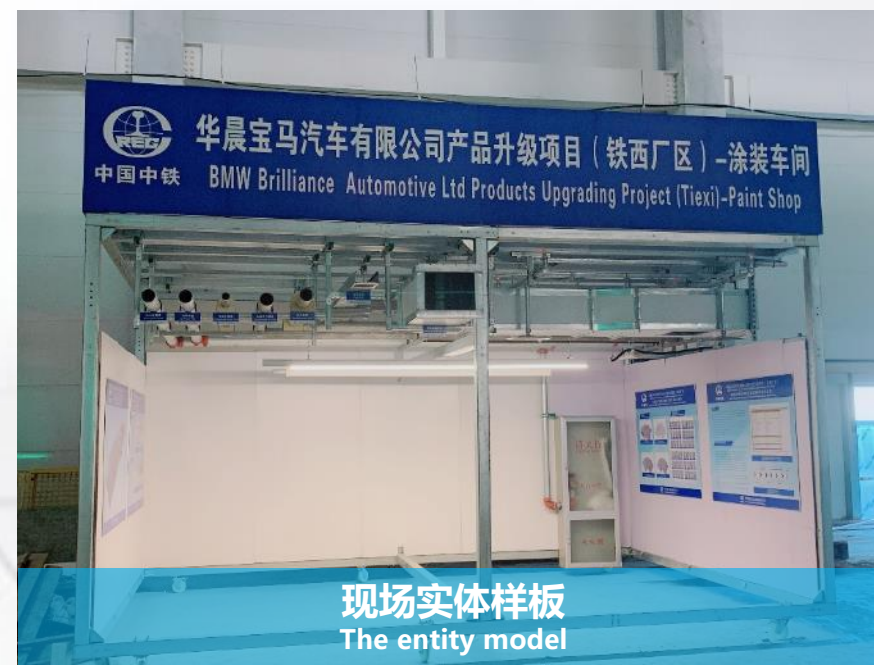
- 严格执行样板引路、方案先行制度，有效控制质量缺陷和质量
- 编制样板施工方案，建立实体样板；
- 区域样板建立，明确工程验收标准；



