AUTODESK

Expanding cities

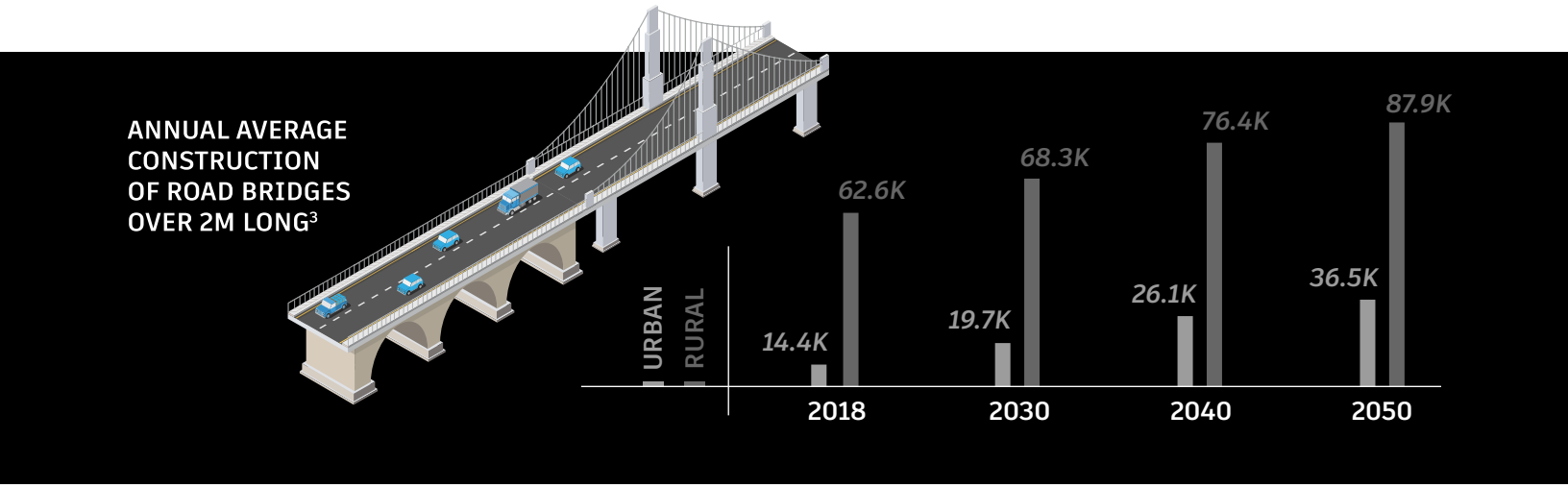
The urgent need for bridge design & maintenance

Bridges are a vital part of global infrastructure, connecting people, goods, and services.

Worldwide, there are more than 3 million bridges with 474 billion trips made over them daily, delivering $9 trillion of goods and services a year.

But these essential elements of our rail and road networks are aging, and bridges worldwide are in a state of disrepair.

France has reported that one third of its 12,000 road bridges need repairs and more than 800 of them pose a threat; while Italy has 300 bridges at risk of collapse. **Japan's most recent survey** revealed that 80,000 tunnels, bridges and other vital components of the nation's road infrastructure are in a very poor state.

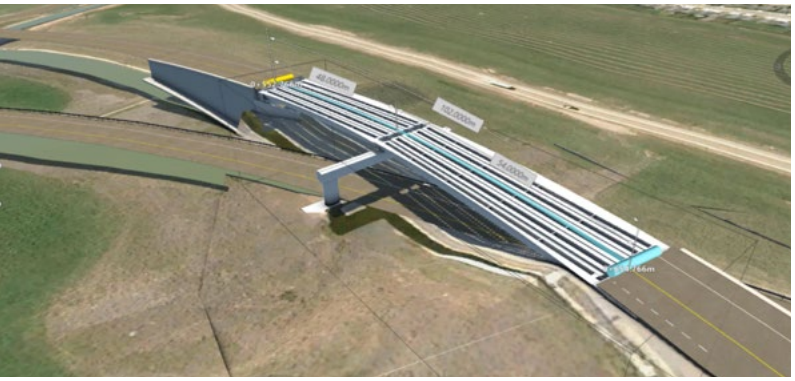


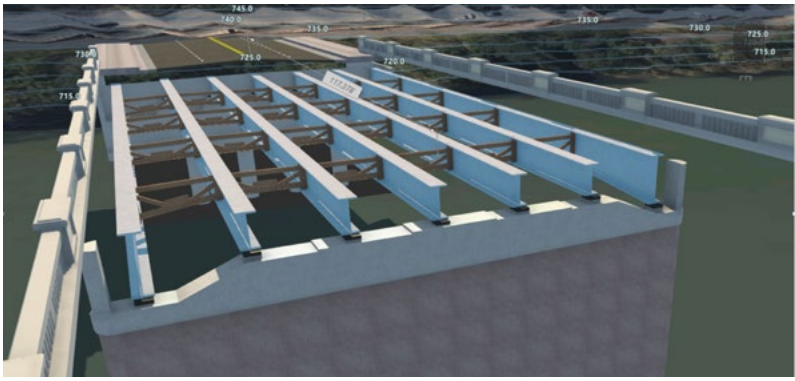
The **latest research by the American Society of Civil Engineers (ASCE)** shows that 42% of America's bridges are at least 50 years old and 7.5% of them are considered "structurally deficient". Approximately 1.78 million trips a day are taken over 46,154 bridges nationwide that are in need of repair. ASCE's report estimates that at the current rate of repair, it would take until 2071 to bring these bridges back to a good condition, and in the meantime more bridges will deteriorate. They recommend that bridge investment is increased by 58% to $22.7 billion annually in order to address this.

The **US government infrastructure bill** announced in January 2022 has allocated $40B for historic bridge repair, replacement and rehabilitation - which is the country's single, largest dedicated bridge investment since the construction of the interstate highway system in the 1950s. It will cover repairs in all US states as well as the District of Columbia and Puerto Rico.

With so many bridges in need of building, upgrading, updating, or replacing, making the bridge design process more efficient, cost effective and collaborative is a priority for civil engineers everywhere.

Finding the right software tools, and processes to boost operational efficiency can help you to reduce risk and improve project delivery so that you can help the nation get back on track with bridge repair and achieve these goals.





"...The teams can share one true model of the design and make updates to it, which can be seen and easily applied by all."

Bridging the collaboration gap

Traditionally, the bridge design process has been hampered by a lack of true collaboration options for key project members – including the road designers, bridge designers, and the documentation team – who haven't been able to easily share and amend their designs across platforms.

Work was done in silos, and each team then had to manually adapt their model when changes were made elsewhere, meaning that the design of projects was more prone to errors, took longer to complete, and delayed handover to the construction teams.

Autodesk's bridge design workflow significantly improves this collaboration problem, as it allows teams to work together on design projects using software supported by **Autodesk's AEC Collection**. The teams can share one true model of the design and make updates to it, which can be seen and easily applied by all.

The workflow supports common highway bridges and rail bridges, and the enhanced integration with road and rail design in Civil 3D supports detailed corridor models with virtually any type of sub-assemblies.

The level of detail for the finer aspects of bridge models has been enhanced while still maintaining the same ease of use, with elements such as complex 3D girders and detailed cross frames and diaphragms easily modeled.

The data models are also aligned with **IFC 4.3 open standard** dedicated for bridge design.

How does it work?

The bridge design workflow

Bringing together three of our design tools – **Autodesk InfraWorks**, **Autodesk Civil 3D** and **Autodesk Revit** – the bridge design workflow connects the road and rail design, bridge design, and documentation teams in one project model.

Enabling them to work collaboratively on very large infrastructure projects within a single overall InfraWorks model rather than just one bridge in isolation. **HDR's Automated People Mover project at LAX** is a good example of this capability.

This applies to teams within one organization as well as in partner organizations. So if your business regularly partners with others to deliver bridge projects, you can still enjoy the collaboration benefits of the bridge design workflow.

When the road design team starts the project, for example, they create their design model in Civil 3D. Once they have a design they are happy with, they publish it to the workflow and the bridge design team can then get started on their part of the design process.