样板间效果图  
Model renderings



区域样板验收  
Regional model acceptance



现场实体样板  
The entity model



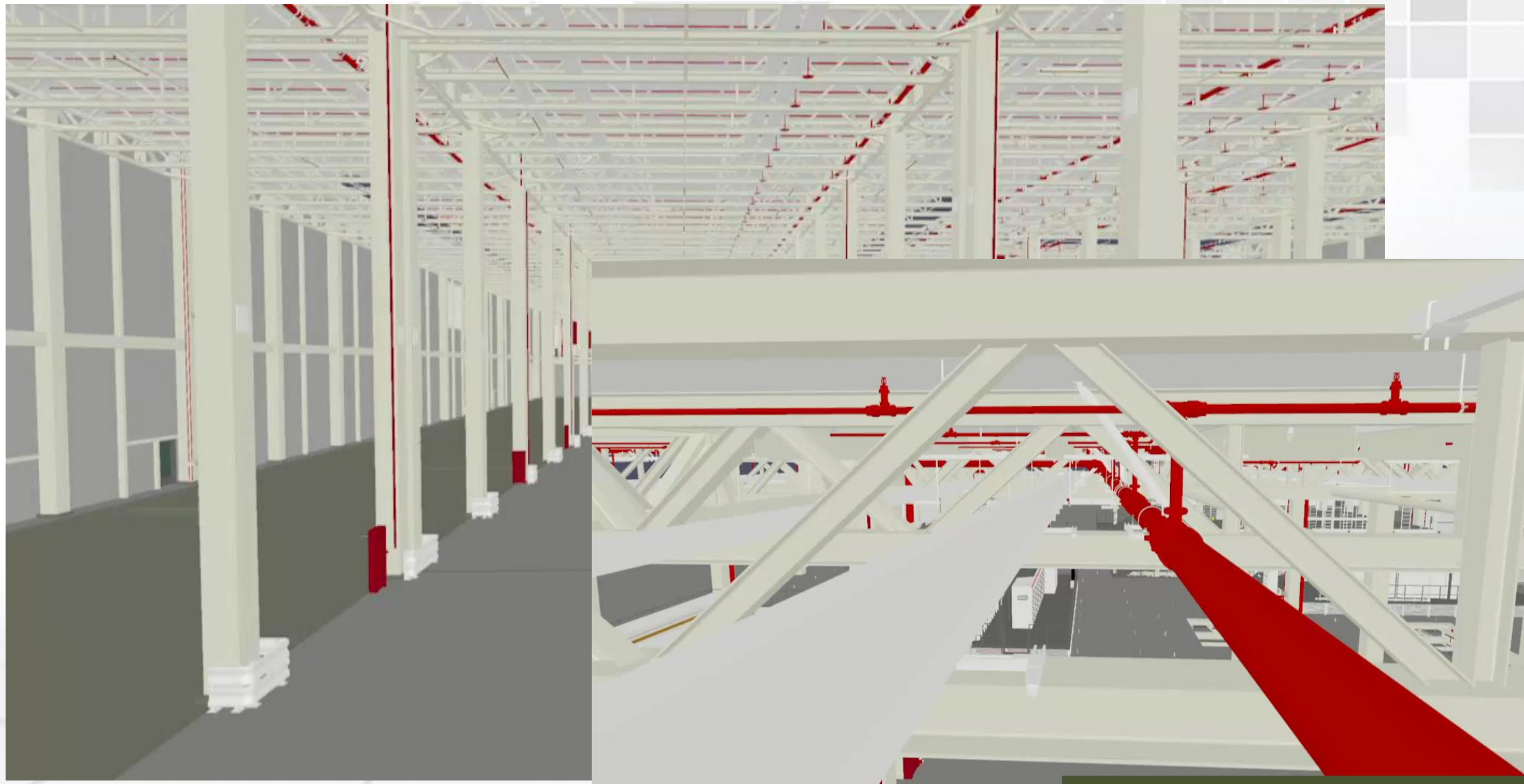


技术文件  
Technical documents



施工方案二维码  
Construction scheme QR codes





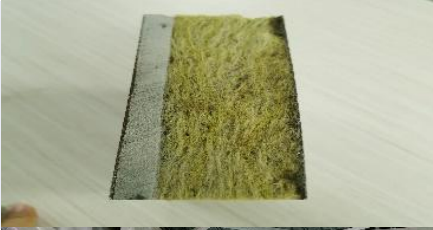




中国中铁

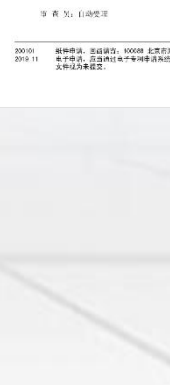
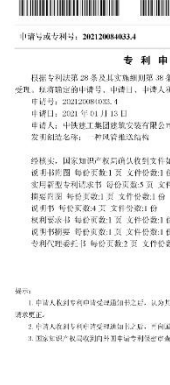
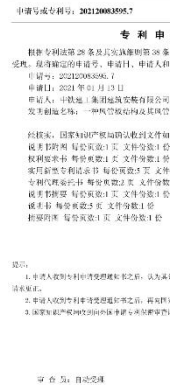
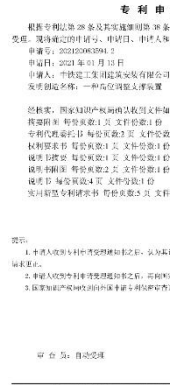
07

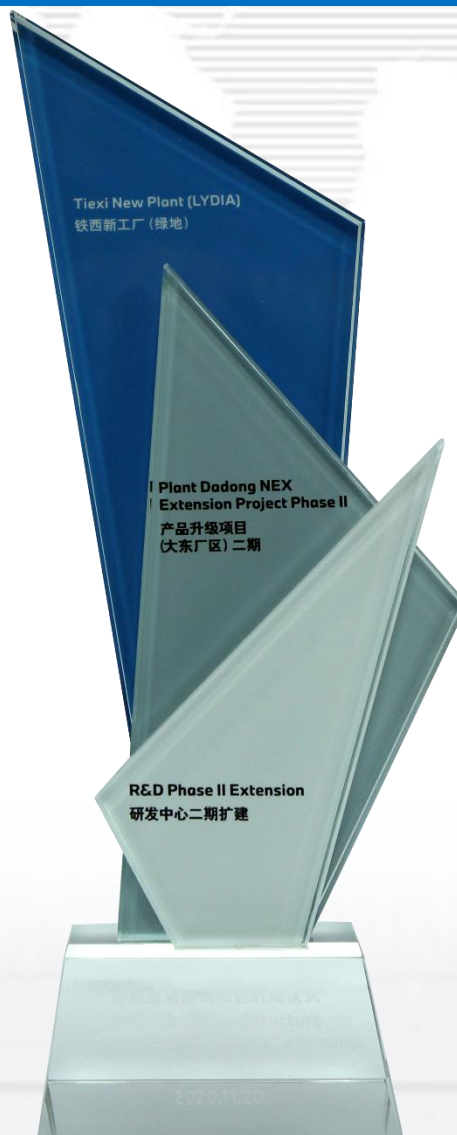
## BIM应用成果总结

| 序号<br>Number | 名称<br>Name                                                                                | 类型<br>type            | 照片或图纸<br>Photographs or drawings                                                     |
|--------------|-------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------|
| 1            | 一种高位调整支撑装置<br>The utility model relates to a high position adjusting support device       | 实用新型<br>Utility model |    |
| 2            | 一种风管板结构/一种风管结构<br>A duct plate structure/a duct structure                                 | 实用新型<br>Utility model |    |
| 3            | 一种风管推送结构<br>The utility model relates to a duct pushing structure                         | 实用新型<br>Utility model |    |
| 4            | 一种管道（喷淋管道）安装结构<br>The utility model relates to a pipe (spray pipe) installation structure | 实用新型<br>Utility model |   |
| 5            | 一种辅梁结构<br>The utility model relates to a auxiliary beam structure                         | 实用新型<br>Utility model |  |



| 序号<br>Number | 名称<br>Name                                                                  | 类型<br>type            | 照片或图纸<br>Photographs or drawings                                                   |
|--------------|-----------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------|
| 6            | 一种圆钢管固定支架<br>The utility model relates to a round steel pipe fixing bracket | 实用新型<br>Utility model |  |
| 7            | 喷淋结构<br>Spray structure                                                     | 发明<br>invent          |  |
| 8            | 一种辅臂起吊装置<br>The utility model relates to an auxiliary arm lifting device    | 发明<br>invent          | 项目资料<br>Project information                                                        |
| 9            | 一种风管板加工装置<br>一种风管板加工装置                                                      | 发明<br>invent          | 图纸和资料<br>Drawings and data                                                         |









中国中铁

08

## 人才培养和团队建设



加强技术学习，提高管理质量：

- (1) 针对BIM组织专项学习，公司深化设计部进行培训；
- (2) 对施工人员进行培训，减少施工误差；
- (3) 邀请厂家在现场对工人进行培训，提高施工效率和施工质量；









# 人才培养和团队建设



|                                                                                                                                                                |                                                                                                                                                                  |                                                                                                                                                                 |                                                                                                                                                                  |                                                                                                                                                                 |                                                                                                                                                                  |                                                                                                                                                                 |                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 张辉<br>身份证号: 210311199301081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 张辉<br>身份证号: 210311199301081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 张辉<br>身份证号: 210311199301081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 | <br>姓名: 张辉<br>身份证号: 210311199301081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

持证人经过此岗位能力培训，经考核，成绩合格，用人单位可凭此对持证人进行能力评价和聘用。



|                                                                                                                                                                                         |                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>持证人参加:</p> <p>BIM 项目管理</p> <p>专业技能培训，完成培训计划所规定的内容，经考核，达到相关要求。</p> <p>特此发证。</p>  <p>2017年8月21日</p> | <br>姓名: 刘旭<br>身份证号: 210281199609144039<br>证书编号: 170090209655<br>发证日期: 2017年8月21日 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                           |                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>持证人参加:</p> <p>BIM 项目管理</p> <p>专业技能培训，完成培训计划所规定的内容，经考核，达到相关要求。</p> <p>特此发证。</p>  <p>2017年8月21日</p> | <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                           |                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>持证人参加:</p> <p>BIM 项目管理</p> <p>专业技能培训，完成培训计划所规定的内容，经考核，达到相关要求。</p> <p>特此发证。</p>  <p>2017年8月21日</p> | <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                           |                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>持证人参加:</p> <p>BIM 项目管理</p> <p>专业技能培训，完成培训计划所规定的内容，经考核，达到相关要求。</p> <p>特此发证。</p>  <p>2017年8月21日</p> | <br>姓名: 李兴<br>身份证号: 13011119901081517<br>证书编号: 1710065285<br>发证日期: 2017年11月16日 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|

全国 BIM 技能等级考试 二级证书



全国 BIM 技能等级考试 二级证书



全国 BIM 技能等级考试 一级证书



全国 BIM 技能等级考试 一级证书



全国 BIM 技能等级考试 一级证书



全国 BIM 技能等级考试 一级证书







中国中铁

勇于跨越 追求卓越

# 汇报完毕，谢谢大家！

中铁建工集团建筑安装有限公司