They model their bridge on the road or railway using InfraWorks, and once they have completed their initial design, they publish again, which means their colleagues in road design can access the latest version.

Of course, this can be done the other way around, and the bridge design team might start off the process. The documentation team can also access and amend the project using Revit. The integration of Dynamo, in both Civil 3D and Revit, allows users to make the multi-persona workflow even more productive by automating repetitive aspects of drawing production.

The workflow within Revit supports road/rail alignments, as part of the published InfraWorks bridge model from InfraWorks. In future releases, this will allow for many more infrastructure workflow related enhancements within Revit.

Enhanced modeling of rebar in the latest version of Revit now supports the more complex geometries that are typical for bridges and tunnels.

The new Adaptive rebar propagation feature allows users to cut and paste complex rebar layouts from one component, such as a bridge pier, to another one, even if their dimensions are different. The rebar automatically adjusts to reflect the differences in host dimensions, delivering significant productivity gains to the process.

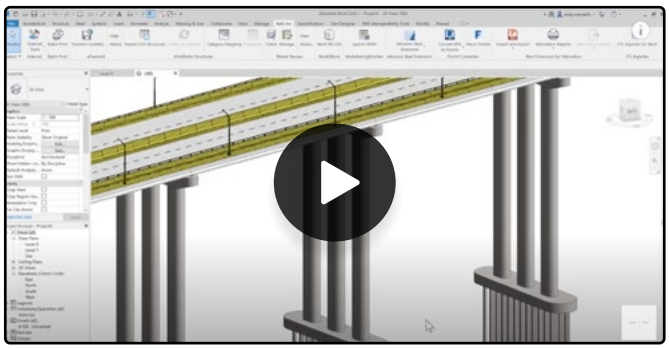
Whenever any change is made to the road or bridge design model, the software can automatically adapt the dimensions of the other steps, and team members can explain the changes they've made in a notes element.

Plus, the designers can choose from a range of components in the catalog to find the best ones for each project. Because this is an "open" workflow, teams can also leverage **Autodesk Inventor** to extend the bridge components libraries with their own requirements.

The bridge design workflow offers fully-integrated, refined bridge analysis capabilities, which enables engineers to quickly perform assessments of bridges at the earliest stages of the project, rather than in the latter stages as is the conventional workflow.

Users can leverage these capabilities to extract fully calibrated finite element analysis models of steel superstructures, based on the detailed parametric geometry of the bridge

This integrated analysis capability also paves the way for a number of exciting future opportunities to leverage AI and machine learning, along with generative optimization techniques that will allow users to explore vast solution spaces.



Watch this video explaining the bridge design workflow, and check out ***these videos*** *for more information.*

Efficient and collaborative workflows for infrastructure projects

The bridge design workflow can help your business deliver civil infrastructure projects of all sizes more efficiently and collaboratively. Because all teams can add their own input into a single project model, this is a big step forward in workflow management for bridge design projects.

Construction documentation and detailing can now commence a lot sooner than previously, as it can be easily amended. The project can get started in Revit early on, and civil engineering professionals can complete their planning and cost assessments for the bridge project well in advance.

The workflow enables engineers to more easily manage bridge design projects from concept through preliminary design to detailed design, cutting the time it takes to move through those stages and providing better project outcomes.

If you'd like to find out more about how this workflow can help your business improve efficiency and collaboration, you can ***get free 30-day trials*** of Civil 3D, Revit, InfraWorks, and many more essential BIM tools included in the Autodesk AEC Collection.

Ara Ashikian is the Industry Product Manager for Autodesk's Bridges and Civil Structures product development teams. Prior to joining Autodesk in 2013, he had over 20 years of experience as a bridge engineer and a software developer, working on a large number of bridge projects, including preliminary, detailed and construction engineering design aspects for a wide range of bridge types. These projects included the detailed construction engineering of the EG LNG suspension bridge in Africa, as well as for the New Bay Bridge (self-anchored suspension bridge in California), the detailed engineering for the launching of the Kicking Horse Canyon bridge in the Canadian Rockies as well as for the Coast Meridian cable stayed bridge in Vancouver.